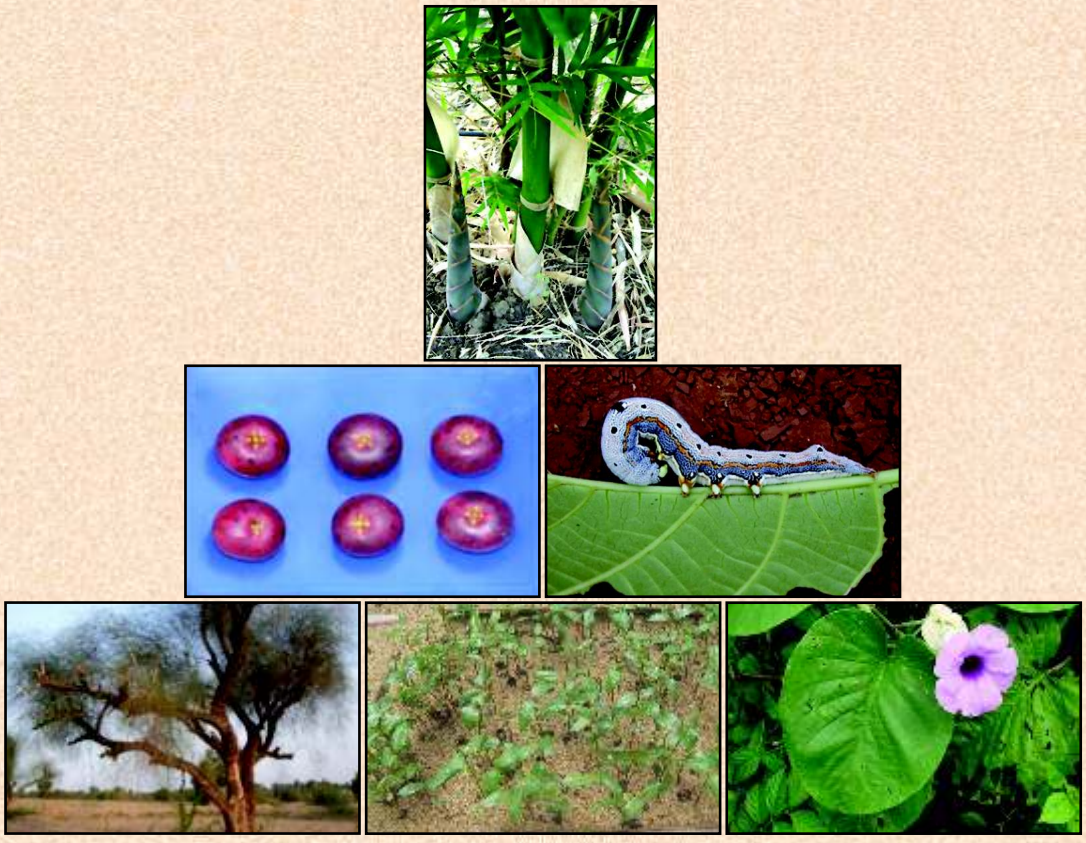
Annual Report

2009-2010



Indian Council of Forestry Research and Education
P.O. New Forest, Dehradun
Uttarakhand, India

ANNUAL REPORT

2009-2010

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

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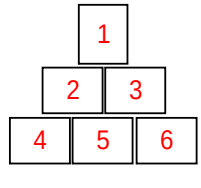

1. *Bambusa vulgaris* in North Eastern region
2. *Garcinia indica* fruits
3. Full grown larva of *Achaea janata* on Mehndi plant
4. *Capparis decidua* in desert dune scrub in Jalore
5. Germination in nursery in *Buchnania lanzan*
6. *Argyreia nervosa* – leaves used for boils and blisters by Vizianagaram tribals

Back Cover : Agroforestry (Poplar- Sugarcane) model- FRI, Dehradun

डा० गोविन्द सिंह रावत
महानिदेशक,भा.वा.अ.शि.प.
एवं कुलाधिपति व.अ.स. विश्वविद्यालय
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(पर्यावरण एवं वन मंत्रालय, भारत सरकार की एक स्वायत संस्था)
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Indian Council of Forestry Research and Education
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(An autonomous body of Ministry of Environment and Forests, Government of India)
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FOREWORD

Indian Council of Forestry Research and Education (ICFRE), an autonomous apex body of Ministry of Environment and Forests, is engaged in taking up research projects for development of a number of technologies for sustainable management of forestry resources of the country. The Council is also engaged in the task of dissemination of related knowledge and information to different stakeholders, viz., state forest departments, industries, farmers and people at large. With a view to sharing information on its activities that helps in improving its delivery, the Council publishes the Annual Report every year.

Keeping in view the desire expressed by the Board of Governors from this year the Annual Report of the Council has been prepared according to the thematic research areas of the Council. There are 7 thrust areas which have been sub divided into 32 themes. ICFRE research projects have been categorized into these thematic areas. Further, important research projects having national level implication have been formulated as All India Coordinated Projects for funding support from the Government of India.

The year 2010 is being celebrated as International Year of Biodiversity. Accordingly, ICFRE has placed high priority on biodiversity conservation and management in its research themes and thrust areas.

In view of the special efforts made by the Concil in the field of climate change, it has been granted observer status by UNCCD besides its observer status earlier granted by UNFCCC. ICFRE is continuously participating in various meetings of UNFCCC, and providing valuable inputs in forestry sector related policy negotiations especially in the field of REDD plus. The Council is also making its presence felt at various international fora in the field of forestry and allied disciplines.

The Council has also undertaken the work of technical facilitation organization under Sustainable Land use and Eco systems Management- Country Partnership Programme (SLEM- CPP). In the field of environment management the Council has carried out several environment related studies in India and Bhutan in various sectors like hydro power, mining and infrastructure development.

The Council has provided Grant-in- aid to 15 State Agricultural/Deemed/Central universities to promote forestry education at Undergraduate and Post-graduate levels to the tune of ` 450 lakh in the year 2009-2010. The Council has accredited forestry curriculum of 9 universities so far on the basis of guidelines issued earlier on the subject.

I take great pleasure in presenting ICFRE Annual Report 2009-2010 which provides insights into research, education and extension activities of the Council.

14th October 2010

(Dr. G.S. Rawat)

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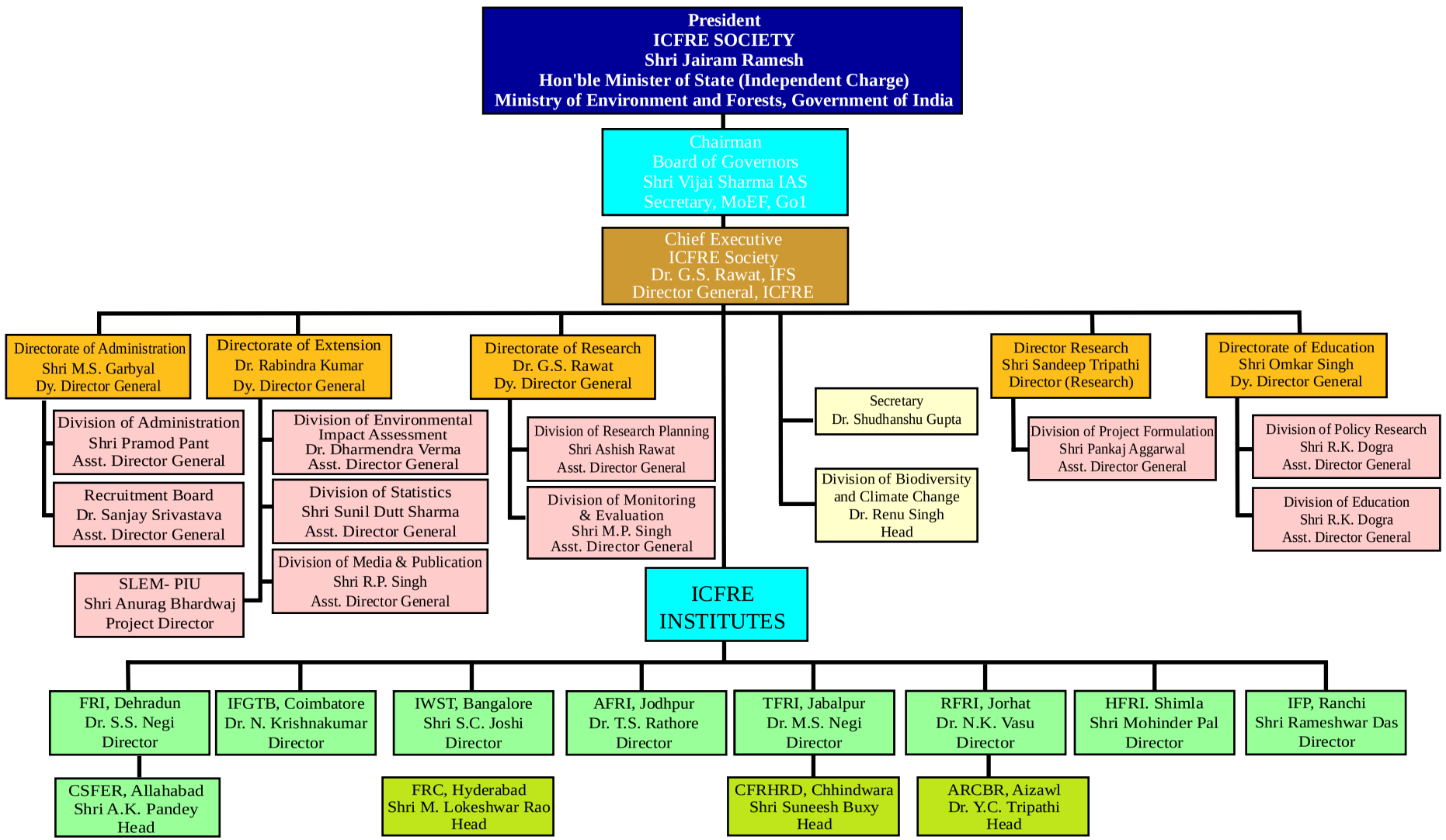
ORGANIZATIONAL STRUCTURE OF ICFRE



Executive Summary

India, with a geographical area of 3287263 km^2, consists of 769512 km^2 of recorded forest area of which, reserved forests constitute 430582 km^2, protected forests constitute 206219 km^2 and the rest is unclassed. The country has a diverse stratification of area with identified fourteen physiographic zones. According to the State of Forest Report 2009 of the Forest Survey of India, recorded forests constitute 23.41 per cent of India's total geographical area. The total growing stock of forests is as high as 6098.23 million m^3 including trees outside forests.

The problems of such a complex and diverse forest system are also complex and require innovative scientific acumen to confront and solve them. Forest productivity assumes importance as the forests are to be conserved along with their role to alleviate poverty and provide sustenance to dwellers of almost 173000 forest villages in the country. Plantation Forestry coming up as an alternative source of forest products is likely to meet the requirement of almost 3000 wood based factories with a total output of more than ` 4000 crore.

The estimated share of the forestry sector to the Gross Domestic Product of our country is 1.7% against the previous figure of below 1%. The rise in share is mainly attributed to the trees outside forests, fodder provided by the forests and income generated through non-wood forest products, which provided subsistence to the forest dwellers and other forest based communities. About 3.4% of the geographical area of India is under grazing and pasture lands, catering to an estimated 500,000 population of livestock.

Through Joint Forest Management (JFM) involving people in management of forests has brought about radical change in forest management. Presently, there are about 60000 Joint Forest Management Committees in the country with 4770 JFM projects. The estimated area regenerated under JFM is of the order of 80,00,000 ha. Afforestation and JFM programmes require quality planting stock of high productivity and ICFRE has worked on various species with focus on increasing productivity of forests. With 4000 ha of Seed Production Areas (SPA) and 114 ha of Vegetative Multiplication Gardens (VMG) of important species like teak, eucalyptus, casuarinas, developed in the past under various research projects and fresh research on other new and lesser known tree species, release of new clones, Indian Council of Forestry Research and Education (ICFRE) has contributed immensely towards providing quality planting stock for various afforestation programmes.

Ecosystem Conservation and Management forms an important area of research programmes of ICFRE. The first forest meteorological observatory approved by IMD was established at Forest Research Institute (FRI), Dehradun to record climatic parameters of FRI Campus. Automatic Weather Station and Agrometeorological station have been installed at Kanha National Park, Bandhavgarh National Park and Madhav National Park by Tropical Forest Research Institute (TFRI), Jabalpur to study grass biomass and soil moisture profile. A Geographical Information System (GIS) Laboratory was established at Rain Forest Research Institute (RFRI), Jorhat for systematic creation, management and upgradation of GIS based forest database of North-East India. Spatial information and attributes pertaining to vegetation, soil, topography of North-East India were integrated in a common GIS platform.

In the field of climate change, new initiatives have been undertaken at ICFRE headquarters and its institutes. The ICFRE has been actively involved in various international negotiations on Climate Change. ICFRE has also been awarded the status of 'Observer' by UNFCCC and UNCCD. It is beyond doubt that

over 70% of India's population lives in villages and agriculture remains their mainstay but there is a general feeling that the hilly areas are more suited for forestry and horticultural activities than for agriculture. The growing farming activities in hills are playing havoc with its ecology. Therefore, there is an urgent need to concentrate on eco-regions as the unit of research, analysis and management.

The ever growing economy and the vision 2020 of India will directly harp upon the natural resources, particularly the forest ecosystems and is certainly a matter of grave concern. Being a mega biodiversity country, forests in India play the critical role in providing several ecosystem services, most of which go unaccounted in the economic terms.

TFRI, Jabalpur is working on climate change, biodiversity and its conservation, tribals and their traditional knowledge system in Central India.

In cold desert regions, continuous removal of plant species for various uses and overgrazing by migratory livestock have resulted in desertification and loss of biodiversity. This genetic erosion coupled with soil erosion may retard prospects of future economic development and welfare of the people, besides posing problems for the fragile ecosystem. Keeping these facts in view, attempts are being made by the Himalayan Forest Research Institute (HFRI) to conserve particular ecosystem at all levels so as to have a detailed knowledge of the biodiversity of the Himalayas which will help in managing the resources strategically.

Institute of Forest Productivity (IFP), Ranchi is implementing projects pertaining to Ecological Dynamics of vegetation structure and assessment of morphological adaptive variation to create baseline data for selected species in Dalma Wildlife Sanctuary. Also the institute is working on creation of Seed Database of economically important forestry species of Jharkhand with an aim to function as Forestry Seed Certification Agency.

With a view to produce Quality Planting Material (QPM) for conservation, production and promotion of *ex-situ* cultivation, IFP, Ranchi is also working on establishment of Medicinal Plants Garden and Propagation Centre in Chhotanagpur plateau. Besides, it has also undertaken the work of documentation and inventorization of indigenous medicinal knowledge of Jharkhand**.**

Institute of Wood Science and Technology (IWST), Bangalore has developed a web based Indian Wood Insects Database (IWID), covering about 1000 timber species and 2500 wood inhabiting insects.

In the field of **Forest Productivity,** studies were conducted on the seed storage of *Diploknema butyracea* (cheura) in order to assess the longevity, viability and vigour of seeds and to enhance the seed longevity through conventional storage methods. Seedling Vigour Index (SVI), Seedling Quality Index (SQI) and Leaf Area Index (LAI) were taken as indicators. A survey was conducted in Doon valley, Tons valley, Uttarkashi district and Nainital and Pithoragarh forest divisions to locate the populations of three species of *Bauhinia*. Population surveys were conducted for *Buxus wallichiana*, an important species for wood carving. The nurseries of important forestry species, prioritized by State Forest Department were raised. The optimum age of the seedlings of fast growing and slow growing species was assessed for transplanting in the field. The effect of different chemical and bio-treatments on the seed germination of selected *Ficus* spp. were compared.

It was found that during germination of rattan seeds, the pricking method produced more germination instead of normal seed sowing in nursery beds. Deodar and Ban Oak nurseries maintained by the Himachal Pradesh forest department were surveyed to obtain information

pertaining to establishment of nurseries. The nursery and field trials were laid and maintained for standardization of tall-planting techniques in deodar. The potential seed sources and clones of selected species of Jharkhand and adjoining states were evaluated in nurseries. Precision silviculture practices for *Casuarina junghuniana* have been developed for both nursery and plantation management.

Research was undertaken on allelopathic influence of litter, humus and foliage of trees and under-storey plants on seed germination of select conifers in laboratory. It was found that leachates of humus reduced and deteriorated radicle growth completely but enhanced germination at higher concentrations, thus, concluding that humus and foliage of specific plants are responsible for regeneration failure in these conifers and not litter as was believed till date.

For adoption of the species under farm land cultivation, multi location trials on micro and macro propagated bamboos, their nutrient management, organic and inorganic farming methods and water management were carried out to develop a species specific package of practices. Model plantations of bamboo were established in different locations covering six agro-climatic zones of Tamil Nadu. On-farm innovation in macro proliferation technique for edible bamboo species and promotion of their commercial plantation through capacity building of the Self Help Group members was conducted by imparting training and demonstration on nursery practices. Sustainable development of quality bamboo resources for employment generation and socio-economic development in north-eastern India was also studied.

Agroforestry demonstration plots were established in five agro-climatic zones along with the annual crops to enhance the livelihood opportunities for farmers. In an agroforestry model at a farmer's field at village Harsh, Tahsil Bilara, District Jodhpur of Rajasthan, wheat crop production was recorded as high as 13.67 quintal/ha during the year.

A library of soil samples of North-East India is being set up at Rain Forest Research Institute, Jorhat. Soil samples from seven north- eastern states covering 29 forest sub-group types have been collected and analyzed. RFRI has assembled 119 elite clones of *Gmelina arborea* selected from various provenances of north- eastern states and West Bengal. Also, studies on restoration of jhum land were carried out.

Pursuing research in **Genetic Improvement,** four high yielding clones of *Eucalyptus* have been released for commercial cultivation through systematic selection and multilocation trials of more than hundred clones. Through hybridization programme, F_1 hybrids of *E. pellita x E. urophylla* were produced. The seed orchards and vegetative multiplication gardens for production of improved seeds and vegetative material have also been established. Through systematic selection and multilocation testing, four high yielding clones of *Casuarina* have also been released for commercial cultivation. Intra and interspecific hybrids of *Casuarina* (*C. equisetifolia* X *C. junghuhniana*) were produced. Work has been initiated on identification of biochemical marker for saline tolerance so that germplasm could be categorized for saline tolerance.

New sets of clones of *Dalbergia sissoo* have been developed to address the problem of poor stem form (crooked stem), forking, ramicorn branching and susceptibility to dieback. A field trial consisting of 49 clones has been established. A total of 230 Candidate Plus Trees (CPTs) of *Melia composita* were selected from different geographical regions and evaluation trials of 21 most suitable families were established. A progeny trial of *Melia azedarach* and *Melia dubia* (10 plus trees each) has been established at Forest Research Centre Campus, Hyderabad. Field trials of *Pongamia pinnata* have been taken up raised for testing stability, adaptability and growth performance.

Variation and inheritance of fruit and seed traits of Gujarat teak were studied for the first time and five good general combiners were identified. A comprehensive genetic improvement programme of *Acacia auriculiformis* and *A. mangium* has been initiated. Breeding population having wide genetic base has been established and considerable improvement in tree form has been observed through progeny trials. Tree improvement programme has been initiated in the indigenous species of *Ailanthus* for boosting the productivity, yield and development of clones/genotypes. Also, tree improvement programme was initiated in tamarind to select and conserve the rare phenotypic variants. The conservation of tamarind genetic resources was carried out by establishing germplasm banks of red and sweet tamarinds.

One hundred eighty eight rhizomes of 115 bamboo clones collected from selected superior mother clumps of target species have been conserved in the gene bank at RFRI, Jorhat. Field trials of tissue culture plants of *Bambusa bambos* and *Dendrocalamus strictus* were also established. Keeping in view the ecological significance and socio-economic relevance of *Arundinaria falcata* and *Thamanocalamus spathiflorus* (Hill Bamboos), a survey was conducted in Himachal Pradesh to identify their populations. A vegetative propagation centre has been established in College of Forestry, Ponnampet, Karnataka for propagation of *Dendrocalamus brandisii* and *Dendrocalamus asper* and to promote cultivation of these two species in Coorg District of Karnataka.

In molecular characterization for breeding programmes, Simple Sequence Repeat (SSR) markers were developed for *Eucalyptus tereticornis* to assess the genetic structure in association mapping population targeting adventitious rooting traits. To identify genetic determinants of salt stress tolerance in *Casuarina*, 82 *Casuarina equisetifolia* clones were screened for high salt tolerance and susceptible conditions. Further, 150 clones were profiled using RAPD markers. Besides, four SSR target primers were developed from ISSR PCR product of *Casuarina equisetifolia.*

In Gene isolation and functional analysis, six transcripts representing six classes of cellulose synthase were characterized from *Eucalyptus tereticornis*. For rapid functional analysis of genes involved in salt tolerance, parameters critical for development of *E. tereticornis* composite plants with transgenic hairy roots were identified. To reduce the destructive harvest of *Aegle marmelos*, cell culture protocol was developed for the species. Enhancement of rooting and planting stock production of selected high yielding *Eucalyptus* clones through micro and mini cutting technique was achieved. Basic protocols for *in-vitro* propagation of *Jatropha curcas* and *Commiphora wrightii* were also developed.

In the field of **Forest Management,** field surveys have been conducted to lay out sample plots of commercially important tree species in semi-arid region of Rajasthan. Demand- supply gap analysis of important tree species of Eastern U.P. has been conducted and the results of the study were communicated to the various stakeholders through extension material. Market price data of commercially important species of timber, fuel wood and bamboos were collected and brought out in the form of "Timber Bamboo Trade Bulletin".

Databases of gene sequences available in public domain can be accessed for applying bioinformatics for enhancing forest productivity. A lead in this direction is being taken by way of consolidating, categorising and classifying wood forming genes in *Eucalyptus*. Database on Red sanders (*Pterocarpus santalinus*) has been developed, while databases on deodar (*Cedrus deodara*), kail (*Pinus wallichiana*) and commercial timber information system are in progress. Work is going on for developing a computerised database for forest pathology herbarium, dynamic database for forestry discussion forum, web portal for forestry research extension and GIS/RS based information system on lac production. Besides

this, information technology services were strengthened and maintained at all Institutes along with development of Indian Forestry Research Information System (IFRIS). ICFRE website is being regularly updated.

The major areas of research in **Wood Products** were evaluation of wood properties and uses of lesser known tree species in order to find the value addition of the timber. Testing facilities for evaluating the performance/ suitability of musical instruments made out of plantation timbers were developed. Studies were carried out on tree-ring analysis of teak from Karnataka and Maharashtra which is an innovative research work which showed good potential to know drought years, flood years, insect attack, fire scars and adaptation of species with changes in climate. Non destructive testing like ultrasonic and FTNIR spectroscopy techniques that are undertaken may prove to be a potential tool for estimating quality of timber in short duration in comparison to the traditional test procedures. The method of laboratory testing for the assessment of the durability of timbers against powder post beetles was standardized. Twenty different imported timber species are being evaluated for their durability against fungi and termites. Eight species of plantation timber were evaluated for their durability against decay fungi and termites. Different treatment regimes were developed for the treatment of difficult-to-treat species to give appropriate retention of preservatives. A two- step temperature vacuum schedule for drying of poplar and a three- step temperature vacuum schedule for teak has been evolved at FRI, Dehradun resulting in saving of energy and cost as compared to previous methods. A conveyor belt microwave dryer system fabricated and installed at IWST Bangalore, was standardized. Different types of joints with round wood were fabricated and tested for mechanical strength. Pole skeleton system comprising of column supports, beam/purlin/ rafter and roof truss was designed. Drawing and construction of architectural model of house, using round timber was done. Roof trusses of Timber Engineering Museum at FRI, Dehradun were repaired, painted and re-erected.

Non-Wood Forest Products (NWFPs) constitute a very important component of trade in forest products. Researches on medicinal plants focusing on survey, development of organic cultivation technology, its post harvest processing including development of value addition processes, bioactivity evaluation, sustainable management and resource development through forest enrichment with natural species have been undertaken by various institutes of ICFRE. Research studies focusing on chemical profiling of wild edibles and other useful NWFPs have been undertaken. Researches have also been undertaken on tree borne oil seeds including chemical analysis of fatty oils. National Multiplication trials of different provenances and clones of *Jatropha curcas* in various states have been undertaken. Chemical analysis of various NTFPs have been undertaken to develop processes for their commercial utilization. Planting materials of various NTFP species including medicinal plants have been raised and supplied to farmers encouraging their cultivation.

In the field of **Forest Protection,** database was developed in MS-ACCESS for computerization of National Forest Insect Collection. One new genus and 13 new species of encyrtids were described as new to science. Relative resistance in selected clones of *Casuarina equisetifolia* against the bark feeding borer, *Indarbela quadrinotata* was identified through analysis of biochemical and physical nature of the clones. Apart from this, 19 fouling and 11 wood boring species were found to be new introductions to Visakhapatnam port and of these, the annelid *Hydroides operculatus* (Treadwell) and the mollusc *Siphonaria* cf. *kurracheenensis* Reeve were recorded for the first time in India. A wood boring gastropod, *Thais blanfordi* (Melvill) was recorded for the first time from the

fouling assemblages along the east coast. *Metarhizium* based mycoinsecticide product named **PESTSTAT** both in powder and liquid forms has been developed and is ready for release and application in the field.

While studying diseases, pathogens and beneficial microbes resistant and susceptible clones of *Dalbergia sissoo* have been identified against *Fusarium solani* causing vascular wilt. Two species of *Ganoderma, G. resinaceum* and *G. weberianum,* have been separated from the collection. The latter is a new record for India. Fifty one ITS sequences have been submitted to GenBank, (National Centre for Biotechnology Information), USA and have been released at NCBI web site. Volatile effect of citronella oil, garlic oil, lemongrass oil and ajwain oil to inhibit growth and germination of spoilage fungi in stored medicinal plant produce was successfully established. Diagnostic kit was developed after standardizing protocols for DNA extraction of *Cylindrocladium quinqueseptatum* from soil, diseased plant parts and post-inoculation pre-symptomatic *Eucalyptus* plant samples infected with leaf, twig and seedling blight which will be helpful in identification of the pathogen and for disease forecasting.

Genes of different isolates of fungus *Cordyceps sinensis* of Himalayan meadows were amplified, sequenced and submitted to NCBI and accession numbers were allotted. Wilt disease caused by *Fusarium oxysporum* in nurseries of *Buchnania lanzan* was controlled. Four genera and seven species of wood-decaying fungi have been recorded for the first time on sal and bijasal stored wood. Five Arbuscular Mycorrhizal Fungal genera and 11 species of *Glomus* have been recorded in mehndi and ashwagandha in Rajasthan. In mehndi, *G. fasciculatum* was found to be the best in improving plant growth and vigour as compared to other treatments, whereas, in case of ashwagandha, indigenous mixed inoculums with dominancy of *G. aggregatum* was found to be the best for all growth parameters.

On the front of **Biodiversity and Climate Change,** ICFRE has been ushering in the field with a stronghold on the subject. During the last year an International workshop on "National Forest Inventory: The Experiences of Non-Annex I Countries" was organized by the Indian Council of Forestry Research and Education (ICFRE), Coalition for Rainforest Nations (CfRN) and Food and Agriculture Organization (FAO), United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing countries (UN-REDD) Programme (27th to 29th April 2009). A delegation of ICFRE participated in the 13th session of the SBSTA and SBI, sixth session of AWG-LCA, and eighth session of AWG-KP at Bonn, Germany. It also participated at "Barcelona Climate Change Talks" (2nd to 6th November 2009). ICFRE has also been awarded the "Observer Status" by the United Nations Convention to Combat Desertification (UNCCD). ICFRE participated in 15th Conference of the Parties to the UNFCCC / 5th meeting of the Parties to the Kyoto Protocol at Copenhagen, Denmark (7th to 18th December 2009). The Biodiversity and Climate Change Division at ICFRE, Dehradun looking after this aspect organized a five days training course for scientists and officers on "Carbon Sequestration" at ICFRE, Dehradun (5th to 9th October 2009). Also ICFRE is vigorously persuing to achieve the status of Designated Operational Entity (DOE) of the UNFCCC in the area of Afforestation/Reforestation CDM projects.

In the field of **Forest Statistics**, the Council has initiated a National Oilseeds and Vegetable Oil Development (NOVOD) Board sponsored project "Development of a Database on Tree Borne oilseeds in India" in August 2009. An ITTO sponsored project "Establishment of a network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry parameters in India"

was also completed during the year. Two issues of the biennial **Forestry Statistics India**, i.e. 2005 and 2007 and two issues of **Timber/Bamboo Trade Bulletin**, a quarterly (Issue no. 58, March 2009) and a half yearly (Issue no. 59, June 2009) were published. The Council is providing Joint Forest Sector Questionnaires to MoEF and International Tropical Timber Organization (ITTO) and is also catering to furnish statistical requirements to end users on demand, like Central Statistical Organization, Ministry of Environment & Forests and other stakeholders.

The Council is undertaking EIA Studies of developmental projects in the field of **Environmental Impact Assessment**. It has completed four projects during last year worth ` 239.13 lakh in the areas of hydropower, mining and other development sectors. The Council was also awarded six new consultancies worth ` 244.02 lakh during the period.

ICFRE has been awarded a project "Policy and Institutional Reform for Mainstreaming and Up-Scaling of Sustainable Land and Ecosystem Management in India" under **Sustainable Land and Ecosystem Management - Country Partnership Programme (SLEM- CPP)**, a joint initiative of MoEF, GoI and Global Environment Facility (GEF). The programme consists of seven projects with the assistance from UNDP, FAO and the World Bank being implemented in ten states in the country. The Technical Facilitation Organisation (TFO) for these projects is housed in the Council.

A poplar based agroforestry project **"Samudai Adharit Samanavit Van Prabhandhan Evam Van Sanrakshan Yojana"** popularly called Bihar project has been implemented by ICFRE in Vaishali district of Bihar. About 59 lakh plants of different species (including 47 lakh plants of poplar) were distributed free of cost to about 61000 farmers of 1396 villages of Vaishali district of Bihar.

Detailed Project Reports (DPRs) of Seventeen (17) All India Coordinated Projects (AICPs) submitted by ICFRE institutes with an estimated budget of ` 115.62 crore for a period of 3 to 5 years addressing a number of identified species viz. Jatropha, Poplar, Casuraina, Shisham, Bamboo, Sal etc. and various emerging forestry issues viz Biological control of *Eucalyptus* gall wasp, Genetic improvement and Tree improvement strategies, Fuel wood utilization etc. were finalized, compiled and submitted to the Ministry of Environment & Forests for arranging funds through Planning Commission.

The Council is providing Grant-in-aid to the Universities for promoting Forestry Education in the Country. Towards this end, ICFRE released Grant-in-aid to the tune of ` 450 lakh to 15 Universities in the financial year 2009-10.

The project of Mid Career Training of IFS by Ministry of Environment & Forests has been finalized after a competitive process, wherein ICFRE has been awarded training for Phase-III (officers 6 to 9 years of service). The total cost of the project is ` 5.89 crore, for a period of three years. The project has been started w.e.f. 14th December 2009. The first training course for IFS officers of 2001-2002 batch was held from14th December 2009 to 20th March 2010. In all 59 participants from all over the country participated. The programme was inaugurated at IIM Ahemadabad on 14th December 2009 by Dr. P.J. Dilip Kumar, IFS, D.G. (Forests) and SS, Govt. of India. As part of the programme participants were taken to US (Colorado State University) & Sweden (Swedish University of Agriculture Sciences) in batches of 30 each. The programme being first of its kind can be termed as pioneering effort in the capacity building of IFS officers jointly by a number of organizations like ICFRE, WII, FSI, IIMA and the foreign partners.

Summary of Projects*

The position of research projects at the end of 2009-10 is as below:

Project	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	76	158	71
Externally Aided	46	78	21
Total	**122**	**236**	**92**

* Data provided under various themes in similar tables may vary from this tally due to the multidisciplinary nature of the projects.

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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.

Mission Statement

To generate, preserve, disseminate and advance knowledge, technologies and solutions for addressing the issues related to forests and promote linkages arising out of interactions between people, forests and environment on a sustained basis through research, education and extension.

Vision

Increasing forest cover and enhancing forest productivity through operationalisation of National Forestry Action Programme and National Forestry Research Plan.

Objectives

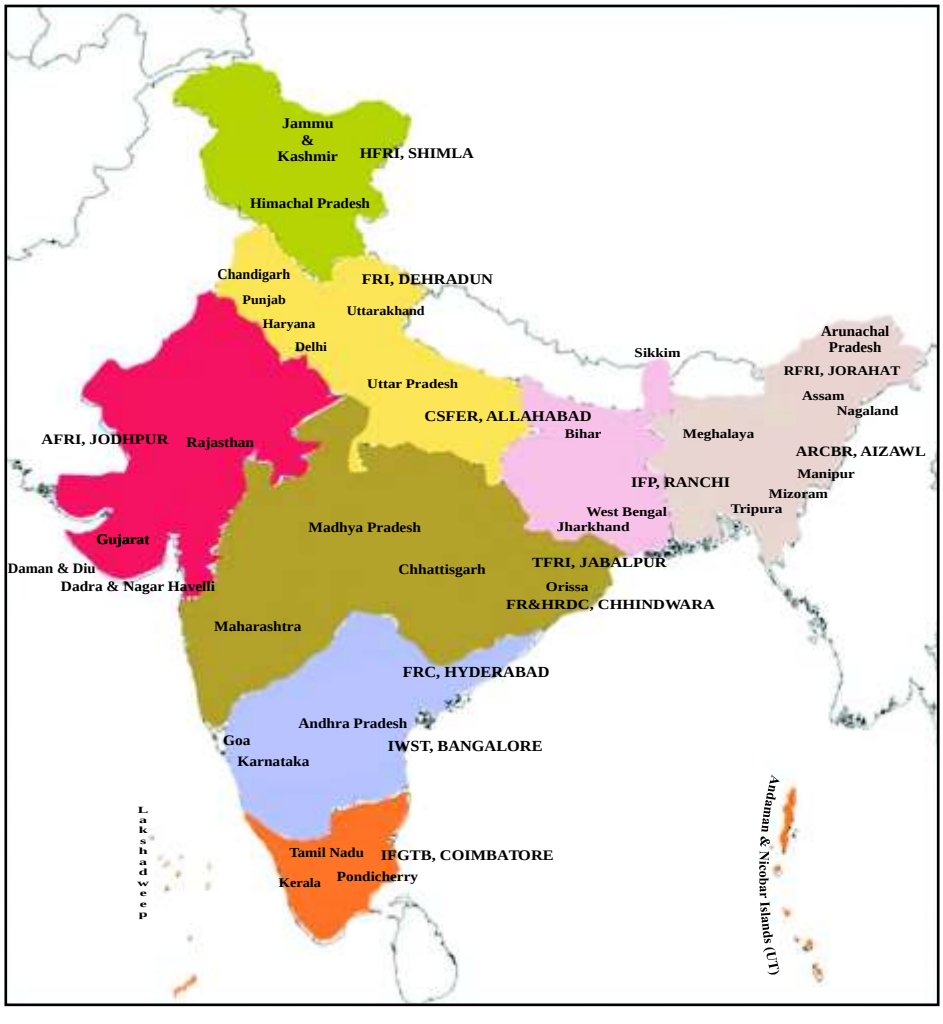
- To undertake, aid, promote and coordinate forestry education, research and their applications.
- To develop and maintain a national library and information centre for forestry and allied sciences.
- To act as a clearing-house for research and general information related to forests and wildlife.
- To 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

Indian Council of Forestry Research & Education (ICFRE) with headquarters at Dehradun has eight research institutes and four research centres spread over across the country to facilitate the forestry research, education and extension.

Forest Research Institute (FRI) located at Dehradun has the reputation of a leading institute in the field of forestry sciences both nationally and internationally and focuses activities in the states of Uttarakhand, Uttar Pradesh, Haryana, Punjab, Delhi and Chandigarh (UT). The institute carries forward the high tradition of forestry research carried out by erstwhile Imperial Forest Research Institute. Research on various aspects of forestry like silviculture, ecology, pathology, entomology, chemistry, non-wood forest products, genetics and tree breeding and forest soil and land reclamation. Keeping in view the present scenario of advancement in the field of science, institute has added two more aspects i.e. Climate Change and Forest Influence Division and Bioinformatics Centre and GIS Cell. The institute has excellent laboratory facilities with sophisticated and modern equipments to support its research. National Forest Library Information

Map Showing Institutes, Centres and their Jurisdiction



Centre of the institute is the biggest forestry library of the country among forestry institutions having about two lakh books and subscribes to 114 foreign and 110 Indian periodicals on forestry and related subjects. Forest Research Institute, Dehradun has also been conferred the status of "Deemed University" by the Ministry of Human Resource Development, Government of India, New Delhi. The institute has Centre for Social Forestry and Eco-Rehabilitation (CSFER) at Allahabad to cater the research needs of eastern UP.

Institute of Forest Genetics and Tree Breeding (IFGTB) at Coimbatore is a national institute and focuses activities in the states of Tamil Nadu and Kerala. The institute was formed by upgradation of the Forest Research Centre (FRC), Coimbatore working under the Forest Research Institute and Colleges existing since 1959. The institute focuses research on various aspects of forestry like genetics and tree breeding, plant biotechnology, forestry, land use and climate change, seed technology, forest protection, biodiversity, bioprospecting etc. The institute has DNA fingerprinting laboratory, Genomics laboratory; Phytochemistry laboratory; Genetic transformation laboratory and Tissue culture laboratory. The institute also has field units at Walayar and Panampally in Kerala; Karunya Nagar, Bharathiyar University

Campus, Veerapandi, Kurumbapatty, Gudalur, Chennai in Tamil Nadu. The institute maintains one of the country's oldest herbaria established in 1911. The oldest forest museum in the country, the Gass Forest Museum established in 1906 maintains 4500 exhibits related to forestry and wildlife. The institute also has a botanical garden recognized by the Botanic Gardens Conservation International (BGCI) and the Indian Botanic Gardens Network (IBGN) which was established in 1973 over an area of 3.7 ha to support *ex-situ* conservation activities.

Institute of Wood Science and Technology (IWST) at Bangalore a national institute to conduct research on wood sciences and technology focuses activities in the states of Karnataka, Andhra Pradesh and Goa. Taking into consideration the expertise available and contributions made, the Indian Council of Forestry Research and Education (ICFRE) has assigned the institute the status of "Centre for Advanced Studies" in the areas of improved utilisation of wood, mangroves and coastal ecology, and research on sandal. The institute aims to develop strategies for use and production of wood and other forest products in a way that sustain their supply. A Shore Laboratory at Visakhapatnam and a Forest Research Centre at Hyderabad are parts of the institute with field stations at Gottipura and Nallal.

Tropical Forest Research Institute (TFRI) located at Jabalpur focuses activities in the states of central India, viz., Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa. The institute conducts research on non-wood forest produce, rehabilitation of mined areas and other stress sites, development and demonstration in agroforestry models, planting stock improvement, sustainable forest management, biodiversity conservation and control of forest diseases and pests. The institute is actively involved in extension activities through its Van Vigyan Kendras. The Centre for Forestry Research and Human Resource Development (CFRHRD), Chhindwara came into existence as a centre to conduct research in the specialized areas like biodiversity conservation, non-wood forest products, forest protection, silviculture and tree improvement.

Rain Forest Research Institute (RFRI) at Jorhat was established in 1988 with an aim to extend knowledge on forestry related issues through research, education and extension and supports forestry research of north-eastern states including Sikkim. The institute focuses on conservation methods to restoration of degraded lands under shifting cultivation, management of community forests, preservation unique heritage of the region for eco-restoration and multi-facet use of bamboo and cane without damage to the ecological characters. The recently constituted Advanced Research Centre for Bamboo and Rattan (ARCBR) at Aizawl, Mizoram, a centre of RFRI, is specially meant for handling research problems on Bamboo and Rattans.

Arid Forest Research Institute (AFRI) at Jodhpur focuses activities in Rajasthan, Gujarat and Dadra & Nagar Havelli. The institute carries out research in forestry and allied fields to enhance land productivity and vegetative cover to conserve biodiversity and to develop technologies for the end-users. The main thrust areas of the institute are soil, water and nutrient management, technologies for afforestation of stress sites, management of plantations, growth and yield modelling, planting stock improvement, biofertilizers and biopesticides, agroforestry, JFM & extension, phytochemistry & non-timber forest products, integrated pest & disease management & forestry education & extension.

Himalayan Forest Research Institute (HFRI) at Shimla was established as High Level Conifer Regeneration Research Centre in

May 1977 with an aim to carry out research on the problems associated with natural regeneration of silver fir and spruce. It is part of Council since 1987 to cater to the needs of J&K and Himachal Pradesh with focused research on eco-rehabilitation of cold deserts, mined areas rehabilitation, insect-pests and disease incidences and management, besides studies on agroforestry practices in hills and regeneration of coniferous and high altitude broadleaved forests. The institute has well developed infrastructure of laboratories, library, herbarium, nurseries and experimental field areas for conducting research and training programmes. The institute has also been declared as the "Advanced Centre for Cold Desert Afforestation and Pasture Management" by the ICFRE for taking up advanced research in eco-restoration of these difficult sites. Research Station located at Tabo and Lahaul-Spiti (HP) caters to the specific research needs of the cold deserts and the institute will soon start its research operations from Field Research Station, Leh (J&K).

Institute of Forest Productivity (IFP) at Ranchi came into existence in 1993 with the objective to formulate, organize, direct, manage and carry out forestry research and education in eastern region of the country i.e. the states of Bihar, Jharkhand and West Bengal. The institute has Forest Research Centre, Mandar, Ranchi; Environmental Research Station, Sukna, West Bengal and Forest Research & Extension Centre, Patna, Bihar to cater the state research needs and extension activities.

RESEARCH HIGHLIGHTS

Introduction

Directorate of Research at ICFRE headquarters plan, coordinate and monitor the forestry research in all the eight research institutes and four centres of the Council and evaluate the progress of various research projects. The Council through Biodiversity Conservation and Climate Change Division addresses the problems in Biodiversity Conservation and Climate Change at international echelon at various platforms and represents the nation in this field.

The BCC Division has been proactive on climate change and related forestry issues. The Division is actively engaged in capacity building programmes by conducting various national and international workshops, and training programmes on climate change, Clean Development Mechanism (CDM) and forestry for forest officers and other stakeholders. The Division is working on forestry and climate change related policy issues leading to international negotiations under United Nations Framework Convention on Climate Change (UNFCCC).

The BCC Division is actively involved in providing technical inputs on "Forestry Sub-Group on Climate Change" to the Ministry of Environment and Forests (MoEF), Government of India, and contributes towards the development of country submissions to the UNFCCC.

Recognising the work done by ICFRE in the area of desertification, climate change and forestry, ICFRE has been awarded the **"Observer Status"** by the United Nations Convention to Combat Desertification (UNCCD) and United Nations Framework Convention on Climate Change (UNFCCC). ICFRE also applied to obtain "Observer Status" in the COP-10 to the CBD meeting to be held in Nagoya, Aichi Prefecture, Japan from 18th to 29th October 2010. An application form for accreditation along with all supporting documents was submitted to CBD Secretariat in March 2010.

BCC Division has compiled and prepared a report of ICFRE on celebration of International Day for Biological Diversity on 22nd May 2009 under theme "Invasive Alien Species" given by Convention on Biological Diversity (CBD), and submitted to MoEF, for onward transfer to the CBD Secretariat, Montreal, Canada.

The BCC Division has taken up three externally aided projects related to climate change:

i. **Assessment of soil carbon stocks and dynamics in forest soil of India for the period 1995-2007:** The project is funded by the UNDP-GEF. The project activity is subcontracted to ICFRE by the Ministry of Environment and Forests, Government of India through Winrock International India under its project: "Enabling Activity for Preparation of India's Second National Communication to the UNFCCC" ICFRE is executing the project in collaboration with Indian Institute of Remote Sensing (IIRS), Dehradun. The BCC Division of ICFRE, the nodal point of communication with collaborator and regional institutes of ICFRE, initiated all activities pertaining to the project.

   Draft final report of the project activity has been submitted to the Winrock International India, New Delhi.

ii. **Measurement of forest carbon exchange using eddy covariance and CDM potential studies in India:** The project is a partnership study between the Department of Forest Science and Resources (DISAFRI),

University of Tuscia (Italy), Indian Institute of Remote Sensing, Indian Council of Forestry Research and Education and Uttarakhand Forest Department.

Under this project, BCC division of ICFRE is entrusted to work on curriculum Development for CDM forestry project and CDM potential studies in forestry sector.

iii **Research Needs and the Financial, Technological and Capacity Needs and Constraints to Address Climate Change Concern vis-a-vis Forests and Forest Products in India:** The project activity is sub-contracted to ICFRE by the Ministry of Environment and Forests, Government of India through Winrock International India with the following three objectives:

a. To provide an overview of the current status of knowledge related to adaptation and mitigation in the forestry sector of India.

b. To identify gaps and constraints to undertake research activities related to adaptation and mitigation aspects for forests.

c. To identify and develop specific research themes and proposals to adaptation and mitigation aspects of forests.

Biodiversity and Climate Change (BCC) Division, ICFRE has also undertaken several short and long term policy programmes to address the problems of Biodiversity Conservation and Climate Change.

Research Planning Division under the Directorate of Research deals with the planning, formulation and finalization of Council's plan funded forestry projects. It coordinates the stakeholders meets, Research Advisory Group (RAG) meetings at each institute and Research Policy Committee (RPC) meeting at National level at ICFRE hqrs. following bottom-up, transparent and participatory approach. It also reviews the ongoing projects under five years rolling plan.

During the year 2009-10, following achievements have been made by this division:

- Research Advisory Group (RAG) meetings of each of the eight ICFRE institutes were convened at Institute level on the dates mentioned below to consider for approval the new research projects proposed by the ICFRE institutes.

IFGTB, Coimbatore	- 16th - 17th Nov. 2009
TFRI, Jabalpur	- 14th - 15th Dec. 2009
IFP, Ranchi	- 7th - 8th Dec. 2009
AFRI, Jodhpur	- 21st - 22nd Dec. 2009
IWST, Bangalore	- 7th - 8th Dec. 2009
HFRI, Shimla	- 23rd - 24th Nov. 2009
FRI, Dehradun	- 17th - 18th Nov. 2009
RFRI Jorhat	- 26th - 27th Nov. 2009

Research Advisory Groups were chaired by PCCFs of the states falling in the jurisdiction of the concerned institutes and attended by the member from different strata of scientists, a range of forest officials, diverse stakeholders viz. NGOs, industries, progressive farmers and universities. The projects were evaluated by two subject experts/referees and accordingly projects were modified to suit the requirement of user group.

- The projects approved by RAGs were placed before **Research Policy Committee (RPC)** in its Meeting, convened from 22nd to 24th February 2010 under the chairmanship of Dr G.S Rawat, DG, ICFRE to give final approval to the new research proposals submitted by eight research institutes under ICFRE.

- During XI RPC, 201 new projects and II All India Co-ordinated Projects (AICP) were

discussed by RPC members, of which 137 projects were approved at institute level through ICFRE funding amounting to `f1478.16 lakh. Approval was also given for two All India Coordinated Projects in Principle. The abstract of institute wise sanctioned new research projects during the period under report is as under:

Abstract of Sanctions of New Projects

Name of the Institute	Number of Projects	Total Amount Sanctioned (` in Lakh)
HFRI, Shimla	3	32.17
IFP, Ranchi	7	87.19
TFRI, Jabalpur	15	108.93
IWST, Bangalore	17	194.19
RFRI, Jorhat	14	144.34
FRI, Dehradun	45	413.72
IFGTB, Coimbatore	29	314.06
AFRI, Jodhpur	7	183.55
Total	**137**	**`1478.16**

- On 25th September 2009, IV **Directors' Meet** was organized in the Board Room of ICFRE hqrs, under the chairmanship of Dr. G.S Rawat, DG, ICFRE. The Directors' Meet was organized to discuss some important issues for which agenda was finalized by different directorates in consultation with the Directors of the institutes.

- ICFRE has been recognized as a Bamboo Technical Support Group (BTSG) by National Bamboo Mission, Ministry of Agriculture, Govt. of India to cater to the research and development needs of eleven States viz., Jammu & Kashmir, Punjab, Haryana, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, Chhattisgarh, Rajasthan and Gujarat in order to facilitate the implementation of the programmes of National Bamboo Mission. BTSG–ICFRE came into existence in July 2007. Activities of BTSG include organizing seminars and trainings for the farmers and field functionaries, publication of bamboo literature, and other promotional campaigns.

  During 2009-10, BTSG–ICFRE organized following five days training programmes for the farmers and field functionaries of State Forest Departments:

  (i) For Madhya Pradesh by TFRI, Jabalpur from 7th to 11th September 2009.

  (ii) For Chhattisgarh by IFP, Ranchi from 14th to 18th September 2009.

  (iii) For Himachal Pradesh by HFRI, Shimla from 26th to 30th October 2009.

  (iv) For Gujarat by AFRI, Jodhpur from 5th to 9th October 2009.

  (v) For Rajasthan by AFRI, Jodhpur from 26th to 30th October 2009.

  (vi) For Bihar by IFP, Ranchi from 9th to 13th November 2009.

  (vii) For Chhattisgarh by TFRI, Jabalpur from 7th to 11th December 2009.

  (viii) For Punjab by FRI, Dehradun from 8th to 12th February 2010.

  (ix) For Punjab by FRI, Dehradun from 8th to 12th March 2010.

  Ten thousand copies of the Hindi posters titled **"Bans aajeevika ka ek sadhan"** were reprinted for free distribution to National Bamboo Mission, State Bamboo Missions and ICFRE institutes for conducting trainings programmes. Distribution was also made to the sister organizations and SFRIs for further distribution up to grass root stakeholders.

- The apex body–Variety Releasing Committee (VRC) was constituted to institutionalize the registration of superior varieties and clones on a uniform basis in forestry sector

throughout the country as per "Guidelines for Testing and Releasing of New Tree Varieties and Clones". Director General (Forests) and Special Secretary to the Government of India, MoEF and Director General, ICFRE are the Chairman and Co-Chairman of VRC respectively.

First meeting of VRC was held on 19th January 2010 at MoEF, New Delhi, which considered the "Variety Release Proposals 2009" submitted by the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore in July 2009 and released elite entries of *Eucalyptus camaldulensis* (IFGTB-EC1, IFGTB-EC2, IFGTB-EC3 and IFGTB-EC4 – 04 nos. for cultivation in Tamil Nadu, and Andhra Pradesh) and *Casuarina equisetifolia* (IFGTB-CE1, IFGTB-CE2, IFGTB-CE3 and IFGTB-CE4– 04 Nos. for cultivation in Tamil Nadu, Karnataka and Union Territory of Pondicherry) developed by the IFGTB, Coimbatore as a maiden venture.

- **Quinquennial Review** in four institutes FRI, Dehradun; AFRI, Jodhpur; RFRI, Jorhat and IFGTB, Coimbatore and one Centre i.e. FRC, Hyderabad (under IWST, Bangalore) was carried out on pilot basis for the period 2002-2007. Reports submitted by the Quinquennial Review Teams were analyzed and necessary directions issued.
- Issues pertaining to the establishment of **National Bureau of Forest Genetic Resources (NBFGR)** were deliberated and revised proposal was submitted to the Ministry of Environment and Forests for consideration.

Monitoring and Evaluation Division deals with review of all the ongoing research projects of ICFRE institutes and suggests corrective measures for timely completion and achieving the objectives meaningfully. Also independent evaluation of some research projects of ICFRE institutes through independent subject matter specialist/experts/agency was done for improvement in the quality of research and transfer of technology developed, to the stakeholders.

To ensure proper implementation of ongoing research projects, the progress of the research projects was monitored on quarterly basis through **Quarterly Progress Review (QPR) by the directors**. Thereafter, information in prescribed format on progress of research projects for each quarter was furnished by the institutes to this division. Quarterly Progress Reports were scrutinized in conformity with the approved action plan and corrective measures, if any, were suggested to expedite the physical and financial achievements for meeting the project objectives.

During 2009-10, 328 (229 ICFRE plan funded and 99 externally aided) ongoing research projects of all ICFRE institutes were reviewed and evaluated. Reviews of research projects of all institutes (as per schedule) were completed by October 2009. Annual Review Reports were communicated to Directors of the ICFRE institutes by December 2009 to take follow up action on the observations made in the report.

Independent External Evaluation (IEE) of 22 projects randomly selected from each institute was carried out through independent subject matter specialists/agencies from outside ICFRE system.

Total 76 projects have been completed during the year 2009-10. Their **Project Completion Reports (PCRs)** were received and scrutinized. The institute wise research projects reviewed as per schedule during 2009-10 is as follows:

Institute-wise Ongoing Research Projects Reviewed During 2009-10

Sl. No.	Name of Institute	Date of Review	No. of Ongoing Projects Reviewed		
			ICFRE funded	EAP	Total
1.	AFRI, Jodhpur	26th- 27th May 2009	16	9	25
2.	TFRI, Jabalpur and FHRDC, Chhindwara	24th - 26th June 2009	13	17	30
3.	IFGTB, Coimbatore	9th - 11th July 2009	32	11	43
4.	IWST, Bangalore and FRC, Hyderabad	13th - 15th July 2009	32	15	47
5.	FRI, Dehradun and CSF&ER, Allahabad	11th - 13th & 17th August 2009	94	30	124
6.	RFRI, Jorhat	1st - 3rd September 2009	9	8	17
7.	IFP Ranchi	4th - 6th September 2009	16	2	18
8.	HFRI, Shimla	12th - 13th September 2009	17	7	24
		Total	**229**	**99**	**328**

Project Formulation Division continued to act as a facilitator between the ICFRE institutes/centres and potential donor agencies for the formulation of research projects in the identified thrust areas and their submission to various national and international donor agencies for funding as per their funding policies. It also coordinated the implementation of the research projects by ICFRE institutes/centres and maintained the record of sanctioned, submitted, completed and rejected projects through preparation of Status Reports.

The division has been collaborating with a number of National and International donor agencies for project funding. During the year 106 projects worth `37.22 crore sanctioned by National donor agencies and 10 projects worth `4.07 crore sanctioned by International donor agencies were being implemented in eight institutes and four centers of ICFRE.

Project proposals like "Planting Stock Improvement and Demonstration for Neem (*Azadirachta indica*), Pungam (*Pongamia pinnata*) and Alexandrian laurel (*Calophyllum inophyllum*) in Tamil Nadu"; "Dissemination of Technological Innovations of Neem and Karanj Prominent TBOs to Farming Communities and End Users to Jharkhand"; and "Post- Harvest Processing of Non-Edible Oilseeds of Arid Zone" were processed for their approval and submitted to NOVOD Board for financial assistance under their scheme on integrated development of Tree Borne Oilseeds.

Two more proposals "Marker assisted Selection of *Eucalyptus* for Adaptation to the Impacts of Elevated CO_2 and Gall Wasp Resistance" and "All India Coordinated Programme for Improvement of Fast Growing *Phyllodinous acacias*" were submitted to CSIRO, Australia and ITTO, Japan through MoEF.

A Project Concept Note on "Community Based Sustainable Natural Resource Management for Poverty Alleviation in Ten States" has been submitted to MoEF for funding through Planning Commission of India.

A project on "Forestry Research Support for Poverty Alleviation" has been submitted for funding through the World Bank.

Project proposal "Development, Evaluation and Standardization of Silvicultural /

Agri–silvi model for treatment of inland waterlogged areas in selected districts of North Bihar" was submitted to MoEF for arranging funds through suitable funding agencies.

A number of MoUs and agreements for the implementation of collaborative projects/ programmes of ICFRE institutes were scrutinised, finalised and processed for the approval of the competent authority such as MoUs of IFGTB, Coimbatore with (i) IFS, Sweden, (ii) CSIRO, Australia and (iii) ITC R&D Centre, Hyderabad and MoU of AFRI, Jodhpur with SFD, Gujarat.

All India Coordinated Projects (AICPs) duly revised and submitted by ICFRE Institutes were scrutinised, finalised and processed for necessary approval and financial assistance. Detailed Project Reports (DPRs) of 17 AICPs with an estimated budget of `115.61 crore for a period of 3 to 5 years addressing a number of identified species viz, Jatropha, Poplar, Casuarina, Shisham, Bamboo, Sal and various emerging forestry issues viz Biological control of Eucalyptus Gall Wasp, Genetic improvement and tree improvement strategies, Fuelwood utilization etc. were finalised, compiled and submitted to the Ministry of Environment & Forests for arranging funds through Planning Commission.

A poplar based agroforestry project 'Samudai Adharit Samanavit Van Prabhandhan Evam Van Sanrakshan Yojana'(Phase-I) popularly called Bihar project has been implemented by ICFRE in Vaishali district of Bihar through Forest Research and Extension Centre (FREC), Patna under IFP. The project is executed by providing training, technical support and quality planting stock to the farmers. This also includes establishing kisan/high-tech nurseries and demonstration plots. Under the project, about 47 lakh poplar plants and about 12 lakh plants of other species viz. teak, mahogani, gamhar, kadamb, semal, jamun, arjun, kathal etc. have been planted by farmers in their fields and it is proposed to plant 14 lakh plants of poplar and 3 lakh plants of other species on farmers' fields by March 2011.

Poplar plants were raised by farmers in Kisan Nurseries. Farmers were provided with poplar cuttings and technical support. The good quality plants of poplar so produced by the farmers were purchased back by FREC at the rate of ` 5/- per plant. These plants were then distributed to the farmers, free of cost, and the farmers planted them in their fields.

Regarding training of farmers, 1561 farmers have been trained till now at Jadua training centre at Vaishali. The farmers were trained in their respective villages also and a total of 3568 farmers have been trained so far. Under "Training–of-trainers" programme, 314 trainers have been trained which include training of 231 staff of the Bihar Forest Department. For visit to the successful models, educational tours were arranged for the farmers and 39 tours of farmers (each tour having a group of 25 farmers) were arranged to Forest Training Academy, Haldwani. Poplar has now gained a very important place in the district of Vaishali. Due to its fast growth, short rotation cycle and good economic returns, poplar has been readily adopted by the farmers in a short span of 3 to 4 years.

The Division examined and updated the Annual and Quarterly Status Reports of approved, submitted, rejected and completed projects with National and International donor agencies as per the inputs received from ICFRE institutes and centres. The discrepancies were communicated to the institutes/centres for correction, wherever required.

Theme based research achievements of the Council follow in the sub-chapters ahead.

2.1 Ecosystem Conservation and Management

Overview

Due to its sheer size and its range of topography, altitude and climate, India exhibits a rich variety of ecosystems, including forests, grasslands, deserts, wetlands, mangroves and coral reefs. These habitats provide for basic needs such as food, fibre, medicine, fodder, fuel wood and timber of a large section of the Indian population. However, in many parts of the country, there are serious threats to ecosystem health and consequently, to human livelihoods as well. Based on an analysis of these trends, it is possible to articulate India's conservation priorities in support of environmental sustainability. There may be six conservation priorities, each of which require specific improvements in knowledge, in capacity and in governance at the local, regional and national level.

- Enhancing India's cooperation with other countries on issues where national, regional and global conservation concerns converge.
- Influencing mainstream policy and programmes to recognise the trade-offs between economic and environmental considerations, and to integrate conservation concerns into the process of decision making.
- Employing effective instruments that encourage environmentally sensitive resource use and discourage unsustainable practices by resource users.
- Designing special measures to ensure the survival of fragile ecosystems in different parts of the country.
- Promoting community conservation of common pool resources, whether owned by the state or by local entities.
- Managing protected areas, reserved forests and other habitats controlled by the state in a manner that balances conservation imperatives with local needs, synthesises scientific conservation principles with indigenous knowledge and provides local communities a long term stake in conservation.

Projects under the theme

Project	Projects Completed During the Year	Ongoing Projects	New Projects Initiated During the Year
Plan	12	23	08
Externally Aided	09	10	11
Total	**21**	**33**	**19**

2.1.2 Climate Change

Climate Change as on date has become one of the most important global environmental challenge because of its multi-faceted implications and disproportionate impact on various sectors including forestry. Accordingly, in the present scenario, issue of highest importance to the developing countries including India, is reducing vulnerability of their natural and socio-economic systems to the projected climate change since these countries are bound to face the challenges of promoting mitigation and adaptation strategies for overall development. Addressing all these issues in a most effective way, the strategy requires a good scientific understanding and coordinated actions both at the national and at the global level.

Effect of Climate Change on the Phenology of Himalayan Rhododendrons

Efforts were made to study the effect of climate change on the phenology of five *Rhododendron* species of western Himalaya. It has been observed that flowering, fruiting, seed

setting and dispersal is advanced by 15 days to one month at all altitudes (*R. arboreum* and *R. barbetum* at 6000-8000 ft.; *R. companulatum*, 10000-11000 ft.; *R. lapidotum* and *R. anthopogon*, 12000-13000 ft. altitudes). The seedlings of *R. companulatum* which is a timber line species were observed growing slightly upwards from their natural range, which is an indication of movement of species to the next zone.

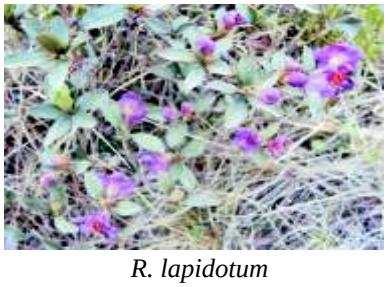
R. arboretum

R. barbetum

R. campanulatum moving upwards

R. campanulatum

R. anthopogon



R. lapidotum

Studies on Response of Important Tree Species to Elevated CO_2 Levels under Simulated Temperature and Moisture Regimes at Seedling Stage

Automated Open Top Chambers' have been established to conduct climate change research with particular reference to studies on response of tree species to elevated CO_2 as well as temperature. As per the programme, three months old seedlings of Teak, Casuarina, Eucalyptus, Ailanthus, Neem and Bamboo were exposed to elevated CO_2 levels in open top chambers at 600 ppm and 900 ppm for a period of three months. Simultaneously, seedlings were also kept in control in open top chambers without CO_2 enrichment. Another set of seedlings was also kept in control outside the chamber in the ambient environment. Observations on growth parameters revealed that there exists significant variation in growth with reference to CO_2 enrichment and control environment. Secondly, the response of seedlings to elevated CO_2 level highly varied among species. Overall the response was positive in terms of height growth. Teak, Casuarina, Eucalyptus and Ailanthus registered greater growth under elevated levels of CO_2 whereas Neem registered the maximum growth under elevated temperature than elevated CO_2. The growth of Bamboo was not positively affected by elevated CO_2 or temperature. The biochemical studies are in progress.

Assessment on Carbon Pool Potential of Important Tree Species at Different Ages, Sites and Management Regimes

By surveying 69 plantations of *Casuarina equisetifolia* in Tamil Nadu and felling 200 trees under different soil types and under irrigated and rainfed conditions, the dry matter production and carbon stock in biomass were estimated. Similarly, 243 Eucalyptus trees were sampled

from 81 plantations and 21 *Acacia mangium* trees in 7 plantations for biomass estimation. Soil samples collected from these plantations were analyzed for organic carbon and various other properties. In Teak plantations, carbon pool assessment is being carried out.

Vegetation Carbon Pool Assessment Andhra Pradesh North Region

Vegetation Carbon Pool Assessment studies were conducted in 11 field sites of Srikakulam, Vizianagaram and Visakhapatnam districts in Andhra Pradesh. Growth parameters that are height, girth, biomass were recorded.

National Vegetation Carbon Pool Assessment for Six Districts of Andhra Pradesh

A total of 36 plots at pre-assigned geographic coordinates were studied by laying out four quadrats of 0.1 ha each. The data on above ground biomass and locality information were collected. Total forest biomass was estimated in six districts of Andhra Pradesh viz., Medak, Mahabubnagar, Guntur, Nalgonda, Ranga Reddy and Hyderabad districts. Estimation of biomass of trees outside forests is scheduled in 40 sites.

Tropical Forest tree species for their potential as carbon sink

Regression equations were developed for *Tectona grandis, Shorea robusta* and *Eucalyptus hybrid* and quantified carbon using these equations in plantations and agroforestry systems. Agroforestry systems were established with *Dalbergia sissoo, Eucalyptus* hybrid and *Pongamia pinnata* and *Tectona grandis* as tree species and *Triticum aestivum, Cicer arietinum, Withania somnifera, Hordeum vulgare and Avena fatua* as agricultural crops. *Triticum aestivum* crop sequestered maximum carbon in agroforestry systems with *Dalbergia sissoo* and *Tectona grandis* as tree species, followed by *Withania somnifera* and *Cicer arietinum*. Maximum reduction in carbon sequestration in agroforestry systems with 15 years old *Tectona grandis* and *Dalbergia sissoo* occurred in *Cicer arietinum*, followed by *Triticum aestivum* and *Withania somnifera.*

Agroforestry system consisting of *Tectona grandis* and *Hordeum vulgare* established at TFRI campus

Vegetation Carbon Pool Assessment in Some Districts in Northern Rajasthan

Assessment of carbon in growing vegetation and carbon dynamics in the forests as well as Tree Outside Forest (TOF) were carried out in Shri Ganganagar, Hanumangarh, Churu, Jhunjhunu, Sikar and Jaipur districts of Rajasthan. A total number of 19 forest sites (76 plots) and 33 plots under tree outside forest have been surveyed in these districts and trees and shrubs have been measured in cluster sample of four at each site in forests. In TOF, some agriculture land, community land, state highway, national highway, railway tract, drainage line and village connecting roads have been surveyed, growth variables measured. Biomass of ultimate branches of a representative tree of different girth classes were recorded both for fresh and dry samples.

Studies on Carbon Sequestration in Different Forest Types of Rajasthan

With the objective to provide an estimate of carbon stock of forests in Rajasthan, twelve districts covering 336 forest blocks and 446 sites in these blocks have been surveyed and growth of

trees and shrubs measured and shrub/herbage biomass recorded. Litter, plant and soil samples have also been collected from the plots. Per cent Soil Organic Carbon (SOC) and Soil Inorganic Carbon (SIC) varied widely among the district. SOC varied from 0.17% in Hanumangarh district to 0.99% in Banswara, whereas, SIC varied from almost nil in Jhunjhunu to 1.12% in Chittorgarh district. Fresh aboveground and belowground biomass of *Leptadenia pyrotechnica* ranged from 0.09 to 19.0 kg and 0.05 to 20.0 kg, respectively with R/S ratio ranging from 0.29 to 2.63 (average of 0.97).

Sand dune scrub in Barmer district are found to be dominated partly by *Calotropis procera* with tree girth of 92 cm, height of 6.5 m and crown diameter of 6.6 m and with root:shoot ratio of 0.68. *Capparis decidua* tree dominated area with growth variables of 190 cm girth, 5.5 m height and 5.6 m crown diameter have also been observed in Jalore forest division. In growth variables of *Leptadenia pyrotechnica* collar girth, height and crown ranged from 5.26-40.50 cm, 55.0-233.0 cm and 36.0-380.0 cm, respectively. A mixed forest of *Mangifera indica* has been observed in Sirohi forest division.

Desert dune scrub of *L. pyrotechnica* and *Colligonum polygonoides* in Barmer

Mangifera indica mixed forest in Sirohi

Euphorbia caducifolia scrub forest in Barmer

Calotropis procera in desert dune scrub in Barmer

Capparis decidua in desert dune scrub in Jalore

Impact of Climate Change on Litter Microbial Dynamics

For studying the impact of climate change on litter microbial dynamics in Dipterocarp Forest in north-east India, eighteen species of microfungi responsible for Dipterocarp leaf litter decomposition of Deomali Reserve forest (Arunachal Pradesh) and Moreh (Manipur) were isolated in different seasons of the year along with three thermotolerant genera (*Aspergillus* sp., *Chaetomium* sp. and *Rhizomucor* sp.) using serial dilution-plate count method. *Aspergillus* sp. did not survive at 55°C and beyond and maximum growth was observed at 35-45°C. In case of *Chaetomium* sp. range of optimal growth temperature was found to be 55-60°C and that of *Rhizomucor* sp. was 45-55°C. The studies on population dynamics of microfungi showed a considerable variation in different seasons depending on the rate of decomposition. Maximum degree of decomposition and microfungal population were observed in rainy season followed by spring and minimum in winter. Higher rate of decomposition was recorded in below ground condition (just below surface layer) as compared to above ground soil. These data (2009-10) were compared for

assessing the changes in litter decomposition rate within the last decade (1999-2000) and results show a decline in decomposition rate from 1.07 to 1.01 and decrease in lignin concentration and increase in nitrogen concentration for the same area.

Development of Remote Sensing Based Bio-climatic Index

Validation of changes in timberline and other classes over the few decades in relation to the altitudinal gradient was assesed. Vegetation ingression in alpine regions of Bedini bughiyal Chamoli Garhwal was analysed. An area of change for ground verification (species composition) has been demarkated. The seedlings and saplings of tree line vegetation specially *Rhododendron campanulatum*, *Abies pindrow* and *Quercus semicarpifolia* were found moving towards alpine zone.

Utilization of Automatic Weather Station/ Agrometeorological Station Data for Agriculture, Forestry and Hydrological Applications

Sites were selected near Automatic Weather Station (AWS) and Agrometeorological Station (AMS) in Kanha National Park (KNP), Bandhavgarh National Park (BNP) and Madhav National Park (MNP). Grass biomass studies were conducted in at selected sites. Soil moisture profile up to the depth of 1.50 m was measured at an interval of 30 cm. Surface and sub-surface soil samples were collected and analysed in laboratory.

Conducting Soil Moisture Profile Studies near AMS at Kanha National Park

Conducting Grass Biomass Studies near AWS at Kanha National Park

Energy and Mass Exchange in Vegetative System

Micrometrological station has been established in Pine plantation (forest ecosystem) in F.R.I. campus, Dehradun with the objectives to measure micrometrological and biophysical parameters over Pine plantation, modelling canopy atmospheric exchange processes and primary productivity using land surface process models, validation of satellite derived parameters using *in-situ* measurements.

Micrometrological Station in F.R.I. Campus

2.1.3 Ecology & Environment Eco-restoration

Eco-restoration Studies in Uranium Mines

A marked improvement was recorded in tailing covered soil properties with the age of bio-reclamation. The accumulation and subsequent decomposition of plant residues have resulted in building the organic matter with an associated increase in nutrient enrichment. The organic carbon and nitrogen contents tend to increase with age. The availability of nitrogen and phosphorous increased with age. The exchangeable cations showed marked improvement with concentration of potassium increasing progressively and attaining a net annual gain of 8.51 kg/ha at the age of two years. The plant species present have, thus, strongly influenced by physico- chemical properties of the tailing covered soil in short period of time.The species with minimum concentration of radio nuclides were identified as *Colebrookea oppositifolia, Dodonaea viscosa, Furcraea foetida*,

Imperata cylindrica, *Jatropha gossypifolia*, *Pogostemon benghalense* and *Saccharum spontaneum*. They are non-edible with shallow root system, evergreen with less height and more crown cover. The seven species selected show minimum concentration or below detective limit of the uptake of radionuclide by plants. Roots of the selected species were confined to the 30 cms. layer of soil and not penetrating the tailings. Growth, diameter, basal area was the same as in natural ecosystem so tailing covered soil impact was found negligible.

Development of Site Specific Regeneration Augmentation Plan for Potential Degraded Areas in Western Ghats, Kerala

Experimental sites were identified at Pudur, Siruvani, Thathangalam and Panthanthodu in Attapaddy Reserve Forests. Inventory of species in and around the experimental plots was prepared. Quantitative assessment of vegetation in and around the experimental plots was also made and recorded the GBH of all the woody species. Pioneer and canopy tree species were selected for different forest sites. Pioneer species selected are *Maesa indica*, *Macaranga indica*, *Clerodendrum viscosum*, *Olea dioca* and *Syzygium cumini* for evergreen forest areas (Siruvani, and Panthanthodu); *Clerodendrum viscosum*, *Holarrhena pubescens*, *Helicteres isora*, *Wrightia tinctoria*, *Glycosmis mauritiana and Erythrina indica for moist deciduous forest area in Thathyangalam;* *Annona squamosa*, *Tarenna asiatica*, *Dodonaea viscosa*, *Glycosmis mauritiana*, *Clausena dentata*, *Cassia auriculata* and *Mundulea sericea* for dry deciduous sites in Pudur area.

A trial was established in Siruvani with five selected pioneer species for studying their performance. Two species (*Tarenna asiatica* and *Dodonaea viscosa*) were planted in the dry deciduous forest site at Pudur.

Seeds of *Glycosmis mauritiana*, *Dodonea viscosa*, *Mundelia sericea*, *Cassia auriculata*, *Narengi crenulata*, *Cipadessa baccifera*, *Clerodendrum viscosum*, *Helicterus isora*, *Holarrhena pubescens*, *Wrightia tinctoria*, *Mallotus philippensis*, *Mallotus tetracocus* and *Olea dioica* were collected for germination and nursery studies

SUCCESS STORY

Eco-restoration of Tsunami Devastated Coastline of Andaman Group of Islands

A project was initiated during 2005 immediately after the Tsunami occurrence in 2004. The objective of the project was to develop shelterbelt plantations in the north, middle and south Andaman Islands using the most appropriate seed source and adopting modern nursery and plantation technology. It also aimed at capacity building of field staff of Andaman and Nicobar Forest Department in these techniques as the project progressed. Nearly 40 ha of shelterbelt plantations have been established in the three group of islands during the project period with the active collaboration of the Forest Department. All these plantations established well with a stocking of over 80%. The local community was involved in all field activities in every location and they are also partners in protecting these biowalls. Establishment and maintenance of these plantations also created livelihood opportunities in the form of employment availability during the critical post-Tsunami period and a major part of the work force constituted women.

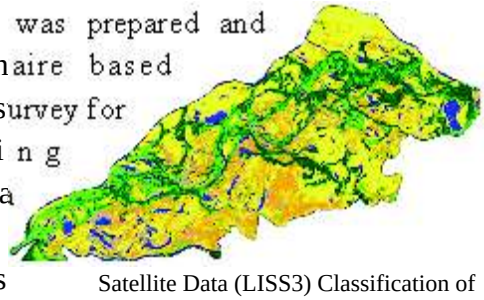
Eco-restoration of Degraded Community Land

Eco-restoration of degraded community land by planting suitable tree species was initiated at Danda Shrinagraja in the District Pauri of Garhwal. Initially the forest tree species like *Terminalia chebula*, *T. balarica*, *Juglans regia*, *Grevillia robusta* and *Melia composita* etc. were planted. *Grevillia robusta* was found performing better and was most suitable for the site. An awareness programme on the eco-restoration and conservation by disseminating information on the species planted at experimental site was carried out for the local people.

Impact of Invasive Species on Forest Ecosystem

Invasive species invasion is a serious problem in some of the most biologically sensitive zones of the country because these species often alter the structure and composition of native ecosystem and therefore threatens the indigenous biodiversity.

Investigations on ecology of *Mimosa invisa* invasion in Kaziranga National Park, Assam was carried out. Biological invasions and the presence of exotic species is a pervasive and costly environmental problem that has been the focus of intense management activities over the last decades. Grid map of size 810 m x 810 m of the study area was generated. Classification of course resolution satellite images (LISS 3) was done. Questionnaire based appraisal survey for presence/absence of Mimosa in each forest range was also carried out. GPS based reconnaissance survey of the study area was carried out for collection of geo-coordinates of Mimosa invaded patches. A "Potential invasion map" was prepared based on GPS information and the preliminary classified map. Vector layers like drainage, roads, camp locations, compartments and grids were integrated with Potential invasion map in GIS environment and base map was prepared. Phyto-sociological study has been carried out in 3 different Mimosa infested sites in Bagori Range of Kaziranga National Park. Data recording on phenological events of Mimosa was completed and phenograms were prepared. Seeds from healthy Mimosa plants identified in invaded areas were collected from Western, Central, Eastern and Buraphar ranges of KNP. Seeds were processed and stored for seed biology and germination studies. Seed germination trials were laid out in laboratory and nursery conditions. Field trials for seedling emergence from soil seed bank were also laid out. A Questionnaire (in vernacular language) was prepared and questionnaire based appraisal survey for existing Mimosa control measures were carried out.



Satellite Data (LISS3) Classification of Kaziranga National Park, Assam, India

Ecological Impact Assessment of Invasion of *Lantana*, its Removal and Subsequent Restoration of Habitat

Vegetation analysis in three years old Lantana removal and Lantana invaded sites in natural forests of Rajaji National park in Uttarakhand was done. Regeneration study of

Invasion of Lantana in the Park Area

Growth of Native Understory Vegetation after Removal of Lantana

dominant tree species in Lantana removal sites was carried out. Impact on plant species diversity and richness as a result of Lantana invasion, removal and subsequent restoration in Eucalyptus plantation areas in Rajaji National Park was also assessed. Marked changes in the dominance of certain understory native vegetation in mixed and Sal dominated vegetation communities was recorded as a result of removal of Lantana.

Bioremediation

Bioremediation of Bauxite Residue Through Bio-inoculants

Bioremediation is a low cost and environmental friendly technique which uses plants and microbes to clean up moderately contaminated areas and problematic soil. Bauxite residue (Red mud) is an industrial waste by product of Alumina industry. Blue Green Algae culturing was developed and propagation of BGA cultures is in progress. Under this project different species of Cyano-bacteria cultures are being propagated and their effect on red mud amelioration has been studied. Nursery experimental trial to study the effect of Bauxite residue and amendment of bioinoculation of Cyano-bacteria cultures on selected species viz. *Dalbergia sissoo, Prosopis juliflora, Acacia auriculiformis, Pithecelobium dulce* and *Cassia siamia* is in progress.

Fungi for Bio-treatment of Waste Water

Experiments with different fungi viz. *Flavodon flavus, Oxyporus ravidus, Schizophyllum commune, Trametes versicolor, T. cingulata* and *Pycnoporus sanguineus* were conducted at different industries to test the growth and bioremediation capacity.

Forests Rejuvenating Microclimate of Some Villages

Studies on phyto-sociological parameters viz. density, frequency, abundance, basal area, Important Value Index (IVI), species diversity index, concentration of dominance and evenness, physico-chemical properties of the soil and daily Meteorological data collected from the two i.e. Nagdev Temple, Puri and Control selected sites showed that there was difference in vegetation and soil aspects of the study sites, but significant differences recorded in weather data of the sites.

Ecological Impact of Urbanization on Floristic Diversity

Increase in trees diversity, undergrowth biomass, relative humidity and decrease in undergrowth species diversity and temperature was observed in the forest ecosystem with respect to distance from urban/village habitations. Habitations located nearby forest ecosystems showed dependence on forest resources for collection of fodder and fuel wood.

Development of Air Pollution Biomonitoring Station for Air Quality Assessment in Dehradun

Air pollution biomonitoring station was established in Selakui Industrial Area, as well as Shatabdi Van Vigyan Kendra, Dehradun. Plant sensitivity index to air pollution and air pollution index were developed for evaluating the air quality status of the industrial area. Several active biomonitoring studies were performed to evaluate the air quality of both the bio-monitoring stations i.e. Selakui Industrial Area and Satabdi Van Vigyan Kendra.

Impact of Tourism on Environment of Roopkund and Pindari Areas of Nanda Devi Biosphere Reserve (NDBR)

There were not much effect of tourism or tourist activities on vegetation, soil, water and landscape of the area. Socio-economic studies of both the areas reveal that the people are very poor; they lack basic amenities like schools (High school onwards), hospitals, telephones, electricity, even

roads to most of the villages. Local people don't have much participation in tourism of the area. Some strategies to promote tourism and local people's participation have been suggested.

Impact of Human Induced Disturbance on Regeneration and Population Structure of *Rhododendron arboreum* and *Myrica nagi*

The flowering, fruiting and seed maturation of *Rhododendron arboreum* in Garhwal Himalaya were monitored. Seeds were collected and tested for viability in laboratory. Permanent plots were marked for monitoring of seed germination and establishment in the field. Establishment of seedlings and saplings in open and close canopy areas was studied. Cyclic behavior of flowering was observed in *R. arboreum*. The number of seedlings and saplings of *R. arboreun* and *M. nagi* were recorded higher in open and exposed areas as compared to dense canopy forest area.

Application of GIS for Monitoring Forest Database

Establishment of GIS laboratory was done for systematic creation, management and up-gradation of GIS based forest-database of North-East India. Geographical Information System have brought revolution in inventorying, monitoring and management of natural resources and provided a powerful tool to the scientists/decision makers. GIS is capable of providing solution to the space and time bound queries in most cost and time effective manner. Keeping in view of the importance and utility of GIS in creation, manipulation and overall management of huge forest-database of this region, the present project was formulated and executed. The project was completed successfully and a full-fledged Geoinformatics Laboratory was established in Rain Forest Research Institute, Jorhat premises with all basic facilities including state of the art hardware, software, data and skilled manpower. Four hundred fifty (450) numbers of Survey of India Topographic sheets of 1:50k and 1:25k scale have been procured from Survey of India, N.E. Circle, Shillong. All are stored and georeferenced in digital format. Forest cover map procured from FSI, Dehradun is re-projected and hyperlinked. Geo-referencing and digitization of soil types, soil erosion, physiographic, geology, and agro-ecology maps is completed. Digitization of Reserved forest from available SOI toposheets is completed. Hyper linking of all available utility and topographic vector layers is completed as a part of creation of GIS based forest data base for entire North-East India.

Identification of Suitable Tree Species for Biodrainage

Effect of seven tree species including *Acacia nilotica, Albizia lebbek, Albizia procera, Dalbergia sissoo, Eucalyptus* hybrid, *Pongamia pinnata and Terminalia arjuna* planted along the left bank canal of Bargi command area, Jabalpur on underground water table was observed using observation wells. Simulated experiments were conducted in lysimetric tanks to observe the

Geoinformatics Laboratory RFRI, Jorhat

Lysimetric Experiments Conducted at TFRI Campus

Plantation along Left Bank Canal of Bargi Command Area, Jabalpur

effect of tree species on water table as well as effect of water table on growth and biomass of the species.

Efficacy and Economics of Water Harvesting Devices in Controlling Run-off Losses and Enhancing Biomass Productivity in Aravalli Ranges

Adoption of different rainwater harvesting techniques (contour trench, gradonie, box trench and V-ditch) on a degraded hilly area in Banswara has improved the biodiversity in the area. There is increase in number of grass and herbs species in the experimental plots and 92 numbers of species recorded in October 2009 as compared to 39, 75, 81 and 81 species in 2005, 2006, 2007 and 2008, respectively. Number of species was lowest in 10-20% slope (4.99 m^{-2}) and increased downward being highest in <10% slope (6.22 m^{-2}). Dry matter production was 246.82 g m^{-2} in <10% to 355.86 g m^{-2} in >20% slope. Among the treatments, dry matter production was 336.99 g m^{-2} in V-ditch plots as compared to 272.81 g m^{-2} in control plots. As a result of protection and afforestation, there was increase in water, fodder and fuelwood availability in the area.

2.1.4 Biodiversity

Biodiversity Assessment and Conservation

India being the seventh largest country in the world and Asia's second largest nation has now emerged as the twelth largest economy in the world. The ever growing economy and the vision 2020 of India will directly impinge upon the natural resources, particularly, the remaining forest ecosystems and is certainly becoming a matter of concern. Being a mega biodiversity country, forests in India play the critical role while providing several ecosystem services which are mostly unaccounted for in the economic terms.

a. Eastern Himalaya

Quantative Assessment and Grid Based Maping of Plant Resources of Upper Assam Region

The eastern Himalayan region of India is one of the twenty five hotspots of biodiversity in the world. The region is estimated to house nearly seven thousand species of plants including those of medicinal value and otherwise, economically important ones. The quantitative assessment and grid based mapping of the plant resources of upper Assam region was initiated. Survey and sampling of 131 belt transects belonging to different sampling grids (6.5 km x 6.5 km of size approximately) is completed. The sampling grids were selected from the districts of Jorhat, Dibrugarh, Golaghat, Lakhimpur and Sibasagar. Collection of plant specimen (for preparation of herbarium), photography of all available plants in and around each belt transects were done accordingly. Information regarding girth, height, phenology etc was also collected as per prescribed format. The GPS location of starting point, midpoint and end point of all belt transects are noted. Information regarding tree, shrub and herb species of sampled area was documented. Herbaria of about 309 specimens were prepared following appropriate procedure. Upgradation of GIS database were done accordingly.

Phytodiversity of Jeypore Reserve Forest

Studies on the assessment of "Phyto-diversity dynamics" for conservation in Jeypore Reserve Forest was conducted. The floristic composition of the tropical wet evergreen ecosystem and regeneration status of trees were assessed and a sample plot (1 ha) was laid out *in-situ*. Sampling has also been carried out for two locations for trees, shrubs and herbs. Data on natural regeneration status of trees was also collected from the study site.

SUCCESS STORY

Role of the Villagers on Conservation of Phytodiversity

Documentation of plant resources of the patch vegetation and its different uses by the villagers in Jorhat district, Assam was conducted. Distribution and ecology of different species of plants were studied in 24 study sites selected throughout the district. Socio-economic survey was conducted in nearby villages of the selected patch vegetation to understand the dependency and the role of the villagers on conservation of phyto-diversity. About 230 species of plants used by the villagers were recorded which includes timber, fire-wood, food, medicine, fodder, feeder plant for silk worm and some other minor uses. Important timber yielding trees recorded in the study area are *Terminalia myriocarpa, Artocarpus chama, Michelia montana, Castanopsis armata, C. tribuloides, Steriospermum chelonoides, Mesua ferrea* and *Schima wallichii.* Some species like *Machilus bombysina, Litsea monopetala, Litsea cubeba and Heteropanax fragrans* are being used by the villagers as feeder plant for silk worm rearing. The patches nearby riverside areas are dominated by *Lagerstromia speciosa, Biscofia javanica, Bombax ceiba, Barringtonia acutangula* along with *Calamus tenuis* and *Clinogyne dichotoma.* Some other economic plants recorded are *Aquilaria agallocha, Canarium resiniferum, Salix tetrasperma, Licuala peltata* and *Livistona jenkinsiana* etc. The different edible fruit giving plants available in the patches are several species of *Garcinia* sp., *Syzygium* sp., *Dileinia indica, Chrysophyllum lanceolatum, Baccaurea sapida, Flacourtia jangomas* and *Elaegnus caudata*. An enquiry into the history of these patch vegetations was done and it has been found that due to the expansion of some other land use practices like agriculture, sericulture, tea cultivation and extension of village area the patch vegetation areas are reducing at a rapid rate.

Rattan Species Diversity in Assam

Exploration of rattan species was carried out in Dihing-Patkai Wildlife Sanctuary, Dibru-saikhowa Biosphere Reserve, Gibbon Wildlife Sanctuary, Kaziranga National Park, Karbianglong Wildlife Sanctuary, Nambor-doigrung Wildlife Sanctuary and Pobha reserved forests of Lakhimpur and Poba reserved forest of Dhemaji districts of Assam. Rattans are found in clustered pockets in Karbianglong Wildlife Sanctuary, Nambor-doigrung Wildlife Sanctuary Dihing-Patkai Wildlife sanctuary, Kaziranga National Park. While, in Gibbon Wildlife Sanctuary, Dibru-saikhowa Biosphere reserve rattans clumps occurred scattered in distribution. Thirteen rattan species were identified namely: *Calamus tenuis, C. floribubdus, C. flagellum, C. guruba, C. latifolius, C. nambareinsis, C. khasianus, C. kingianus, C. gracilis,C. erectus, C. leptospadix, Daemonorops jenkinsiana* and *Salacca secunda*. Highest species diversity was achieved in Karbianglong Wildlife Sanctuary, from where 12 rattan species were reported highest density of rattan (532.3±12.0 individuals/ha) was found in Kaziranga National Park, with total regeneration of 289.8±5.0 individuals/ha. Propagules of all the rattan species were collected from study sites, conserved and established in a demonstration plot in Botanical Garden, Rain Forest Research Institute, Jorhat, Assam.

Biodiversity Studies of Orthoptera in Kaziranga National Park

Biodiversity studies of Orthoptera in Kaziranga National Park, Assam, revealed a total of 36 species of grasshoppers belonging to 30 genera, and 4 families in different habitats viz., forestlands, savannahs and grasslands of KNP. The family Acrididae had the largest species

representation (19 species) followed by Tettigoniidae (9 species), while the least representation was recorded in Gryllidae family with 3 species only. The grasslands of KNP harboured greater number of *Orthoptera* species (21 species) followed by savannahs and forestlands (19 species). Besides, the population fluctuations of *Orthoptera* species showed a considerable variation depending on the seasons of the year and species diversity were lowest in January-April where as, it was maximum in the months of July-August.

Phytodiversity of Nambor Reserve Forest

A phyto-sociological study in Nambor reserve forest was carried out through quadrate method and at each location 1ha. plot was established. Data on various ecological parameters like frequency, density, basal area, etc. were collected for 96 species. Socio-economic survey in the fringe villages & market survey at Koilamati & Shilonijan areas was done.

b. Western Himalaya

Ecological Assessment of Floristic Diversity in Kalatop Khajjiar Wildlife Sanctuary of District Chamba, Himachal Pradesh

The phyto-sociological analysis of vegetation was conducted for Kalatop Khajjiar Wildlife Sanctuary under altitudinal gradients. In Dankund to Jyot, total number of plant species were 70 with the dominance of *Picea smithiana, Viburnum erubescens* and *Bergenia ciliata*. In Dankund to Ala, total number of plant species were 94 and dominant species were *Picea smithiana, Sarcococca saligna, Viburnum erubescens* and *Valeriana jatamansii*. In Matuni to Kakala, total number of plant species were 106 and dominant species were *Picea smithiana, Sarcococca saligna* and *Valeriana jatamansii*. In Madrani to Khajjiar, total number of plant species were 103 and dominant species were of *Persea duthiei, Picea smihiana, Sarcococca saligna* and *Valeriana jatamansii*. In Dankund to Khadgot, total number of plant species was 108 and dominant species were *Cedrus deodara, Picea, Sarcococca saligna, Sorbaria tomentosa* and *Rumex napalensis*. In Kalatop to Kakala area, total number of plant species were 97 and dominant species were *Cedrus deodara, Sarcococca saligna, Rumex napalensis* and *Valeriana jatamansii*. In Kalatop to Talai area, total number of plant species were 115 and dominant species were *Cedrus deodara, Sarcococca saligna, Bergenia ciliata* and *Pilea scripta*. In Khajjiar to Parel, total number of plant species were 129 and dominant species were *Pinus roxburghii, Quercus leucotrichophora, Rubus niveus, Rhododendron rboreum, Anaphalis triplinervis*. In Gate to Jyot, total number of plant species were 107 and dominant species were *Quercus leucotrichophora, Picea smithiana, Berberis aristata, Viburnum erubescens, Rumex nepalensis* and *Anaphalis triplinervis*. In Lakadmandi to Khajjiar, total number of plant species were 103 and dominant

Digitalis purpurea

Calanthe tricarinata

A View of Khajjiar Lake

species were *Cedrus deodara, Sorbaria tomentosa* and *Valeriana jatamansii*. The maximum number of species were recorded in Khajjiar to Parel (129) followed by Kalatop to Talai (115) and Dankund to Khadgot (108). The ethnobotanical study was conducted in 8 villages and documented 40 plant species used for different purposes. The threatened plant species recorded from the areas were; *Podophyllum hexandrum, Taxus wallichiana, Zanthoxyllum armatum* and *Cinnamomum tamala*.

An Ecological Assessment of Floristic Diversity in Hemis High Altitude National Park, Ladakh, Jammu & Kashmir

The ecological and taxonomic studies in Rumbak Valley of the Hemis High Altitude NP were conducted. Various points taken for detailed study were Umrutse (4200 m), Ganda La (5100 m), Stok La (5000 m), Manskarmoh (4800 m), Changma (4300 m), Stok (3900 m) etc. Floral collections were also taken from the Spituk, Martselang, Mathod and Hemis region of the park. In-depth ecological and taxonomic studies in Markha Valley of the area were conducted at various high altitude camp sites; viz, Chilling (3800 m), Kaya (3700 m), Skyu (3800 m), Markha (4000 m), Shingo (4200 m), Chalak (3900 m) etc. Floral collections of unique specimens for herbaria was made. Ethno-botanical information were collected via informal chats/discussions with village elders, guides and amchis.

Surveying the Phytodiveristy in the Hemis High Altitude National Park, Ladakh, Jammu & Kashmir

Waldheimia glabra

Thermopsis barbata

Taxonomy, Biodiversity and Habitat Association of Noctuid Moths (Lepidoptera: Noctuidae) in Various Conifer Forests of Himachal Pradesh

The moth (Lepidoptera) samples were collected from Malan, Sairighat, Townbhrari, Theog, Shimla, Janjheli, Khajjiar, Narkanda, Akpa, Bharmour, Manali, Pattan Valley and Asrang. Damage done to the host (only selected conifers and associated vegetation) by these species was also recorded. The pest status of noctuid species of respective hosts has been given in parenthesis i.e. *Trichoplusia orichalcea* Fabricius (Polyphagous, herbs of the Deodar forests), *Agrotis segetum*, (cutworm of deodar and other conifers, polyphagous), *Agrotis yplsion*, (cutworm of deodar and other conifers, polyphagous), *Spodoptera lituro* Fabricius (Polyphagous), *Spodoptera cilium* Guenee (Polyphagous) and *Plecoptera reflexa* Guen. (Major pest of *Dalbergia sissoo* in the zone of Chirpine).

Fourteen study sites were selected and 2740 specimens of Lepidoptera were collected from these sites. Out of these, 663 were noctuid and only 66 species were identified. Data on herb, shrubs and trees were recorded from three sites. Description of wing venation and genitalia of 45 identified species has been completed. To understand the habitat of the noctuid moths, the data on plant biodiversity of 3 sites have been analysed till date and the plant biodiversity data

Fig: 3a to 3h species of the Genus *Chrysodeixis*

of fir and spruce forest of Manali shows that the number of tree species were 8 with the dominance of *Picea smithiana* followed by *Abies pindrow.* Number of shrub species were 14 with the dominance of *Berberis aristata* followed by *Rubus niveus.* Number of Herbs species was 55 with the dominance of *Anaphalis triplinervis* followed by *Fragaria indica.* Index of dominance (C value) for tree, shrub and herb species was 0.328, 0.099 and 0.035 whereas; diversity index (H') was 1.408, 2.458 and 3.630 respectively. It is concluded that distribution of most of plant species was contiguous. In another site i.e. deodar forest of Manali, the number of tree species was 2 with the dominance of *Cedrus deodara* followed by *Pinus wallichiana.* Number of shrub species was 17 with the dominance of *Sarcococca saligna* followed by *Cedrus deodara* sapling. Number of herbs species was 52 with the dominance of *Rumex nepalensis* followed by *Gerardiana diversifolia.* Index of dominance (C value) for tree, shrub and herb species was 0.927, 0.120 and 0.041 whereas; diversity index (H') was 0.161, 2.422 and 3.457 respectively. Distribution of most of plant species was contiguous in this area also. After identification, the host plant will also be confirmed by consulting the literature available for the species.

Ecological Studies of Prominent Species (*Capparis spinosa, Ribes orientale, Caragana gerardiana, Colutea nepalensis, Cratagus songarica, Elaeagnus angustifolia, Hippophae rhamnoides* and *Rosa webbiana*) of Cold Deserts

Detailed ecological studies for the identified species were carried out at Gue, Tabo, Mane, Ladang, Kurith, Hurling and at Samdoh falling in Spiti Valley; Sisso, Gondhla and Udaipur in Lahul valley and Spillo, Pooh and Khab etc. in Kinnaur district of Himachal Pradesh.

Colutea nepalensis

Cratagus songarica- through Cuttings

Cratagus songarica- through Seeds

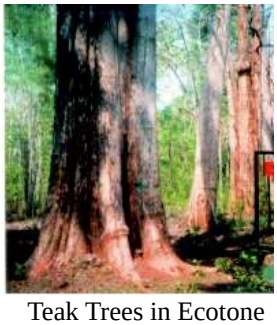
Field Plantations of Different Species

Ribes orientale

c. Central India

Plant Diversity in Sal and Teak Ecotone Zone

Two ecotone sites, one in Jagdalpur (Chhattisghar) and another in Umaria (M.P.) were studied. Two sites dominated by sal and teak forest near ecotone zone have also been selected for comparative study. Number of trees, shrub and herb species were found comparatively more in ecotone zone than in teak and sal of both the study sites. The data showed that the surface soil of teak forest was neutral (7.0) to slightly alkaline in nature, whereas, in sal forest, soil was acidic (5.5). The pH of the soil of ecotone zone was found in between (6.2) of teak and sal forests. Organic carbon percentage was almost same (1.12%) in ecotone and sal forest, where as, in teak forest, the value was comparatively low (0.65%). The following indicator species are found in both the ecotone sites: *Dalbergia latifolia, Litsea gluiosa, Terminalia chebula, Sterculia urens* and *Holarrhena antidysentrica* tree species; *Litsea gluiosa* shrub and *Diospyros melanoxylon* in herb/seedling stage. Phytosociological study showed that the diversity of trees, shrubs and herbs were high in ecotone site. However, in pure sal and teak forest, the same was recorded comparatively low.



Teak Trees in Ecotone Zone, Jagdalpur, CG

Among tree species, *Tectona grandis* was found dominant and having highest IVI in ecotone zone of both the sites. S*horea robusta* in sapling stage was found dominant species in Jagdalpur and at Umaria sites, *Cassia tora* was found to be having the highest IVI. Temperature difference of 1° C was observed in general in both locations (inside and outside forest). Ecotone and teak forest showed very less variation but temperature was obviously higher than sal forest. The temperature of sal forest (inside forest) was recorded comparatively low.

Sal and Teak Trees in Ecotone Zone, Umaria, MP

Humidity percentage in sal dominated area of two sites was comparatively high whereas, in teak dominated area of both the sites, the values were comparatively less. In ecotone zones, the values were found in between. Microfloral study revealed that fungal population in ecotone zone of Jagdalpur and Umaria site were comparatively more than that in pure sal and teak forest.

Achanakmar-Amarkantak Biosphere Reserve

Documentation of data on vegetation status, number of species of flora, fauna, threatened species and human population of all three zones of Achanakmar-Amarkantak Biosphere Reserve was done and existing information updated. The inventory of flora includes 1111 species of angiosperms, 16 gymnosperms, 40 pteridophytes,16 bryophytes, 130 lichens, 178 fungi and 7 species of algae. The inventory of fauna included 27 species of mammals, 142 birds, 15 lizards & snakes, 10 amphibians, 16 pisces, 27 beetles & cricket, 85 butterflies & moth and 5 species of centipedes. Survey of NTFP's revealed nearly 39 species in village market trade. Biannual Biosphere Reserve Information Series (BRIS) Vol. 1 (1 & 2) was published and circulated among scientists and BR managers. Besides this, a questionnaire proposed by Seville strategy under Madrid action plan was prepared. A complete document on Achanakmar- Amarkantak Biosphere Reserve for nomination in the World Network of

Biosphere Reserve was prepared and submitted to State Forest Department of Chhattisgarh.

Ecological dynamics of vegetation structure and assessment of morphological adaptive variation to create base line data in Selected Species in Dalma Wildlife Sanctuary was taken up during the year 2009-2010. The cumulative physical achievements were as follows:-

- A total of 16 sample plots are laid out in the sanctuary covering four ranges.
- Plant specimens are collected and herbari are prepared.
- So far 66 plant species are identified and authenticated.
- Few species of elephant food like *Mallotus philippensis* were collected for bark and leaf nutrient estimation.

d. Southern India

Structure, Diversity and Germination Syndrome in Tropical Evergreen Forest Findings: A Case Study from Western Ghats of Karnataka using Permanent Preservation Plots (PPPs)

Vegetation analysis of data collected of PPPs in 3 sites; Makuta, Muchiladuka and Malemane falling in South, Central and Northern part of Tropical Wet Evergreen Forests of Western Ghats, Karnataka from 1937-2008 completed. Parameters like diversity index, similarity index, population structure worked out. Regeneration trends of these forest types represented by the PPPs worked out according to four regeneration category classes. Among the dominant species in Makutta and Malemane, *Kingiodendron pinnatum* had the maximum MAI of 1.49 cm and followed by *Vitex altissima* 1.39 cm and *Dipterocarpus indicus* 1.32 cm, while minimum, MAI was by *Knema attenuate* (0.48cm). There was problem in regeneration class IV where the seedlings failed to get established due to anthropogenic pressures particularly in Makutta than in Malemane. Similar trend was also observed in the case of endemic and RET species in both Makutta and Malemane.

Seed Infestation by Insects Among the Emergent Rain Forest Canopies at Makutta, Western Ghats

Insect emergences and extent of seed predation were recorded in rain forest canopies at Makutta, Western Ghats. Field and lab germination studies for *Dipterocarpus indicus* were carried out. Sampling work during the pre-monsoon period yielded seed fall from very few species – *Knema attenuata* and *Dipterocarpus indicus*. Although *Knema* had low infestation by insects (<5%), all the seeds of *Dipterocarpus* were damaged by insects. Seed predation of *Vateria indica* was substantive while it was low in *Knema attenuata*, *Myristica* sp. and *Dipterocarpus indicus* during June 2009. Seed fall during January to March 2009 was extremely poor and no insect emergence was recorded from the seeds.

Ex- situ conservation initiative

- Preparation of species inventory and quantitative assessment of threatened species of Delhi, Uttarakhand and U.P. Establishment of Bamboosetum at Delhi.
- The *ex-situ* conservation of *Dendrocalamus strictus* field germplasm bank was established at F.R.I. campus. The germplasm of this species had representatives of 16 states of the country.
- The field germplasm bank of 15 Hill bamboo species was established at Field Research station Khirshu, Pauri Garhwal.

Field Germplasm Bank of *Dendrocalamus strictus* at F.R.I. campus

· A clonal nursery for multiplication and demonstration of various propagation technologies of bamboo was established at city centre F.R.I. under a National Bamboo Mission funded project.

Germplasm Bank Bamboo Species Research Station, Khirshu, Pauri Garhwal

To minimize the pressure on our reserve forests, quality planting material of promising indigenous fuel wood and fodder tree species was produced for tropical, sub tropical and temperate tree species and more than 60,000 seedlings and rooted cuttings of these prominent species were distributed among farmers of Uttarkashi, Rudrapryag and Dehradun districts of Uttarakhand.

Collection of Fuelwood and Fodder from Forest

SUCCESS STORY

Bamboo Propagation Technology

Due to unavailability of seed, bamboo propagation for producing plantation stock is always a problem for foresters, farmers and industries. A good success has been achieved by Forest Research Institute, Dehradun for developing farmer's friendly, low cost propagation technology of bamboos by rooting of single nodal juvenile shoot cuttings and branch cuttings. This technology was experimented initially for three varieties of *Bambusa vulgaris* var. green, wamin and striata in which more than 50% cuttings were rooted. Other important bamboo species are under experimental stages.

Vegetative Propagation Technologies of Bamboos

Rooting of Single and Bimodal Branch Cuttings

Rooting of Single Nodal Juvenile Cuttings of *Bambusa vulgaris*

2.1.5 Forest Botany

Impact of Biotic Factors on Forest Biodiversity

Biodiversity assessment and cause of degradation in Delhi ridge forest was carried out. The major factors responsible for habitat degradation were identified as spread of invasive species (*Prosopis juliflora* and *Lantana camara*), grazing, lopping, development activities, etc. Species richness and diversity index were low in the threatened sites. Superior material of number of indigenous species (*Diospyros montana, Balanites aegyptica, Pongamia pinnata, Azadirachta indica, Albizia lebbeck, Cassia fistula, Holoptelea integrifolia , Bombax ceiba Pterospermum acerifolium, Holoptelea integrifolia, Dalbergia sissoo, Ziziphus mauritiana* and *Butea monosperma*) of the area were raised in the nursery and were re-introduced.

At Khirsu, Pauri Garhwal and surrounding areas were under various degree of threats mainly because of invasive species (*Eupatorium adenophorum, Lantana camara* and *Argemone mexicana*), fire, development activities, grazing etc. The regeneration of major tree species is affected by these threats. Species such as *Myrica, Rhododendron and Berberis* etc. were considered for *ex-situ* conservation.

Nanda Devi Biosphere Reserve (NDBR) was impacted with peripheral villages through the biotic influence of cattle, sheep, horses and goats. Rare and threatened plants of medicinal and economic values of the region are *Picrorhiza kurrowa* (kadawi), *Saussurea lappa* (kuth), *Aconitum heterophyllum* (Atees), *Vicatica stewartii* (Kala jeera), *Swertia chiraita* (chiraita), *Allium consanguinium* (Jambu), *Dactylorrhiza hatazeira* (Hatha-jhari), *Artemisia* species (Badrinath tulsi) and *Rosa webbiana* etc.

In Dudhawa National Park, invasion of invasive species (Lantana, Ageratum, Argemone etc.) was major factor for habitat degradation. A list of 60 threatened species was prepared. To educate the local people about the biodiversity conservation and utilization, training programmes were organized and lectures were delivered in various Van Vigyan Kendras.

An expert system entitled 'Wood Anatomy Information system' has been developed with the help of National Informatic Centre, New Delhi. Database of commercial timbers of India was created. The software allows quick retrieval of information based on well-organized data of Timber species arranged in a very systematic manner along with the photographs. Identification of Indian Timber samples has become very quick and simplified. Identification is made with minimum number of anatomical features. Fast retrieval of desired features for desired species is possible. Expert system reduces the dependency of the researchers and wood users on the infra-structure like Xylarium and micro slides. Unique anatomical features combinations corresponding to families, genus and species are available.

Digitization of Forest Research Institute (Dehradun Herbarium) Herbarium

Five thousand seven hundred seventy two species details and 27515 specimen details were prepared. Nine hundred eighty nine genera, 4725 species detail and 20015 specimen details were incorporated into the database. Forty eight thousand four hundred two specimen photos were taken and 25491 photos were edited. Three thousand one hundred seventy five species detail and specimen details were edited.

Revision of Indian Woods–their Identification, Properties and Uses –Volume II

Revision of Indian Woods–their Identification, Properties and Uses – Volume II was undertaken by adding microstructure details

and latest information on wood properties and uses.

Taxonomic and Wood Anatomical Studies of Exotic *Pinus* species

Taxonomic and wood anatomical studies of exotic *Pinus* species was undertaken to differentiate various tropical *Pinus* species.

Fluorescent Studies of Indian Hardwoods

Studies was undertaken with the objective to study the fluorescent behaviour of all Indian hardwoods for the purpose of their identification.

Inheritance Pattern of Wood Anatomical Traits in *Populus deltoides* Bartr. Ex Marsh

Seven hundred (700) samples from 60 ramets of parents (G48 and G3) and F_1 and F_2 offspring's were collected for intra and inter-ramet variations and to observe the inheritance pattern of wood traits. The important findings of the project are as under:

- Variance ratio test (F) revealed that both G3 and G48 clones were significantly different for fibre length, fibre diameter, vessel element diameter and specific gravity.
- The fibre length, fibre diameter, vessel element length and wall thickness is higher in G48 (female) clone than G3 (male).
- Vessel element diameter and specific gravity were higher for G3 (male clone).
- It showed that female clone have better fibre dimensions while male have better specific gravity.
- Specific gravity and vessel element dimension were significantly varied from pith to periphery locations.
- Intra-ramet variation for height was significant for vessel element diameter and specific gravity.

Assessment of Wood Properties and Growth of Clones of *Populus deltoides* Bartr. ex Marsh

Samples from 50 progenies raised by WIMCO Seedlings Ltd. were collected and being analysed for different wood traits.

Field Evaluation of Tissue Culture Plants of *Eucalyptus* hybrids

Two promising F_1 hybrids of Eucalyptus; FRI 5 (*E. camaldusensis* X *E. tereticornis*) and FRI 14 (*E. torreliana* X *E. citriodora*) were multiplied through tissue culture and planted in field. Plants were in sixth year of age. There is significant variation in characters studied such as plant height, Clear Bole Length (CBL), diameter and volume, of both hybrids across the sites. In FRI 14, height and diameter at breast height was maximum at Kharkan site Hoshiarpur while in FRI 5, height and diameter at breast height was maximum at Haldwani site.

Creation of seed database on economically important forestry species of Jharkhand aiming at functioning of forestry seed certification agency was taken up during the year 2009-2010. The cumulative physical achievements were as follows:-

- Collection of seeds of more than 20 species for physical and physiological studies.
- Studies on physical parameters of seeds (i.e. seed weight, length and width, volume, colour, seed/fruit weight etc.) of collected species.
- Studies on initial moisture content and germination percentage and rate of seeds of collected species.

- Experimentation on seed storage in different types of containers under ambient and cold temperatures.
- Viability of stored seeds analyzed after 3 months, 6 months and 1 year storage.

2.1.6 Tribals and Traditional Knowledge System

Ethnobotanical Studies of Northern Part of Eastern Ghats in Andhra Pradesh

Ethnobotanically important plant species were identified and listed for Srikakulam, Vizianagaram and Visakhapatnam districts of Andhra Pradesh.

- Ethnobotanical data on 180 floral taxa from Savara, Khond, Jatapu, Kondadora, Nukadora, Bagatha and Porja tribes in respective regions were recorded.
- Utilitarian aspects of important medicinal plants such as *Alocasia fornicata* (Wounds), *Argyreia nervosa* (Boils and blisters), *Arisaema tortuosum* (Ulcers), *Caesalpenia bonduc* (Body pains), *Careya arborea* (Fibre), *Clerodendrum serratum* (Bone fracture), *Curculigo orchioides* (Stomach pain), *Curcuma pseudomontana* (Skin diseases), *Diospyros malabarica* (Bone fracture), *Ficus racemosa* (Jaundice), *Holoptelea integrifolia* (Cough and cold), *Lippia javanica* (Insecticidal), *Mucuna pruriens* (Muscle pains), *Pavetta indica* (Wounds), *Polyalthia suberosa* (Fever), and *Zinziber roseum* (Menstrual disorders) were recorded for the first time

A total of 143 plant specimens were collected, made into herbarium and identified. Scrutinized and screened collected ethnobotanical data with available literature.

Argyreia nervosa *Careya arborea*

Utilization Pattern of Plants in Ethno-medicinal uses Prevalent in Tribal Pockets of Satpura Plateau in Madhya Pradesh

Documentation of traditional knowledge was done from traditional herbal healers from tribal pockets of Mandla, Jabalpur, Katni and Chhindwara districts of MP . In all 327 plants of medicinal value, which are being utilized by 80 traditional herbal healers of tribal pockets of the above four districts for cure of various diseases prevailing among tribal/local people were documented.

Existing utilization pattern alongwith formulation and duration of treatment etc. of medicinal plants being utilized by traditional herbal healers against various common diseases were also documented.

Survey of Mandla, Jabalpur, Katni, Satna, Chhindwara, Bhopal and Sagar districts of MP were carried out to document the channels involved in marketing of herbal plants. 37 traders involved in trading of herbal plants/parts were contacted to collect the information on trading. The price structure of sale of raw herbal medicinal plant parts was collected from local traders.

Pamphlets and slogan were published on uses and conservation of medicinal plants for distribution and creating awareness among tribal and local communities.

Potar (*Smilex zeylenica*)

Hathfan (*Leea macrophylla*)

Documentation and Inventorization of Indigenous Traditional Medicinal Knowledge

Documentation and inventorization of indigenous traditional medicinal knowledge of Jharkhand, Sadar, Churchu, Barkatha and Vishnugarh blocks of Hazaribagh district, Barwadih, Garus blocks in Latehar district, Chainpur block in Palamau district, Borio, Banhji and Mandro blocks of Sahibgang district and Dalbhumgarh and Chakulia blocks of E. Singhbhum districts of Jharkhand were surveyed for collection of plant material from forests and herbal practitioners.

- Kisan, Kharwar, Karmali, Birhor, Sourya Pahariya, Parhaiya, Manjhi and Sabar tribal groups of Jharkhand were studied.
- Plants viz. *Vitex peduncularis* (Nagbael), *Helictres isora* (Aaintha), *Aristolochia indica* (Ishwarmul), *Hyptis suaveolens*, Hathi panjar, Kilo and koraya (*Holarrhena antidysentrica*), *Calotropis procera* (white variety), *Cyperus rotundus*, *Aeratum conizoides* and *Aristolochia indica* were collected and preserved as voucher specimens.
- Nearly 85 herbal practitioners belonging to Bathudi, Birgia, Birhor, Chero, Karmali, Kharwar, Kissan, Parhaiya, Sourya Paharia and Sabar tribal communities have been interviewed so far regarding the use of medicinal herbs for curing their ailments.

2.2 Forest Productivity

Overview

The productivity of Indian forest is quite low while compared to the world's average. Key factor for this and the related issues impinge directly upon the quality of the planting stock selected during establishment of plantations which are normally driven by the targets. For achieving plantation targets, the quality of planting stock is invariably compromised ignoring the fact that the success behind any of the plantation programme is the quality of nursery stock. Though, there are some morphological parameters fixed in case of important tree species for selecting the stock for planting, yet, these are not adhered to for want of the number of seedlings required for achieving the targets. In fact, culling is rarely practiced in the forest nurseries in the country which, otherwise, is the most important component for getting higher survival percent and better establishment of plantations for enhanced productivity. Seeds though take up only a minor proportion of the overall cost of plantation, establishment and their management yet their insufficient supply is often seen as a major bottleneck for carrying out various improvements in the production of planting stocks. The research on collection, processing and storage of the forestry seeds, standardization of nursery techniques of important commercial forestry species including Lesser Known Tree, threatened species and bio-fuel species and plantations of superior exotic and indigenous species of commercial importance and their management can enhance productivity.

Proper scientific management of land and forest resources, especially in the hills, is quite important for achieving the long term conservation and production needs of the particular forests. Government of India has declared a moratorium on the green felling and this issue of ban is always taking the back seat while the question of scientific management of the forest resources is discussed across, mainly because of the lack of scientific data behind. In addition to the number of parameters multiplying the problem, lack of data on the assessment of floral components always remains the concern. On the top of it, all these factors have got some bearing on the productivity of forest.

Increase in the population and over-exploitation of the forest resources for meeting the requirements of the growing populace is the major factor responsible for degradation of forest and its productivity. The demand for fuelwood, fodder etc., can no longer be met with from the existing resources. Accordingly, practice of agro-forestry in its true sense needs to be popularized. The development of medicinal plant based agroforestry system and sustainable development of bamboo based agroforestry systems for increased income generation are being undertaken. No doubt, some of such practices in India have been known and recognized since time immemorial and are being followed traditionally in different manners all across the country but it needs to be documented and understood with reference to its ecological, bio-physical and socio-economic aspects.

Development of low cost vermicompost for commercial production, selection and evaluation of potential seed sources and/ clones, integrated strategy for evaluation of indigenous fast-growing multipurpose trees and species and reclamation of degraded forest soils also need urgent attention for increasing the productivity.

Hence, the ICFRE is making all out efforts in these directions through some research projects so as to suggest specific strategy to the stake holders.

The population of *Diploknema butyracea* (cheura) is almost localized in Pithoragarh district (Uttarakhand) particularly in the areas bordering Nepal. The principal objective of seed storage of *D. butyracea* was to assess the longevity, viability & vigour of seed and to enhance the seed longevity through conventional

storage method. Observations on morphological traits i.e. length, width, thickness, colour, etc of seed were recorded. For storage studies, the seeds were desiccated to three moisture levels i.e. 20 %, 15 % and 10 % and desiccated seeds were stored at four temperature viz., ambient room temperature, 15^0C, 10^0C and 5^0C. Stored seeds were subjected to germination test every week and observations recorded on germination %, viability and vigour. Observations on growth parameters (height & collar diameter) of seedlings raised from stored seeds were recorded monthly. Seedling Vigour Index (SVI), Seedling Quality Index (SQI) and leaf area were measured for seedlings raised in different containers i.e. root trainers, polybags and in nursery beds. Least Safe Moisture Content (LSMC) for seeds of *Diploknema butyracea* was 20% and they are tropical recalcitrant in nature.

The three species of *Bauhinia* viz. *Bauhinia variegata*, *Bauhinia purpurea* and *Bauhinia retusa* have good fodder value. A survey was conducted in Doon valley, Tons valley, Uttarkashi District and Nainital and Pithoragarh Forest divisions to locate the populations of these three species of *Bauhinia*. Pods were collected at maturity from Manduwala, Vikasnagar, Katapathur, Kainchidham, Bhatwari, Srinagar, FRI, Dehradun, Mussoorie and Tehri. Variations in seed morphological parameters such as total sample weight, seed length, seed width, seed thickness, seed colour, 100 seed weight, purity %, moisture content, number of seeds in a single fruit, number of seeds in 100g seeds were recorded. Fresh seeds from all the sources had 85-95% germinability. Seeds of all the three species from two sources each were stored at 15^0C and subjected to germination and moisture content determination every three months to observe the deterioration in seed viability. *B. variegata* seeds retained 92%, *B. purpurea* 78% and *B. retusa* 68% germinability after eight months in storage.

Buxus wallichiana is very important species for wood carving. Population surveys were conducted for *Buxus wallichiana* in Chakrata Forest Division and Mandal Forest (Uttarakhand). Fruits were collected at

Population of *Buxus wallichiana* at Jadi Village, Chakrata Forest

different stages of development/maturity and morphological parameters of fruits and seeds were observed. Stages of development and maturation of fruits were studied. The fruits were collected from Chakrata Forest Division in September and from Mandal Forest in November.

Cuttings of *Buxus wallichiana* in Mist Chamber

Seeds were extracted and almost 55-60% of the seeds were found empty. Fresh seeds yielded 15-20% germination and that too was very slow. Since the seeds were dormant, they were given various pretreatments like soaking the seeds in 0.05% and 1% GA_3 solution for 24 and 48 hours, in 0.02% KNO_3 for 24 and 48 hours and moist stratification. 0.05 % GA_3 treatment for 48 hours resulted in higher (40%) and early germination/ growth of radical in seeds. For vegetative

propagation of *B. wallichiana*, its hard wood and leafy cuttings were collected from Chakrata and treated with 2000 and 6000ppm of IBA and with combination of 1000 ppm each of NAA+IBA.

The nursery of important forestry species, prioritized by State Forest Department viz. *Terminalia arjuna, Bombax ceiba, Pongamia pinnata, Tamarindus indica, Azadirachta indica, Artocarpus heterophyllus, Syzigium cumunii, Pithecellobium dulce, Heterophragma adenophyllum, Dalbergia sissoo , Tectona grandis Albizia procera, Ficus glomerata* and *Acacia auriculiformis* were raised. The suitable age of the seedlings of fast growing and slow growing species was assessed for transplanting in the field. Species like Semel, Shisham, Imli, Kathal and Siris performed well for 1 yr old seedlings in plantations. Other species like Eucalyptus, Jungle Jalebi, Katsagaun, Karanj and Australian Babool performed well for one as well as two year old seedlings in the trials. Thus, it can be concluded that later five mentioned species can be planted even if two years old but former five species should be planted with one year old seedlings for better growth performance and survival.

Seeds of *Hippophae salicifolia* were collected from Uttarakhand seed sources and their germination study was carried out in field and laboratory under different lights and temperatures conditions. Plants were raised in the high altitude nursery at Chakrata and vegetative propagation study was carried out by using growth regulators.

Fruiting in *Hippophae salicifolia*

Mature and immature fruits of four *Ficus* spp. viz. *Ficus religiosa* (Peepal), *Ficus lacora* (Pakad), *Ficus bengalensis* (Baragad) and *Ficus glomureta* (Gular) were studied for their germination trial after different pre-sowing treatments viz. Biotreatments and chemical treatments. The effect of different chemical and bio-treatments on the seed germination of selected *Ficus* sps. was compared. In case of Baragad, germination of partly matured seeds was better than that of fully matured seeds. In case of *Ficus religiosa* (Pipal), matured seeds germinated well and biofertilizer treatments performed better in comparison to other treatments. In *Ficus glomureta* (Gular), matured seeds germinated well and treatments with hot water performed best.

Soaking of seeds of *Strychnos nux-vomica* and *S. potatorum* in cow dung slurry proved best to give 88% and 54% germination respectively. Nitrogen and phosphorus separately or in combination significantly boosted the growth of seedlings. Soaking of seeds of *Terminalia chebula* in water for 7 days and then drying for 2 days proved best to give 82% germination.

The seeds collected from the plus trees of *Pterocarpus marsupium* treated with cold water for 24 hrs before sowing in July gave higher germination. Potting mixture consisting of 80% organic compost, 20% soil and 250cc size root trainer found to produce healthy seedling. Branch cutting from mature tree collected in February-March and treated with 500, 1000, 1500 and 200 ppm for 24 hours resulted only shoot formation after 14 days in mist chamber. Root-shoot cuttings treated with 400 ppm IBA for 24 hours produced 96% healthy plants.

Germination of rattan seeds was found greater by pricking method instead of sowing normal seeds in nursery beds. Seed germination studies were also conducted on seeds of *Acacia nilotica* and *A. catechu* collected from various seed sources of Gujarat (AFRI). The second fortnight of March was found to be optimum time for collection of seeds of *Anogeissus latifolia*. The seeds of *Juniperus polycarpos* treated with different pre-sowing treatments, recorded an excellent germination under nursery conditions.

With the objective to collect information pertaining to raising of the nurseries of the mandated species, the deodar and ban oak nurseries, as maintained by the State Forest Department, Himachal Pradesh, were surveyed. Considering the various morphological parameters of the nursery stock of deodar and ban oak, the experiments to assess their field performance were established. The nursery and field trials were laid and maintained for standardization of tall-planting techniques in deodar.

The potential seed sources and/ clones of selected species of Jharkhand and adjoining states were evaluated in nursery. Precision silviculture practices for *Casuarina junghuniana* have been developed for both nursery management and plantation management.

Natural regeneration failure is one of the characteristics of high level conifer forests (*Abies pindrow* and *Picea smithiana*) in western Himalayas. Since 19th century, the problem is supposed to be associated with the presence of excessive litter in the forests. As allelopathy played a major role in regeneration failure in many cases, research was undertaken on allelopathic influences of litter, humus and foliage of trees & under-storey plants on seed germination of the species in laboratory. It was found that leachates of humus reduced and deteriorated radicle growth completely but enhanced germination at higher concentrations; however, litter leachates had no pronounced effect. Foliage leachates of *Sarcococca saligna, Viburnum nervosum* and ferns *(*under-storey plants) also had inhibitory effects on germination and radicle growth but stimulation in germination by one species at higher concentrations. This research concludes that humus and foliage of specific plants are responsible for regeneration failure in these conifers and not litter as supposed till date.

Multi location Bamboo trials on micro and macropropagated plants, nutrient management, organic and inorganic farming methods and water management were carried out to develop a species specific packages of practices for larger adoption of the species under farm land cultivation.

Training was organised for 145 Officers of State Horticulture Department on bamboo diversity, nursery techniques, plantation techniques, management of pest and disease problems, bamboo based industries and bamboo value added products.

Bamboo model plantations were established in different locations covering six agroclimatic zones of Tamil Nadu namely North-Western Zone, North-Eastern Zone, Cauvery Delta Zone, Western Zone, Southern Zone and High altitude and hilly area Zone using seven species. The seedling, macropropagation and tissue culture of *Bambusa bambos, Bambusa nutans, Bambusa tulda, Bambusa vulgaris, Bambusa balcooa, Dendrocalamus strictus* and *Dendrocalamus stocksii* were used in the plantations and the performance of species within a location and across locations were studied. Package of practices for bamboo cultivation and management was developed.

Ninty accessions of 31 bamboo species were assembled from Forest Department, Assam and State Forest Research Institute (SFRI), Itanagar, Arunachal Pradesh, Kerala Forest Research Institute (KFRI), Peechi and Ladpur Nursery of Uttaranchal Bamboo and Fibre

Development Board (UBFDB), Dehradun for establishment of bamboo Germ plasm. 65 Accessions of Candidate Plus Clumps (CPCs) of 4 species of bamboos have been obtained from Rain Forest Research Institute (RFRI), Jorhat for establishing bamboo multiplication garden.

Suitability of different bamboo species in non-forest areas was also studied. It was observed that *Bambusa vulgaris* had maximum height in yellow soil (Granite), whereas, *B. bambos, B.longispathus, B.tulda, B.nutans* and *Dendrocalamus strictus* showed maximum growth increment in black (basaltic) soil.

On farm innovation in macroproliferation technique for edible bamboo species and promotion of their commercial plantation through capacity building of the Self Help Group members was conducted by imparting training and demonstration on nursery practices. Sustainable development of quality bamboo resources for employment generation and socio-economic development in North-Eastern India was achieved through development of suitable agroforestry models for promoting bamboo cultivation outside forests in NE region.

Clonal material comprising 1,08,000 cuttings and 48.5 kg seeds of *Jatropha curcas* accessions having more than 30% oil content were supplied to Department of Biotechnology, Govt. of India for nation-wide trials. Clonal trial, progeny trial, clonal seed orchard and seed seedling orchard were established during the year. Seed oil content was not found to have any significant correlation with seed germination. Variation in seed oil content was caused by variation in germination percentage of the accessions rather than to variation in intrinsic adaptability of germinated seedlings of different accessions to the nursery environment.

Performance of *Jatropha curcas* in un-reclaimed sodic soils was found to be unsatisfactory. At 3½ years of age, the plants exhibited poor survival and growth. None of the accessions could record growth rate comparable to plantation of this species on a good site. Less than 10 per cent plants produced flowers; the seed yield was negligible. Accessions viz. FRI-WB-Banku-0306-C-31, FRI-WB-Banku-0306-C-32 and FRI-WB-Midna-0306-C-33 of *Jatropha* were found to possess the following unique features: presence of hermaphrodite flowers, rough bark, resistance to frost damage and resistance to viral attack. This indicates that clonal plantations of *Jatropha curcas* are not suitable for un-reclaimed sodic land.

In Dehradun valley, at two years of plantation age, 2m x 2m spacing gave greater seed yield per hectare. However, long term monitoring of the trial is required to optimize the spacing.

Fifteen thousand numbers of Neem and Pungum quality planting stock were raised for taking up 50 ha of model plantations in different agroclimatic zones of Tamil Nadu.

Physiological and nutritional parameters studies have been undertaken in 30 *Eucalyptus* clones developed by the institute by establishing field trials in four locations viz., Pudukottai, Tirunelveli, Sivaganga and Coimbatore. Wood samples have been collected from the 30 clones for carbon isotope analysis to determine the water use efficiency of the selected clones.

For evaluation of indigenous fast-growing multipurpose trees of eastern India for plantation forestry, information was collected on natural populations and plantations of kadamb and semul in Jharkhand and West Bengal. 30 candidate plus trees have been identified.

Agroforestry demonstration plots were established in five agro-climatic zones (3ha per zone) with tree components viz., *Casuarina equisetifolia, Casuarina junghuhniana, Melia dubia, Tectona grandis, Eucalyptus* spp. and *Ailanthus excelsa* and horticultural components viz., Mango, Guava, Sapota and Lemon along with the annual crops to enhance the livelihood opportunities for farmers.

The agroforestry systems with *Casuarina equisetifolia, Casuarina junghuhniana* and

Eucalyptus camandulensis and medicinal plants viz. *Decalepis hamiltonii* and *Asparagus racemosus* as intercrop were also established at four locations namely Karaikudi, Sendurai, Jeyamkondam and Karaikal in Tamil Nadu.

Agroforestry model being maintained at farmer's field at village Harsh, Bilara, District - Jodhpur revealed that performance of *Ziziphus mauritiana* was the best as horticultural species and *Colophospermum mopane* was the best as silvicultural species. The plant growth was higher in agroforestry plots as compared to the control (without crop). Wheat crop production was recorded 13.67 quintal /ha during the year.

An agroforestry model by growing tomoto and potatos in between *Emblica officinalis* and *Moringa oleifera*; medicinal plants *Andrographis paniculata, Asparagus racemosus, Rauvolfia serpentina, R. tetraphylla* and *Withania somnifera* under *Aegle marmelos* and *Moringa oliefera* was developed.

On the basis of experiments conducted to develop medicinal plant based agroforestry system, teak-turmeric system proved significantly best.

Productivity of maize in *Dalbergia sissoo*- Zea mays agroforestry system was studied to conclude that the tree distance of 5x5m with 60cm tree to crop line spacing proved best for maximum yield of maize crop.

After field survey four sites in lower hill zone at Puruwala & Kot in Himachal Pradesh and Nudh & Basanterbella in Jammu & Kashmir measuring 5.0 ha have been identified and experimental trials of *Gmelina arborea* established.

Litter production by important agro-forestry species brought out that *Grewia optiva, Morus alba, Celtis australis, Bauhinia variegata, Toona ciliata* and *Albizia chinensis* contributes significant amount of litter-fall annually through various litter fractions.

A library of soil samples of NE is being set up at Rain Forest Research Institute, Jorhat. Soil samples from 29 forest sub-group types have been collected and analyzed from 7 North-East states.

Restoration of jhum land was carried out through intercropping Rhizobium inoculated legume trees with agricultural crops in Assam.

In order to characterize forest soils of Rajasthan, the soil profiles were examined and sampled at 210 places covering Sri ganganagar, Hanumangarh, Jhunjhunu, Sikar, Bikaner, Nagaur, Barmer, Sirohi, Jalore and Jaisalmer districts in 170 forest blocks of 89 forest ranges.

In a lysimetric study, *A. nilotica* and *Tamarix aphylla* showed higher tolerance towards salinity as compared to *E. camaldulensis*. However, under water logging condition at shallow depth *E. camaldulensis* outperformed *A. nilotica* and *T. aphylla*.

Acacia bivenosa proved to be the most hardy plant surviving the extemely harsh conditions of high salinity, heat stress and drought conditions and achieving adequate growth on highly saline black soil after 30 months of growth.

Effect of different rainwater harvesting techniques (contour trench, gradonie, box trench and V-ditch) and hill slopes on plant growth, runoff loss and soil moisture status were studied on a degraded hill in Banswara district. Performance of *E. officinalis, S. cumini, A. catechu* and *H. integrifolia* were better in contour trench plots, *G. arborea* and *Z. mauritiana* in box trench plots. *A. indica* and bamboo performed better in V-ditch plots. Contour trench reduced run-off losses to a greater extent.

Cordia gharaf and *Cenchrus ciliaris* combination was the best silvipastoral on arid sandy degraded forest soil at Bhuj after 38 months of establishment.

The assessment of bio-drainage potential of tree species indicated that *Eucalyptus rudis* performed the best with respect to growth, biomass, transpiration rate and overall bio-drainage potential where ground water level receded by 145 cm within a period of 54 months.

Species suitability and reclamation strategy for degraded forest soils of Chhotanagpur Plateau, Jharkhand were developed. Works relating to nature and degree of degradation and other limiting factors of the soils have been covered before taking up the reclamation measures.

While studying the impact of invasion Forest Invasive Plants on the biodiversity, the following plants were found to invade in different forest covers:

- Deodar (*Cerdrus deodara*) Zone (Temperate): *Sarcococca saligna* : killing deodar seedlings due to roots competition.
- Banj (*Quercus leucotrichophora*) Zone (Sub-tropical): *Eupatorium odoratum* and *Artemisia vulgaris.*
- Sal (*Shorea robusta*) Zone (Tropical): *Lantana camara* and *Ageratum conyzoides.*
- Burnt Plots of sal: *Eupatorium adenophonum, Viburnum erubesuns, Adathoda vasica* and *Lantana camara*.
- Burnt plot of banj: *Prinsepia utilis, Berberis lyceum, Viburnum stellulatum, Rubus ellipticus, Cotoneaster tetrasperma, Mahonia nepaulensis* and *Rosa moschata.*

The Govt. of India banned green felling above 1000 m elevation in early eighties in the Himalayas. To observe the impact of ban on green felling in coniferous forests**,** twenty four sites were selected in the coupes which were prescribed for felling but felling was not carried out and

Unfelled Coupes of Deodar & Kail
Uttarkashi Forest Division

Felled Coupes of Spruce & Fir Forests-
Chopal, Shimla

where felling was actually done in deodar, kail, fir and spruce forests. The coupes were selected in Badrinath, Uttarkashi and Chakrata forest divisions of Uttarakhand, and Kullu, Shimla and Chamba forest divisions of Himachal Pradesh. Data were collected on phyto-diversity, growth of trees, regeneration status, socio-economic condition of the people and humus and soils from felled and unfelled coupes. Data is being analyzed.

Projects under the theme

Project	Projects Completed During the Year	Ongoing Projects	New Projects Initiated During the Year
Plan	13	25	03
Externally Aided	13	15	04
Total	**26**	**40**	**07**

2.2.2 Silviculture

Evolving Silvicultural Practices for *Casuarina junghuhniana* ssp. *Timorensis*

The project envisaged developing silvicultural techniques for establishing *C. junghuhniana* plantations under different agro-ecological conditions. Trials under nursery and field conditions had been carried out under these project. Nursery trials were carried out to study the effect of different potting media formulations (30 nos) and container types and sizes (10 nos) on quality seedling production of *C. junghuhniana*. Also trials to study the effect of cutting height on rooting success as well as effect of biofertilizers on seedlings were carried out. Field trials were laid out in 8 locations spread over different agro climatic zones of Tamil Nadu– both in inland and coastal conditions– to study the survival and growth performance of *C. junghuhniana* in comparison with *C. equisetifolia.* The results are under analysis.

Bamboo Location Trial (NMBA)

The project funded by National Mission on Bamboo Applications (NMBAs), Technology, Information, Forecasting and Assessment Council, Department of Science and Technology, Government of India was part of a network project being coordinated by G.B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar, Uttarakhand. Five field trials involving multilocation species trial, trials on micro and macropropagated plants, trials on nutrient management, trials on organic and inorganic farming methods and trials on water management were laid out in the IFGTB Field Station, Bharathiar University Campus, Coimbatore as per the approved technical programme. Periodical data at three month interval were collected on survival and growth of bamboo clumps established under the trials. The data are being analysed.

Field Functionaries Training on Bamboo under National Bamboo Mission (TANHODA-I)

The Tamil Nadu Horticulture Development Agency (TANHODA), Chennai - nodal agency to carry out various activities envisaged under the National Bamboo Mission in Tamil Nadu identified the Institute of Forest Genetics and Tree Breeding, Coimbatore as training Institute to impart training to 150 Officers of Horticulture and Agriculture Departments of Government of Tamil Nadu. Accordingly, Institute imparted training to 145 Officers - at the level of Deputy Directors of Horticulture to Horticulture Officers - on various aspects of bamboo. The issues covered under the training ranged from bamboo diversity to nursery techniques to plantation techniques to pest and disease problems to bamboo based industries to value added products. Demonstrations on nursery techniques and field visits to bamboo field trials, bambusetum, bamboo industries etc formed part of the training schedule.

Establishment of Bamboo Model Plantations in Different Agro-climatic Zones of Tamil Nadu using Quality Planting Stock (DBT)

Bamboo model plantations were created in 20 ha area during 2006-07, 40 ha in 2007-08 and 30 ha in 2008-09 and 10 ha in 2009-10 using quality planting stock raised through seedling, macropropagation and tissue culture of *Bambusa bambos, Bambusa nutans, Bambusa tulda, Bambusa vulgaris, Bambusa balcooa, Dendrocalamus strictus* and *Dendrocalamus stocksii*. The plantations were raised in different locations covering six agro-climatic zones of Tamil Nadu namely North-Western Zone, North-Eastern Zone, Cauvery Delta Zone, Western Zone, Southern Zone and High altitude and Hilly area Zone. A total of 100 ha plantations have been raised. The growth performance of bamboo species within a location and across locations have been assessed periodically. Data on rainfall,

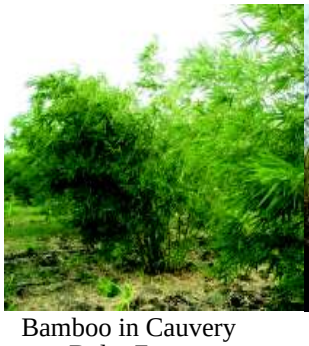
temperature, humidity have been collected and soil analysis both for macro and selected micro nutrients were completed for all locations. *B. vulgaris*, *B. tulda*, *B. nutans.* and *B. balcooa* grow well in all the zones except in clay soil, soil

Bamboo in North-Western Zone

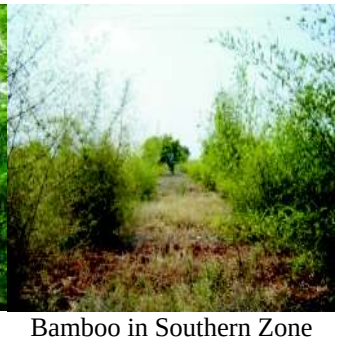
Bamboo in Western Zone

Bamboo in North-Eastern Zone

with low water holding capacity and waterlogged areas. *Bambusa vulgaris* produces more culms when compared to *B. tulda*, *B. balcooa* and *B. nutans*. *B. bambos* and *Dendrocalamus strictus* grow moderately well in all locations with moderate culm production. The performance of *Dendrocalamus stocksii* is poor in all the locations.



Bamboo in Cauvery Delta Zone



Bamboo in Southern Zone

Banana and Bamboo

Improving Productivity of Bamboo Cultivation in Farmlands of Tamil Nadu (NBM-1)

The project funded by National Bamboo Mission envisages establishing silviculture trials in 3 locations each in three agro- climatic zones of Tamil Nadu apart from establishing a Bamboo germplasm bank and Bamboo multiplication garden. Around 11,500 bamboo plants belonging to five species were procured from North- East India - apart from raising seedlings locally - for meeting planting stock requirement of field trails. Silvicultural trials at seven locations were laid out spread over 3 agro- climatic zones. For establishing bamboo germplasm bank, 90 accessions of 31 bamboo species were assembled from Forest Department, Assam and State Forest Research Institute (SFRI), Itanagar, Arunachal Pradesh, Kerala Forest Research Institute (KFRI), Peechi and from Ladpur Nursery of Uttarakhand Bamboo and Fibre Development Board (UBFDB), Dehradun. Sixty five Accessions of Candidate Plus Clumps (CPCs) of 4 species of bamboos have been obtained from Rain Forest Research Institute (RFRI), Jorhat for establishing bamboo multiplication garden.

Development of Elite Planting Material and Model Plantation (NOVOD)

The project envisages raising of model plantations of Neem and Pungam - 25 ha each- totaling 50 ha, spread over the 5 agro-climatic zones of Tamil Nadu suitable for raising them.

Around 15,000 numbers of Neem and Pungum quality planting stock have been raised and are being maintained for raising model plantations during the 2010 monsoon season.

Characterization of *Eucalyptus* Clones for Physiological and Nutritional Parameters

For characterization of *Eucalyptus* clones for physiological and nutritional parameters, field trials have been established in four locations viz., Pudukottai, Tirunelveli, Sivaganga and Coimbatore. For the short-listed 30 *Eucalyptus* clones, parameters like chlorophyll A. B and total chlorophyll, total leaf area were worked out. For assessing the water use efficiency of 30 clones, wood samples were collected and powdered and sent for carbon isotope analysis at University of Agriculture and Sciences, Bangalore. Nursery studies have been completed for the above selected clones for root characterization and biomass. Observations on physiological parameters have been completed under the four locations. The study is continuing.

Standardization of Nursery Technique of *Strychnos nux-vomica* and *Strychnos potatorum*

Seed germination studies of *Strychnos nux-vomica* and *Strychnos potatorum* under different physical and hormonal treatment were conducted. Seeds of *S. nux-vomica* and *S. potatorum* were sown in polythene bags to conduct fertilizer trial in order to accelerate the growth of seedlings. Data on germination, survival and growth of both the species under different experiments were recorded. On the basis of three year's observation, it may be inferred that 72 hrs soaking of seeds of *S. nux-vomica* and *S. potatorum* in cow dung slurry gave maximum 88% and 54% germination respectively. Nitrogen and phosphorus separately or in combinations significantly boosted the growth of seedlings height, root length and collar diameter. The highest value for the different components of the seedlings was observed to be under the treatment receiving 100 ppm nitrogen with 100 ppm phosphorus.

Development of Nursery Techniques for *Terminalia chebula* Retx. (Harad)

Studies on seed germination of *Terminalia chebula* under different physical and hormonal treatment were conducted from the seeds collected from Chandrapur (Maharashtra), Bhilaigarh (Chhattisgarh), Tamia (Madhya Pradesh) and Sambalpur (Orissa). The maximum 82% germination was noted under 7 days soaking and 2 days drying of seeds collected from Sambalpur (Orissa).The maximum 86% germination was observed under IBM 500ppm + 7 days soaking and 2 days drying of seeds collected from Sambalpur (Orissa).

Seed Physiology of the Tropical Forest Species with Special Reference to their Maturity and Storage

Seed storage trials were continued this year on *Schleichera trijuga, Hardwickia binata, Sapindus laurifolia, Rauvolfia serpentina, Moringa oleifera, Mimusops elengi, Holoptelea integrifolia* and *Emblica officinalis* and *Terminalia chebula*, for assessment of viability and moisture contents. The results from the effect of temperature and moisture content on viability of seeds indicated that the seeds of *Schleichera trijuga, Hardwickia binata, Sapindus laurifolia, Rauvolfia serpentina, Moringa oleifera, Emblica officinalis, Holoptelea integrifolia* and *Terminalia chebula* are of orthodox type as there was negative relation between them. Storage experiments on *Mimusops elengi* seeds supported its intermediate nature. The viability constants for the orthodox seeds were estimated for prediction of storability of seeds at a particular storage condition. Protein and carbohydrate contents of different stages of three types of seeds were estimated and data were analyzed.

Standardization of Nursery Technology of *Pterocarpus marsupium*

Seeds of *Pterocarpus marsupium* (bijasal) were collected from healthy trees from Gondia (Maharashtra) region and experiments were carried out in the nursery to study the effect of different seed treatments on the germination and growth of seedlings in the nursery. The seeds treated with cold water for 24 hours showed better germination as compared to hot water treatment. The bigger sized seeds gave higher germination percentage and germination value as compared to the small size seeds. Higher germination percentage observed in July and minimum percentage of germination was recorded in January. Potting mixture in the ratio of 80% organic compost + 20% soil was found to be best combination where as 250cc size of root trainer gave better results with respect to root and shoot biomass production. Urea, di- ammonium phosphate and murate of potash @ 2, 4 and 6 gm respectively per plant was applied, but initially no effect of inorganic fertilizers on growth and development of seedlings was observed. Collected branch cutting from matured tree of *P. marsupium* (Bijasal) in the month of February and March and experiment was laid out in mist chamber by treating the cuttings with different concentration of IBA 500,1000,1500 and 2000 ppm for 24 hours. Shoot formation was recorded after 14 days but no root formation was observed. Root shoot cuttings of *P. marsupium* treated with different concentration of IBA 100, 200, 300 and 400 ppm for 24 hours produced 62%,76%,84% & 96% healthy plants. A field trial of different types of seedlings (seedlings raised in polybags, root-trainers and root-shoot cuttings) has been established at Centre for Forestry Research and Human Resource Development, (CFRHRD) campus with three replications at spacing of 5x5 metre in randomized block design for evaluating the planting stocks of *P. marsupium.*

Ninty eight percent success was achieved in nursery trials carried out by pricking method-sowing pre-germinated seeds of rattan in poly bags, instead of normal seeds of nursery beds at Rain Forest Research Institute, Jorhat.

Enhancing Productivity of Saline Wastelands in Kachchh- through Improved Tree Planting Techniques and Silvipastoral Study (Gujarat SFD sponsored project)

Silvipastoral Study:

Silvipastoral trial was laid in 2007 in Bhuj. Survival rate of plant species was more than 90% in both the experiments at 38 months of age. Species wise maximum survival was *Cordia gharaf* (99.5%), followed by *Zizyphus mauritiana,* (92.5%) and *P. cineraria* (91.2%). Overall periodic percent survival recorded was 95.64 in *Cenchrus setigerus,* and 93.8% in *C. ciliaris,* there was slight decrease, 1.9% with *C. setigerus* and 2.3% with C. *ciliaris* as compared to survival at 24 months. However, survival with grass was higher in case of *C. ciliaris* (97.5% to 90.1 % in control) as compared to *C. setigerus* (92.0% to 98.1% in control). At 38 months, maximum mean tree height was recorded with *C. ciliaris* (162.4 cm), followed by *C. setigerus* (142.8 cm). Mean tree height was significantly higher for control trees as compared to with grass in case of *C. setigerus*. However, trees with C. *ciliaris* grew 3-5% taller. Species wise, maximum mean height was recorded in *Z. mauritiana* (203.5 cm), followed by *C. gharaf* (192.3 cm) and *P. cineraria* (62.1 cm). Except for *Z. mauritiana,* other species did not record crown growth. *Z. mauritiana* recorded 31.3% and 14.2% incremental growth for control and with grass treatment at 38 months of age.

Based on mean height and crown diameter component wise, aboveground biomass estimation was carried out for *Z. mauritiana* and *C. gharaf* in control and with grass treatments.

With *C. setigerus* sowing was done at high seed rate biomass yield for control trees was 2-3 fold more with *C. gharaf* (7.5 kg/tree) and *Z. mauritiana* (4.0 kg/tree) as compared to trees grown with grass *C. gharaf* (4.8 kg) and *Z. mauritiana* (1.6 kg tree). While, in case of *C. ciliaris* (sown in scattered manner at low seed rate) biomass yield was 4.5 to 5.3kg/tree for *Z. mauritiana* and 8.0 to 8.6 kg/tree for *C. gharaf* with grass and control treatments, respecitively. Result suggests that at low seed rate grass sowing promote tree growth.

During the year 2009, total rainfall was 419 mm and most of which (202 mm) was received late in August in three days (29-31, 2009) after a long day spell of nearly 30 days. The mean yield was 1.01 kg/m^2 for *C. ciliaris* and 0.76 kg/m^2 *C. setigerus.* It was 57.5% and 61.7% more as compared to that of last year. Tree growth did not influence the grass yield and green grass yield was maximum with *C. gharaf* (1.11 kg/m^2) for *C. ciliaris* and *Z. mauritiana* (0.83 kg/m^2) for *C. setigerus*, respectively, which was comparable to control. A green weedmass of 0.35 kg/m^2 mainly unpalatable grasses was obtained from the experimental area.

Improved Tree Planting Techniques

Research trials were laid with *A. ampliceps*, *A. bivenosa* (exotic) and *S. persica* (indigenous) on black silty clay (medium), soil depth: 40-75 cm at Kordha, Sami Range in Patan, Gujarat at the fringe of WAS in July 2007 to find out suitable exotic and indigenous fodder plant species with appropriate planting practice. *S. persica* proved to be most hardy plant surviving the extemely harsh conditions of high salinity, heat stress and drought conditions and suffered minimum casualities and maintained high rate of survival (92.8%) at 30 months of planting, followed by *A. bivenosa* with 77.3% survival at 30 months.

Among the selected species *A. ampliceps* suffered the maximum damage due to salt laden hot winds from rann side in May 2009, probably due to its being on the border area and also with maximum height. Initial sprouting was observed in most plants. However, there was 41% decrease in mean survival (which was 44.1% at 30 months and 74.6% at 12 months).

All the three plant species displayed shrubby nature favoured more crown diameter than height after two years of growth. In *S. persica* mean height was 120.8 cm as compared to mean crown diameter 154.2 cm at 24 months. Comparatively, *A. bivenosa* attained maximum crown growth among all the plant species at 24 months. The mean height, 112.6 cm, was significantly less than the mean crown diameter (208.5 cm). Two factor ANOVA analysis showed that treatments influenced the growth and both FYM and Wheat husk treatments favoured significant higher growth (height and crown diameter) as compared to other treatments. The individual plant had 4-19 branches in different treatments. Initially, up to 18 months, *A. ampliceps* attained very high growth and flowered and produced viable seed within a year, but after heat shock, growth in term of height showed declined trend. Nearly 90 % plants of *S. persica* flowered in January 2010, however, fruit setting was in 6 % plants in March 2010. No flowering was observed in *A. ampliceps* and *A. bivenosa* in a deficient monsoon year.

Per cent soil moisture was ranging from 8.1 to 12.6 % in 0-25 and 25-50 % soil layer inside plant pit for *A. bivenosa* in January 2010 (there was 8 mm rain on 14th December 2009), which was reduced to 2.4 to 4.73 % in the upper soil layer inside plant pit. Soil working may have resulted in moisture loss as moisture content in inter row space was more (3.02 to 5.01%) in upper soil layer. Soil pH and EC were analysed from

A. ampliceps in summer 2009. The soil pH values were in normal range. However, EC values were higher ranging from 1.7 to 4.06 dSm^{-1} and 2.30 to 4.01 dSm^{-1} in 0-25 and 25-50 cm soil layer. EC values after the heat shock were ranging from 1.2 to 3.9 dSm^{-1} and 1.4 to 5.5 dsm^{-1} indicating that salinity levels were high during heat shock.

Plantation activities promoted weed growth, *Chloris virgata* was the most dominant species, followed by *Sueada fruticosa*, *Aristida* spp. and *Zygophyllum simplex*. Overall, 517.3 gm^2 yield was recorded. However, tree species wise, variation was observed and it was 503.8 gm^2 (*A. bivenosa*) and 530.8 gm^2 (*A. ampliceps*).

Studies on Seed Traits of Seeds Collected from Seed Stands

Due to poor seeding in the Gujarat state, SFD was unable to supply quality seeds of desired species. Instruction manual for establishing seed certification system has been prepared and submitted to CCF/DCF, Gandhinagar and Rajpipla for implementation.

Seed samples of 12 seed sources (2 seed stands and 10 CPTs) of *Acacia catechu*, 14 Jatropha CPTs were collected and tested for seed parameters. Seeds were examined physically and none was defective and all seeds were healthy. Seeds of *A. catechu* were golden-brown in colour. *Acacia catechu* seed lot no. 2557 showed 77.5% germination and 143.38 vigour Index, while seeds collected from outside area (accession no. 2558) showed 77.5% germination and 145.7 of vigour Index. Seeds of 10 CPTs of *A. catechu* showed variation in 100 seed weight from 3.79-5.48g, seed germination from 69 to 91.5% and vigour index from 88.14 to 152.73. Removal of seed coat from seeds of *Terminalia chebula* enhanced percent germination from 10% control to 72% after kernel removal. Number of seeds in 10g of seed weight in 14 CPTs of jatropha varied from 17- 23 and oil from 27.6 to 41.1% on seed basis.

Determination of Morphological and Physiological Quality Parameters of Nursery Stock of Deodar (*Cedrus deodara)* and Ban Oak (*Quercus leucotrichophora*)

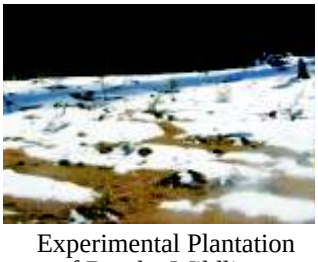
The nursery stock of deodar (6,000) and of ban oak were raised and maintained (24,000) at Model Nursery, Shimla and Shilly Nursery, Solan respectively. Sites were selected for carrying out experimental plantations in Shimla and in Solan Forest Divisions. To achieve the objective pertaining to the development of interim minimum standards of quality of the planting stock of deodar and ban oak through interviews of regular producers and users of nursery stock of these species, visited nurseries (35 no.) of the forest department of Himachal Pradesh and collected information regarding nursery raising and quality parameters from the field functionaries being adopted for deodar and ban oak. The survey has been done through structured questionnaire developed for that purpose. It has been found that only one physical parameter i.e. height (shoot length: 9" or more) of the nursery stock is adopted in the SFD's nurseries for measuring the quality of these species. As far as another objective of the project is concerned, experimental plantations after inclusion of the other parameters like morphological parameters, root collar diameter, type of production system (polybag or bare root), age, site conditions of plantation area etc. of these species were established during August 2008 & August 2009 on six sites three for each of the species. On the basis of field discussions, interim minimum standards for nursery stock of deodar and ban oak have been proposed for further discussions and finalization. However, the experimental sites received very less snow fall/rains during 2008 and 2009 followed by continuous drought like conditions during summer resulted in heavy mortality in experimental plantations. Growth and survival

data pertaining to experimental plantations are being recorded regularly. The project activities were also evaluated by the external expert during 2009.

Inspection of the Deodar Stock and Ban Oak Plantation

Development of Techniques for Raising Deodar (*Cedrus deodara)* Plantations through Tall Plants

Field survey was conducted and experimental area was selected near Shillaru in Shimla district for establishment of trial by using deodar wildlings/tall plants. Established experimental plantations of deodar wildlings during August 2008, February 2009 and August 2009 in the identified sites at Shillaru and Kandyali. Wildlings were planted on the basis of height and root collar diameter classes. Experiments were also carried out on the basis of time of root exposure, root desiccation, protecting substances and planting wildlings directly in the field as well as in the nursery in Gunny bags. Nursery studies initiated during March 2009 as



Experimental Plantation of Deodar Wildlings

Raising of Deodar Tall Plants in Nursery

per the availability of tall plants in nursery beds. Experiments are also being conducted on pruning, root exposure time during transplanting and root desiccation protecting substances similarly as being done in case of direct planting. Experimental plantations are being maintained in the field intensively. The data pertaining to field survival recorded regularly. The plantation success through wildling is still a critical issue and is being investigated under this project. However, field survival results of Deodar wildlings are not encouraging till date.

Standardization of Methodology for Seed Collection, Seed Handling, Storage and Breaking Seed Dormancy in *Juniperus polycarpos* C. Koch and *Fraxinus xanthoxyloides*

The germination studies to overcome seed dormancy in *Juniperus polycarpos* seeds treated with different pre-sowing treatments recorded excellent (70%) germination under nursery conditions. The seedlings raised through seeds are being continuously monitored in the nursery. The repeat trials laid out to find the optimum time of seed collection in both the species are being maintained.

The seed storage trial in *Fraxinus xanthoxyloides* and *Juniperus polycarpos* by using different type of storage containers/storage environment was maintained and viability test of the seeds carried out periodically. The *Fraxinus xanthoxyloides* seeds stored in different type of storage containers/environment showed decreasing trend in seed viability and seeds stored in airtight polysac container placed in refrigerator (<5.0C) retained >70% viability after 24 months of storage whereas other storage containers/ storage environment showed decreasing trend in seed viability. Similarly, *Juniperus polycarpos* seeds also showed decreasing trend in seed viability and seeds stored in airtight polysac container placed in refrigerator (<5^{0}c) retained >50% viability after 24 months of storage, whereas, other storage containers/storage environment showed decreasing trend in seed viability. Fresh seeds were collected and repeat trials laid out.

Seedlings of *Juniperus polycarpos* in the Nursery Conditions

Study on Impact of Ban on Green Felling in Deodar, Kail, Fir and Spruce Forests of Uttarakhand and Himachal Pradesh.

Basic information pertaining to study sites from the offices of respective divisional officers collected and forests in Chamba, Shimla and Kullu districts identified for the detailed investigations. Survey undertaken in Chamba, Chopal and Kullu Forest Divisions of the identified districts. Basic information/ details of the forests collected from Compartment History Files from the respective ranges. After having the basic details, preliminary discussions were held with the concerned Divisional Forest Officers in their respective divisions and the matter was also deliberated upon at the institute as well. It was finalized internally that the institute will propose the sites falling in three districts viz., Chamba, Kullu and Shimla in the state of Himachal Pradesh. Accordingly, sites for carrying out the studies were selected in Naggar Range of Kullu Forest Division, Upper Chamba Range in Chamba Forest Division and Chopal Range of Chopal Forest Division. Meeting with the PI and the Head of Silviculture Division were also held for more clarifications and discussions on the issue. Sites in the various ranges/ blocks of the above Forest Division of the identified districts as referred to above were visited with the PI and accordingly, identified for finalization by the team from FRI, Dehradun. Thereafter, basic details of the areas were recorded and literature consulted. Floristic survey in fir and spruce forests conducted in Riuni & Riyana sites falling in Chopal Forest Division. HFRI now will undertake field activities at its own because of separate allocation of budget but will discuss the detailed from time to time with the PI at Dehradun.

Production of enriched vermicompost & analysis of vermicompost samples and training & demonstration have been carried out under the project, "Development of low cost of enriched vermicompost for commercial production"

Collection of seeds/clones and establishment of nursery have been done under the project "Selection and evaluation of potential seed sources and/ clones of selected species from Jharkhand and adjoining states".

2.2.3 Social Forestry, Agroforestry/ Farm Forestry

Development of Agroforestry Models for Eastern Uttar Pradesh

Farmers practicing agroforestry in their fields were identified. Agroforestry plots of Aonla, Eucalyptus, Teak and Poplar were studied, soil samples analyzed for their physico-chemical characteristics. Aonla based agroforestry system was identified as the most suitable and profitable option of agroforestry in Allahabad District. Whereas, for Jaunpur region, Teak based agroforestry system, for Gorakhpur region, teak and poplar and for Barabanki Eucalyptus and Teak based agroforestry were found suitable. The major constraints in adoption of agroforestry was also identified and it revealed that market linkages of forestry produce is very poor other constraints are lack of agroforestry wood based industries viz Pulp & Paper, Plywood and furniture etc, poor accessibility of state run marketing agency e.g. Forest corporation for agroforestry products, Non Lucrative Minimum Support Prices for Agroforestry products, Timber and Forest products transit rules and regulations and lack of agroforestry products' based Marketing Information System etc. in marketing. Further, less availability of agricultural land, long span of period required for getting benefits, legal problems in harvesting, unavailability of market, lack of awareness, unavailability of planting material, personal disputes, are other major factors identified as constraints in adoption of agroforestry by the farmers.

Demonstration of Agroforestry Technologies for Enhancement of Livelihood Opportunities in Different Agro-climatic Zones of Tamil Nadu

The project is being implemented in collaboration with the National Research Centre for Agroforestry, Jhansi and Forest College and Research Institute, Mettupalayam. The existing agroforestry systems being practiced by the farming communities in five agro-climatic zones were documented along with major tree species and annual crops. Agroforestry demonstration plots were established under 15 ha in five agro-climatic zones (3 ha per zone) with tree components like *Casuarina equisetifolia*, *Casuarina junghuhniana*, *Melia dubia*, *Tectona grandis*, *Eucalyptus* spp. and *Ailanthus excelsa* and horticultural components like Mango, Guava, Sapota and lemon along with the annual crops. Under the established agroforestry demonstration plots, intercropping activities have been carried out under above mentioned agroforestry systems and the yield was assessed. Also biomass samplings have been carried out under the established agroforestry systems with annual crops and the same have been compared with sole

Mango with Groundnut based Agri-horticulture System in Villupuram of Tamil Nadu

Teak with Sugarcane based Agri-silviculture System in Cuddalore District of Tamil Nadu

crops. *Casuarina* with cotton registered higher net income of R` 31,250/ha in Cauvery delta zone followed by Lemon with sunflower (`18,750/ha) in Southern zone, Teak with black gram and cowpea (`14,650/ha and `12,500/ha respectively) in western zone and Ailanthus with black gram and cowpea (`12,840/ha and `10,230/ha respectively) in North-Eastern zone.

Lemon with lab-lab based Agri-horticulture System in Tirunelveli District of Tamil Nadu

Development of Agroforestry Systems with Economically Important Medicinal Plants under Industrial Tree Species of *Casuarina* and *Eucalyptus*

The planting of tree species like *Casuarina equisetifolia, Casuarina junghuhniana* and *Eucalyptus camandulensis* has been completed at four locations namely Karaikudi, Sendurai, Jeyamkondam and Karaikal in Tamil Nadu. Planting of medicinal plants viz. *Decalepis hamiltonii* and *Asparagus racemosus* as intercrop along with the tree species has been completed. Soil samples from all the planting locations were collected before undertaking the planting, for understanding the nutrient status.

Studies on Assessing Growth Performance of *Guadua angustifolia* Kunth under Different Management Schedules (NMBA)

Field trials were established viz; spacing (5mx5m and 5mx9m) and fertilizer trials consisting seven treatments at two sites viz; Yelwala near Mysore and Gottipura (Hoskote) near Bangalore in 2005. Survival rate < 50% in Hoskote and < 10% in Mysore by the end of third year indicating the unsuitability of *Guadua angustifolia* under semi-arid conditions.

Cultivation of *Guadua angustifolia* Kunth and *Dendrocalamus asper* Backer in Kerala and Karnataka (NMBA)

Farm demonstration trials were established in tropical humid conditions in 2 sites (Aluva and Palakkad) in Kerala and in Thithimathi, Coorg, Karnataka at two spacings to study growth performance. Intercropping was carried out with nutmeg, sandal and *C. sappan* in these 3 sites. Growth performance data collected for the 3 sites in 2008 indicate best performance in Coorg, followed by Aluva and then, by Palakkad.

Bamboo Locational Trials – BLT (NMBA)

Eight bamboo species viz; *Bambusa bambos, B. balcooa, B. nutans, B. tulda, Dendrocalamus asper, D. hamiltonii, D. giganteus* and *D. stocksii* (in Bangalore) and *Guadua angustifolia* in place of *D. stocksii* (in FRC, Hyderabad) trials were established during July-September 2005 and maintained at Nallal, Bangalore and Dulapally, Hyderabad using 5m x 5m spacing. Maximum (100%) survival rate was in *B. balcooa* and minimum (50%) in *D. asper*. Among the eight species, *D. hamiltonii* proved the best in terms of height of culm (5.89m) and diameter (31.8 mm) in Bangalore as well as at Hyderabad, followed by the *D. stocksii*, *B. balcooa* and *B. nutans*. Minimum height (1.6 m) exhibited in *D. asper.*

Ecological, Economic and Socio-cultural Evaluation of a Traditional Ficus based Agroforestry System in Mandya District, Karnataka

Around 140 individual farmer surveys and 11 village level surveys have been completed

covering 6 taluks in Mandya District. Litter traps were setup in farmers field, litter is being collected monthly and analysed for various nutrients. For litter decomposition studies litter bags are retrieved monthly, processed and analysed for assessing the decomposition pattern. Micro climatic parameters are being recorded monthly in the field.

Development of Multitier Cropping Models for Medicinal Plants in Andhra Pradesh (Funding Agency: (N M P B)

Three crops of medicinal plants namely, *Andrographis paniculata*, *Ocimum sanctum* and *Withania somnifera* were raised in six hectare area in combination with Teak+Sandal, Rosewood+Sandal, Eucalyptus+Sandal trees and in combination with Teak and their respective sole crops. Rosewood+Sandal combination was found to be very suitable for the growth of all the three medicinal plants. *A. paniculata* followed by *O. sanctum* and *W. somnifera are* found to be better suited in that order. The growth data of Teak trees reveal better growths in inter crop as compared to control. Two training-cum-workshops were organized for extension of the research findings. Further, two on-farm trials were laid out in Munnanoor and Thiruppalapuram villages of Gopalget mandal with Sandalwood, Rosewood and all the three medicinal plants.

Multilocational Introduction-cum-Demonstration Trial and Field Evaluation of Six Important Bamboo Species viz; *Bambusa balcooa. B. nutans, Dendrocalamus asper, D. hamiltonii, D. stocksii* and *Guadua angustifolia* in Andhra Pradesh, Karnataka and Goa (DBT)

Periodically, data collection at all the four sites [Buggapadu (10ha) & Chintalapudi (10ha) in Andhra Pradesh, Navtoor (20ha) Karnataka and Aglote (5ha) Goa] carried out during 2009-2010. Mortality replacement at Navtoor site, KFD carried out during July-August 2009. Officials of Goa Forest Department were trained on bamboo macroproliferation and construction of low cost polytunnel for macropropagation of bamboo species. Vegetative propagation techniques like; culm cuttings, branch cuttings and rhizomatous cuttings were demonstrated to the officials of Goa Forest Department.

Development of Agroforestry Models in *Wrightia tinctoria* R.Br and *Gmelina arborea* Roxb. as Tree Species in Semi- arid Tropics of Andhra Pradesh

A farmer's field has been selected and prepared for laying out trials. Seedlings of *Gmelina arborea* have been raised and seeds for *Wrightia tinctoria* have been collected for planting as tree component of the various treatments.

Evaluation of Medicinal Plant based Agro-forestry System (Silvi-medicinal) under Existing Teak Plantations

Medicinal plant based agroforestry (Silvi-medicinal) system viz. teak-turmeric, teak-keokand and teak-kalihari were developed. The developed models were transferred to the user groups through demonstration of field trial and training. Among these three silvi-medicinal systems, teak–turmeric system was widely appreciated by the user groups.

Field Demonstration to the Farmers of Jabalpur District

Evaluation of Productivity of Maize in *Dalbergia sissoo* - *Zea mays* Agroforestry System

Laid out an OSR trial with hybrid maize at TFRI campus in two year old *Dalbergia sissoo* plantation with 21 plots of size 10m x 10m at 3 different spacings of 4m x 4m, 5m x 5m and 6m x 6m and 3 plots were kept as blank outside the plantation area. Hybrid maize seeds were sown at same spacing of 60cm x 20cm with tree to crop

D.sissoo - *Z.mays* Agroforestry System

line spacing of 60cm and 120cm following Randomized Block Design. The maize crop was harvested and yield data recorded, tabulated and analyzed statistically. The tree distance of 5m x 5m with 60cm tree to crop line spacing proved best for maximum yield of maize crop. Growth parameter i.e. collar diameter and height of *Dalbergia sissoo* plant was recorded at the time of planting and harvesting of maize crop. Maximum increase in height and collar diameter were observed in block with the tree spacing of 5m x 5m. Soil samples collected at the time of planting and harvesting of maize crop were analyzed for pH, EC, organic carbon, available N,P,K and Ca++, Mg++.

Samples of Harvested Maize Intercropped under Sissoo-Maize System

Sustainable Development of New Bamboo Agroforestry Techniques for Increased Income Generation in Central India

Harvesting of wheat from the Bamboo-Wheat agroforestry system established as an On Station Research (OSR) trial in the agroforestry experimental plot at TFRI, Jabalpur was done in the month of April 2009 and wheat yield was estimated following threshing and cleaning.

The casualty replacement was done in the two bamboo species, i.e., *Dendrocalamus strictus* and *Bambusa nutans.* Soil samples were collected from the Bamboo-Wheat agroforestry system after the harvesting of wheat and analysed for various physico-chemical properties and constituents.

A Participatory Rural Appraisal (PRA) exercise was conducted to identify progressive farmers at the Rawan Range, Barnawapara Project Division, Chhattisgarh. Training on the benefits of adopting bamboo based agroforestry system was imparted to the farmers on the 14th and 15th May 2009. Thereafter, polypot seedlings, as per needs expressed by the farmers, were provided for planting on their agricultural field boundaries. Similar exercise was conducted to identify progressive farmers at the Bamboo Centre, Gwalior, Madhya Pradesh. Training on the benefits of adopting Bamboo based agroforestry systems was imparted to these farmers on 25th-26th May 2009. Thereafter, polypot seedlings, as per needs of the farmers, were provided for planting on their agricultural field boundaries.

Training on the Benefits of Adopting Bamboo based Agroforestry Systems

A Bamboo-Urad (Black gram) agroforestry system was established as an OSR by sowing Urad seeds in the Bamboo plantation created while establishing bamboo-wheat agroforestry system. The growth data, viz, collar diameter and height of every bamboo plant of *D.strictus* and *B.nutans* present in the OSR were recorded before the sowing of Urad seeds. Soil samples were collected from the experimental plot before the sowing of Urad seeds and are being analysed for various physico-chemical properties and constituents in the laboratory.

The growth parameters i.e. collar diameter and the height of the leading culm of *D. strictus* and *B.nutans* were recorded and tabulated. Soil samples were collected after the harvesting of Urad and are being analysed for their chemical constituents and physical properties.

The experimental plot was prepared for sowing of wheat to establish a Bamboo-Wheat agroforestry system as an OSR trial in the second cycle. Soil samples were collected before the sowing of wheat were analysed for various physico-chemical and physical properties and constituents. The growth parameters i.e. collar diameter and the height of the leading culm of the two bamboo species viz, *D. strictus* and *B.nutans* were recorded before the sowing of wheat.

Wheat was sown using a seed driller among the two planted bamboo species i.e. *D. strictus* and *B. nutans* for establishing a Bamboo-Wheat agroforestry system in the several cycle as an OSR trial. Germination of wheat was observed and the said agroforestry system so established is being maintained till date.

Agroforestry Model with Medicinal Trees and Herbs

Quality seeds of important medicinal plants and trees were collected from identified sources. About 30,000 seedlings of *Aegle marmelos, Andrographis paniculata, Asparagus racemosus, Moringa oleifera, Rauvolfia serpentina, R. tetraphylla* and *Withania somnifera* etc. were raised in the nursery for distribution to farmers. *Emblica officinalis* and *Moringa oleifera* based agroforestry plantations were established with the existing annual crop like tomato and potato. Established medicinal plants plot of *Andrographis paniculata, Asparagus racemosus, Rauvolfia serpentina, R.tetraphylla, Withania somnifera* under the shade of *Aegle marmelos* and *Moringa oleifera* as well as in the open to study the effect of shade on growth of medicinal plants. FYM and biofertilizer, soil and sand have been purchased and distributed to the 12 farmers under the project. To make awareness among the people about the importance and cultivation of medicinal plants to get additional benefit both from top storey of medicinal plants and other agricultural crops, 100 people have been given training under the project.

At Rain Forest Research Institute, Jorhat, a total of 77 villagers from 65 families have been trained in different aspects like macro proliferation techniques, bamboo agroforestry management, fishery, bee keeping, nursery technique of bamboo and rattans, low cost and short duration nursery technique of Gamar. Five nos. of villagers were trained on artisanship/ craftsmanship at CBTC, Guwahati. The agroforestry model developed by RFRI has been adopted by the villagers for optimised and sustained productivity. Two bio-gas plants were also installed in the village and the benefit goes to maximum no of families. The study reveals that

there has been improvement in availability of energy for household purposes besides saving their time to engage themselves in other productive works and also minimize the extraction of fire wood and thus reduced environmental pollution. The villagers were trained on various aspects of fish farming viz. soil testing, size and shape of a pond, proportion of slope; maintain pH level, selection of different fish species and feeding pattern etc. Fingerlings of different species like Rohu, Catla, Grass Carp, Mirika, Silver Carp and Common Carp, were prescribed suitable to the local condition for rearing. One thousand two hundred fingerlings of assorted species was introduced and made a net profit of `10,500.00 in the first year. In the subsequent year, the income will enhance marginally and the villagers will get more profit on a sustainable basis. Fifty villagers were trained on bee keeping. During the training, various aspects of beekeeping like selection of bee, colony cleaning, placement of extraction chamber, requirement of food materials in absence of flowers, catching of swarm bee, method of extraction of honey, fixing and fitting of honeycomb, time of displacement and other management aspects were covered. Each beneficiary extracted honey in one bee box and obtained 6 to 7 kgs of honey earning `1,200/- to `1,400/- in a year. The crop harvested from the inter cropping with bamboo and Gamar and introduction of horticultural and seasonal vegetable more particularly the Bhot jolokia (HOT CHILLI) also provided additional income to the farmers in phase manner.

Under the project on farm, innovation in macroproliferation technique and promotion for commercial plantation of edible bamboo, capacity building of the Self Help Group members was done through training and demonstration on nursery practices using macropoliferation technique and bamboo plantation management for edible shoot production .Villagers have also been motivated to utilize the interspaces by intercropping locally preferred crops for an additional income. Liaison meeting with the local entrepreneurs has also helped them in marketing of edible shoots by developing linkages to shoot processing industries located in Jorhat (60km from the site).The results were found to be very much encouraging and the model was replicated in nearby villages.

Under the project documentation of baseline information on shifting cultivation in NE India, eleven representative sites were selected throughout NE states. Field survey was done for collection of information/data on shifting cultivation practices. Time series data showed a declining trend in area under shifting cultivation in NE states. Four typologies of shifting cultivation were observed in NE states. Among the transformations recorded in shifting cultivation areas, major ones are conversion of fallow jhum lands into horticulture and forestry plantations. The methodologies adopted in this study for isolation of Rhizobium, inoculation technique, Physico chemical analysis of soil, yield analysis of crops are appropriate and effective to meet the set objectives of the project.

Development of Suitable Agroforestry Models for Promoting Bamboo Cultivation outside Forests in NE Region

Under the project, agroforestry plantations have been established. Inter cropping trials on horticulture and agricultural trials; experiments on the effect of biological root barriers and canopy manipulation are undergoing. The technical programme and methodologies proposed under the project as mentioned above have been found suitable to achieve the objectives.

Development of Economically Viable and Integrated Agroforestry Models for Arid Region

Agroforestry model was established and maintained at farmer's field at village Harsh, Bilara, District - Jodhpur. *Sesbania aculeata* (Dhaincha) was grown during the year in the field for green manuring. Performance of *Ziziphus mauritiana* (grafted ber) species was found the best as horticultural species, while *Colophospermum mopane* was the best as silvicultural species.

Colophospermum mopane plants attained (average) maximum height of 181 cm, followed by *Prosopis cineraria* (173 cm), *Cordia mixa* (169 cm), *Ailanthus excelsa* (165 cm) and *Ziziphus mauritiana* (136 cm). Collar diameter was maximum in *A. excelsa* (5.96 cm), followed by *Cordia mixa* (5.83 cm), *C. mopane* (4.52 cm) and *P. cineraria* (4.19 cm). The plant growth was higher in agroforestry plots as compared to the control (without crop). Wheat crop production was recorded 13.67 quintal /ha during the year.

Introduction and Performance Trials of *Gmelina arborea* for Agroforestry in Lower Hills of Himachal Pradesh and Jammu & Kashmir

Procurement/collection of seeds was done through the Institute of Forest Productivity, Ranchi, from five locations. Nurseries of the institute located at Johron (Paonta Sahib) and Bir Palasi (Nalagarh) representing the low hill zone were used for the production of planting stock. After field survey, four sites in lower hill zone at Puruwala & Kot in Himachal Pradesh and Nudh & Basanterbella in Jammu & Kashmir, measuring 5.0 ha have been identified and experimental trials following RBD design with three replications established. Though very early to predict, yet preliminary growth data indicated that the *G. arborea* is performing well on the study sites and have attained an average range height of about two metres within two years of establishment. However, growth data of preliminary results shows that *G. arborea* may be a future planting species for the lower hills keeping in view its short rotation period.

Evaluation of Soil Fertility Status and Nutrient Return from the Important Indigenous Agroforestry Tree Species in Himachal Pradesh with Special Reference to Hamirpur district

Quantitative parameters of agri-silvicultural system have been recorded for developing correlations and recommendations. The results indicated that the six important agroforestry species (frequency > 56%) selected for taking up the present study are also integral part of the naturally occurring agri-silvicultural agroforestry systems in the region. Collected soil samples were analyzed and Nitrogen was observed higher in the upper soil horizons which tend to decrease towards lower horizons of soil in most of the agroforestry species under the study. The preliminary results of soil analysis indicate a positive role of agroforestry species in maintaining the fertility status of the soil.

Nutrient contents in the litter of major (five) agroforestry species were to be assessed, whereas, experimentation on six important agroforestry species i.e., *Grewia optiva, Mours alba, Celtis australis, Bauhinia variegata, Toona ciliata* and *Albizia chinensis* was undertaken. Litter samples collected from the experimental area were further segregated for grinding and further chemical analysis. Preliminary results of litter production by important agroforestry species mentioned above indicated that these species all together contributes significant amount of litter-fall annually through various litter fractions. Results on nutrients contents in litter of agroforestry species preliminarily indicated that leaves of these six important species have higher concentrations of either of the

five nutrients (Nitrogen, Phosphorous, Potassium, Calcium and Magnesium) studied, which may be helpful in drawing various corelations/ conclusions at the end of the study.

Information on natural populations and plantations of kadamb and semul have been collected and 30 candidate plus trees have been identified in Jharkhand and West Bengal. Relative analysis of CPTs on physiological parameters and experiments designed for evolving clonal propagation procedures have been completed under the project viz.: "Integrated strategy for evaluation of indigenous fast-growing multipurpose trees of eastern India for plantation forestry".

2.2.4 Forest Soils & Land Reclamation

Status of Soils and Organic-C Store in Giri Catchments, H.P.

The study was carried out in Giri catchments of Himachal Pradesh. Geologically, the study area comprises of the Pre-Tertiary rocks. Lithologically, the rock formations consists of Limestone, Dolomite, Slates, Shales, quartzites, Sandstones, Schist, Phyllites, Conglomerates, Boulders etc. Giri catchment has 8,165,593.15 (8.16 million) tons of soil organic carbon store in the forest area. Under agriculture land use, soil organic carbon store is 3,167,521.58 tones (3.16 million tons). Alkaline soil reaction are found on Mandhali formation, neutral on Infra Krol formation whereas acidic soil reaction are observed on Krol formation. Soil pH in dense forests was observed in decreasing order of pine (6.42), deodar (5.91) and spruce (5.00). Available phosphorus was found poor on Blaini and Krol formations, medium on Mandhali and Krol formations and high on thrust and faults locations. Available potash was high on thrusts and Krol formation and medium on Mandhali and Blaini formations.

Recommendation of Landuse Model for Degraded Forests of Nainital

The study was carried out in Nainital and adjoing areas, Nainital forest division. Different landuses were identified and studied in the area:

Pine Forests:

Dense: The soils are acidic in reaction, low in conductivity and have sandy loam texture. Organic matter in these soils varies from 1.63 to 3.85 %.

Open: The soils are acidic to alkaline in reaction, low in conductivity and have sandy loam texture. Organic matter varies from 3.35 to 3.70 %.

Sal Forests:

Dense: Soils are generally loam to silty loam. It has low to medium electrical conductivity. low to medium in organic matter (1.66-3.79 %).

Open: The soils are acidic in reaction (5.15 - 5.68), low in conductivity and have sandy loam texture. Organic matter in these soils varies from 1.66 to 3.10 %.

Miscellaneous Forest:

Dense: The soils are acidic in reaction (5.31-5.95 pH), low to medium in conductivity and have sandy loam texture. Organic matter in these soils varies from 1.62 to 5.41 %.

Open: The soils are acidic to alkaline in reaction (5.40- 7.85 pH), low to medium in conductivity and have sandy loam texture. Organic matter in these soils varies from 1.66 to 4.38 %.

Oak Forests:

Dense: The soils are acidic in reaction, low to medium in conductivity and have sandy loam texture. Organic matter in these soils vary from 3.7 to 6.1 %.

Open: The soils are acidic in reaction, low to medium in conductivity and have loam to sandy loam texture. Organic matter in these soils vary from 3.7 to 5.40 %.

Plantation techniques for degraded sites have been given and suitable species for afforestation on different degraded lands were suggested.

Relative Effect of Geology, Vegetation and Climate on Soil Formation of Uttarakhand

Uttarakhand forests of North-Western Himalaya is a confluence of all the rock formations resulting in different soil and vegetation types on different climatic zones. The importance of geology in forestry research is of great significance in evaluating the soil fertility status and in managing the soil for greater production. The area was surveyed and collected the soil samples from Dehradun, Chamoli, Pithoragarh, Almora and Bageshwer districts of Uttarakhand under different natural forests from predetermined depths. Representative sites were selected in each location depending upon the variation in geology, vegetation and climate. Three soil profiles were also excavated at each sampling points and samples have been collected from different genetic horizons. Soil samples collected so far are being analysed for their physico-chemical attributes. The fresh rock samples have been collected from different sampling sites having similar or different vegetation and geological formations. Suitable number of 10x10 metre quadrates for tree species were laid down in each sampling site and the trees within the quadrates will be enumerated for dbh, height and crown area. Sand and clay fractions separated from soil are being prepared for mineralogical investigations.

Soil Organic Carbon Inventory of Uttarakhand

Concentration of atmospheric CO_2 can be lowered either by reducing emissions or by taking CO_2 out from the atmosphere and stored in the terrestrial, oceanic or aquatic ecosystems. Soil especially, the forest soil, is one of the main sinks of carbon on earth because these soils normally contain higher carbon as compared to vegetation. No systematic project/ study has been undertaken to estimate the soil organic carbon in forests, as well as in other land uses in Uttarakhand, by following uniform methodology for field and laboratory work.This project would generate comprehensive and authentic information using standard IPCC methodology, about the soil organic carbon by ground truthing in the different land uses in all the districts of Uttarakhand. During 2009–10, total 1108 soil samples were collected from different land uses for soil organic carbon estimation from 202 different locations spreaded over in all the districts of Uttarakhand. 846 samples from different forests covers, 135 samples from different plantations, 94 from different horticulture land use and 34 samples from agroforestry models in different districts of Uttarakhand have been collected during this year.In addition to the above samples, 404 soil samples have also been collected for bulk density and coarse fragment estimation from the above 202 locations. All the samples were analysed for Soil Organic Carbon, Bulk Density and Coarse fragments.

Litter Decomposition in Sal Forests of Central India and its Impact on Nutrient Status of Soil

Study sites were selected from sal forest of Madhya Pradesh, Chhattisgarh and Orissa. Litter samples from different layers were collected for study of microflora and fauna involved in decomposition of litter. Fourty five isolates of fungi are maintained in the laboratory. Carbon flux in 3 different sites was recorded. Identification and documentation of selective decomposing fungi is under progress. The present study will highlight litter decomposition and its conversion into nutrients which will be recycled and used by sal for their growth and biomass production.

Bamboo Species Suitability for Different Non-Forest Areas of M.P.

Nine different bamboo plantation sites were selected in non forest areas of M.P. namely Sinduri bharri (Shahdol), Majgaon (Katni), Ghugri (Jabalpur), Sanaidongri (Lakhnadon), Rajgarh (Rewa), Barelipar & Dhokli (Sarni/Betul),

Bamboo Plantation in Non-Forest Degraded Area at Ghugri, Jabalpur

Delakhadi & Sonapipri (Chhindwara) for undertaking observations on growth performance (average height & collar diameter) of bamboo culms. Two pot culture experiments were laid out at TFRI nursery to study a) Suitability of different bamboo species in two different parent material of soil, and b) Performance of *D. strictus* in three different parent material of soil. Growth data of

Library for Soil Samples of North-East

bamboo seedlings raised in two different pot culture experiment are being recorded quarterly. Growth increment of three months old bamboo seedling indicate that *B.vulgaris* had maximum height in yellow soil (Granite), whereas rest of other bamboo species viz. *Bambusa bambos, B.longispathus, D.strictus, B.tulda, B.nutans* had maximum growth increment in black (basaltic) soil. Ninty soil samples from 29 forest sub-group types collected from North-East states have been analyzed. A library for soil Samples of North East is being set up in Rain Forest Research Institute, Jorhat.

Characterization and Classification of Forest Soils of Rajasthan

With the objective to characterize and classify the forest soils of Rajasthan, following the USDA classification system, soil profiles have been studied at 210 places covering Sri Ganganagar, Hanumangarh, Jhunjhunu, Sikar, Bikaner, Nagaur, Barmer, Sirohi, Jalore and Jaisalmer districts in 170 forest blocks in 89 ranges. Physico-chemical characterization of the soils has been done in the field as well as in laboratory. Soil structure, consistency, colour,

Northern Dry Mixed Deciduous Forest (5B/C2) on Very Shallow Soil, Ratapani, Dungarpur; pH: 6.32-6.45; Ec: 0.06-0.09 dSm^{-1}; SOC: 0.27-1.26; Carbon stock: 22.1 $Mgha^{-1}$

Desert Dune Scrub (61S1) on Deep Aeolian Deposit in Ganganagar; pH: 8.67; Ec: 0.16 dSm^{-1}; SOC: 0.11-0.13; Carbon stock: 31.9 $Mgha^{-1}$

pH, electrical conductivity, organic carbon, NO_3 and NH_4 – nitrogen and phosphorus have been estimated for 751 samples. Ecological study in an area of 0.1 ha near each of the soil profile pit has been completed. Soils in Shri Ganganagr district are mainly aeolian deposits in the form of desert dunes, inter-dunal plane and old alluvial plains, where no vertical development of horizon has taken place, indicating nature of Entisol. Soil carbon stock varied greatly among different sites, depending on % organic carbon and depth of soil, being high in Gander, Pratapgarh (341 Mg per ha). Very low stock of carbon was estimated for Panch kunda (12.6 Mg ha^{-1}) and Kala Bhakar (13.5 Mg ha^{-1}) blocks in *Euphorbia* scrub and *Anogeissus pendula* scrub, respectively having very shallow soil depth and low soil organic carbon.

Studies on Characteristic Features Pertaining to Biodrainage Potential of Some Selected Tree Species

Performance of *Corymbia tessellaris*, *Eucalyptus camaldulensis*, *Eucalyptus fastigata* and *Eucalyptus rudis* in a canal side (Indira Gandhi Nahar Pariyojana) waterlogged area and their impact on ground water depletion and soil nutrients was studied. *E. rudis* performed the best among the tree species with respect to growth, biomass, transpiration rate and overall bio-drainage potential. Ground water level receded by 145 cm (from stagnant water of 20 cm to a depth of 125 cm) in *E. rudis* plot. In *C. tessellaris*, *E. camaldulensis* and *E. fastigata* water level receded by 90 cm, 70 cm and 60 cm, respectively. Soil electrical conductivity, SOM, NH_4 and NO_3 – N and PO_4 – P varied significantly among different species. All these parameters, except PO_4 – P were high in *E. rudis* and low in *E. fastigata*. No significant variation was observed in the soil pH in these species.

Growth of Different Tree Species under Waterlogged Condition in Indira Gandhi Nahar Pariyojana (IGNP)

Interesting observation was also on heavy natural regeneration of *Eucalyptus camaldulensis* in a water logged area in Indira Gandhi Nahar Pariyojana (IGNP) as a result of soil working (tractor ploughing) that was done before raising an experimental plantation. The regenerated plants were mostly concentrated between 6 and 10 m from the tree trunk of the mother trees situated at the edge of the experimental site. Number of seedlings varied between 13 and 36 per m^2 area. Ground water table has receded from 25 cm to 201 cm depth within a period of five and half year. Apart from the planted species, *Prosopis juliflora*, *Tamarix dioca* and *Saccharum munja* also have come up in the area with recession of ground water table as natural succession and contributed significantly for further lowering of ground water table and increasing productivity.

Transpirational response of *A. nilotica*, *E. camaldulensis* and *T. aphylla* to different water regimes and salinity were studied under controlled condition [water logging at 50 cm (W_3) and 100 cm (W_2) soil depth along with a control treatment (W_1) in in-filled non-weighing type of lysimeters and S_1: No salinity; S_2: 7/12 dSm^{-1} and S_3: 12/24 dSm^{-1}]. High transpiration rate was recorded in *A. nilotica* plants, followed by *E. camaldulensis* and *T. aphylla*. Species wise height, and collar girth was significantly high in

E. camaldulensis whereas, crown growth was high in *A. nilotica*. With increase in salinity, *E. camaldulensis*, *T. aphylla* and *A. nilotica* registered 33%, 20% and 20% reduction in growth respectively as compared to the control. With increase in water logging, higher growth was recorded in *E. camaldulensis,* however, a decrease in growth parameters recorded in *A. nilotica* and *T. aphylla.*

Water use per day per tree was significantly affected by salinity level and depth of water logging. Under water logging at 50 cm soil depth with normal water, *E. camaldulensis*, *T. aphylla* and *A. nilotica* used 64, 55.6 and 30.3 litre water per day, respectively. In *E. camaldulensis* and *T. aphylla*, increase in water use has been observed with increase in water logging at non-saline condition. However, in *A. nilotica* water use increased up to W_2 and reduced drastically in W_3 treatment. Under non-saline condition, highest water use of 73.6 litre per day was recorded in *A. nilotica* in W_2 treatment. With increase in salinity level, a decrease in daily water use was observed, which was greatest in *E. camaldulensis* (66%). Whereas, *T. Aphylla* and *A. nilotica* recorded 57% and 51% decrease in water use, respectively. *Eucalyptus camaldulensis* plants in W_3S_3 treatment started wilting permanently at the age of two years (22 months after the water logging and salinity treatments initiated). The native species showed higher tolerance towards salinity as compared to *E. camaldulensis*. However, under water logging condition at shallow depth, *E. camaldulensis* outperformed *A. nilotica* and *T. aphylla*.

Studies on Species Suitability & Reclamation Strategy for Degraded Forest Soils of Chhotanagpur Plateau, Jharkhand were conducted with a view to assess the species suitability under degraded soil condition of Chhotanagpur plateau areas of Jharkhand and strategizing the mode of reclamation of these soils optimally. Works relating to nature and degree of degradation and other limiting factors of the soils have been covered before taking up the reclamation measures. The limiting factors for tree growth of the sites have been assessed. Nursery and field trial plots have been developed on stress and barren sites at Lalgutwa. Seedlings of 60 tree species have been raised and utilized for pot and field trial on species suitability and reclamation strategy of degraded soils. Species suitability under degraded soils of Chhotanagpur plateau area have been assessed from growth and biomass data. Impact of amendments as indicators of moisture conservation and growth performance of the planted species will be assessed after final data collection and analysis of samples. All the achievable data would facilitate to develop packages for practice for these type of degraded soils.

2.2.5 Watershed Management

Efficacy and Economics of Rain Water Harvesting Devices in Controlling Runoff Losses and Enhancing Biomass Productivity in Aravali Ranges

Effect of different rainwater harvesting techniques (contour trench, gradonie, box trench and V-ditch) and hill slope on plant growth, runoff loss and soil moisture status were studied on a degraded hill in Banswara district. Plants were taller and thicker in <10% slope area and decreased with increase in slope gradient. *Embilica officinalis*, *Azadirachta indica* and *Zizyphus mauritiana* performed better in <10% slope, Bamboo and *Acacia catechu* in > 20% slope and *H. integrifolia* in 10-20% slope. Among the treatments, *E. officinalis*, *S. cumini*, *A. catechu* and *H.integrifolia* performed better in contour trench plots, *G. arborea* and *Z. mauritiana* perfrmed better in box trench plots

and *A. indica* and bamboo performed better in V-ditch plots. In 2009, runoff loss was 12.71% in <10% slope and 17.61% in 10-20% slope, it was highest in control (17.59%) and lowest in the Contour trench plots (12.99%). Losses of PO_4-P was highest from >20% slope, but the losses of NH_4-N and NO_3-N were highest in 10 - 20%.

Soil Water Content (SWC) of June 2009 did not differ ($P>0.05$) due to both slope and rainwater harvesting treatments. However, SWC was highest in <10% slope and lowest in >20% slope. Among the treatments, it was highest in Box trench area and lowest in Gradonie plot in upper 0-40 cm soil layer. In <40 cm soil layer, SWC was highest ($P<0.05$) in <10% slope and lowest in 10-20% slope, whereas, it was highest in Gradonie and lowest in V-ditch plots. Soil carbon stock in 0-40 cm soil layer increased significantly from 2005 to 2009 as a result of soil and water conservation. Highest increase in carbon stock was in >20% slope. Though not differed significantly, the highest increase in carbon stock was in V-ditch plots, than in the other rainwater harvesting structures.

2.3 Genetic Improvement

Overview

Realizing the importance of production forestry, strategic activities for tree improvement are in progress in ICFRE. The primary consideration to bring about genetic improvement in a particular species is the development of a sound scientific programme based upon the available genetic variability and application of appropriate breeding methods to utilize the variability. Applied and basic research in the field of genetics, clonal forestry and molecular biology is being carried out to meet the requirement of the stakeholders particularly state forest departments, industries and farmers. Developing appropriate strategies for tree improvement and integrating them with the tree genetics, activities of the state forest departments are crucial. In this approach, the emphasis is on species oriented tree improvement programme in collaboration with state forest departments. ICFRE institutes during the last several years have been working on comprehensive strategies for tree improvement programme for species like *Eucalyptus*, *Casuarina*, *Acacia*, Teak, *Ailanthus*, Tamarind, Poplars, *Dalbergia*, *Melia*, *Buchnania lanzan*, *Scleichera oleosa*, *Jatropha curcas*, Bamboos and medicinal plants like *Asparagus racemosus*, *Rauvolfia serpentin*, *Saraca indica*, *Tinospora cordifolia* and *Acorus calamus* to establish Seed Production Areas (SPAs), Clonal Seed Orchards (CSOs), Seedling Seed Orchards (SSOs) and also selection of productive accessions.

Clonal propagation is one of the indispensable components in tree improvement programme by means of mass multiplication of superior genotypes for clonal forestry programme and thereby improvement of productivity. Therefore selection of superior trees, clonal multiplication and establishment of clonal plantation has been taken up in the different tree species.

ICFRE institutes also impart training to officials of the state forest departments of various levels on field application of various techniques of planting stock improvement, forest genetics and clonal propagation. The short term trainings are provided to the students of different universities and educational institutions on tree improvement and biotechnology.

Eucalyptus spp.

Through systematic selection and multilocation testing of more than hundred clones, four high yielding clones of *Eucalyptus* spp. have been released for commercial cultivation. The seed orchards and vegetative multiplication gardens for production of improved seeds and vegetative material have also been established.

Casuarina spp.

Genetic gain tests with seeds of first generation orchards revealed an improvement of 13 to 28 % in yield with respect to additional wood in plantations depending upon the site conditions. Through systematic selection and multilocation testing, four high yielding clones of *Casuarina* have been released for commercial cultivation. Produced intra and interspecific hybrids of *Casuarina* (*C. equisetifolia* X *C. junghuhniana*).

A 2 years old Hybrid Progeny Trial of *Casuarina* at Panampalli, Kerala

The interspecific hybrids between *C. equisetifolia* and *C. junghuhniana* (right) in a 2 years old hybrid progeny trial of *Casuarina* at Panampalli, Kerala have shown substantial superiority in growth and tree form and disease resistance over either of parent species (left).

Dalbergia sissoo

New sets of clones have been developed to cater the problem of poor stem form (crooked stem), forking, ramicorn branching and susceptibility to the dieback . Five clones of *Dalbergia sissoo* viz. GBW, JB, FXB, FZK and RB were multiplied to study the genetic variation for *in-vitro* morphogenetic potential and evaluation of their field performance. Investigations were also carried out to find out endogenous auxin level and its relationship with adventitious rooting potential in *D. latifolia.*

***Melia* spp.**

A total of 230 Candidate Plus Trees (CPTs) of *Melia composita* were selected from different geographical regions and analyzed for index value based on height, diameter at breast height, straightness, clear bole height, crown diameter and knots. Further, evaluation trials of 21 most suitable families was established in six geographical locations of Haryana, Punjab, Uttar Pradesh and Uttarakhand. A progeny trial of (10 plus trees each) *Melia azedarach* and *Melia dubia* has been established at Forest Research Centre Campus, Hyderabad.

Pongamia pinnata

The plantations of *Pongamia pinnata* were surveyed in the states of Punjab, Uttarakhand, Uttar Pradesh and Haryana and identified promising genotypes for higher seed productivity and oil content. Field trials have been raised with 49 selected families at Jhumpa (Haryana) and Pantnagar (Uttarakhand) for testing stability, adaptability and growth performance.

Tectona grandis

Understanding the bottlenecks related to reproductive success in teak seed orchards limiting their usefulness was developed. Variation and inheritance of fruit and seed trait of Gujarat teak was studied for the first time and identified five good general combiners.

Phyllodinous Acacias

Comprehensive genetic improvement programme of *Acacia auriculiformis* and *Acacia mangium* was initiated. Breeding population having wide genetic base has been established and considerable improvement in tree form has been observed through progeny trials. Work has been initiated for development of advanced generation seed orchard using the selections from the existing breeding populations.

Ailanthus excelsa

Tree improvement programme has been initiated in the indigenous species for boosting the productivity, yield and development of clones/genotypes. *Ailanthus excelsa* seeds were collected from Tamil Nadu, Rajasthan, Gujarat, Uttarakhand, Madhya Pradesh and Andhra Pradesh and germplasm assemblage was done in three different locations in Andhra Pradesh and Tamil Nadu, as base population for the future breeding programme.

Tamarind

Tree improvement programme has been initiated to select and conserve the rare phenotypic variants by conducting survey in different parts of southern India and identified 47 red and 30 sweet tamarinds in various parts. The conservation of tamarind genetic resources was carried out by establishing germplasm banks of red and sweet tamarinds.

Buchnania lanzan

Seeds of *Buchnania lanzan* collected from phenotypically superior candidate plus trees and progeny trial has been established.

Bamboo

- Thirty five clones of *Bambusa tulda*, 18 of *Bambusa balcooa*, 23 of *Bambusa nutans*, 14 of *Bambusa pallida* and 23 of *Dendrocalamus hamiltonii* have been collected from different places of northeast India and established in bamboo germplasm bank of RFRI. In all 115 clones and 188 rhizomes collected from selected superior mother clumps of target bamboo species are conserved in the gene bank.

- Field trials of tissue culture plants of *Bambusa bambos* and *Dendrocalamus strictus* were established at three places, two in Rajasthan and one in Gujarat. *D. strictus* produced 16% more new culms and *B. bambos* produced 74% more new culms/clump at Dahod almost after three years with fertilizer treatments.

- Keeping in view the ecological significance and socio-economic relevance of *Arundinaria falcata* and *Thamanocalamus spathiflorus* (hill bamboos), conducted survey in Kullu, Shimla and Sirmaur districts of Himachal Pradesh for the identification of their populations. Accordingly, 22 sites in these districts for further collection of the germplasm and establishments of the seed orchards have been identified.

Gmelina arborea

Reproductive biology of *Gmelina arborea* has been studied for generating base line information for improvement programmes. Rain Forest Research Institute has assembled 119 elite clones of *Gmelina arborea* selected from various provenances of North-Eastern states and West Bengal.

Tecomella undulata

A progeny trial with 40 candidate plus trees was established at Bikaner and Jodhpur during September 2008. The progeny from Chohtan (Barmer) demonstrated good growth at Jodhpur and progeny from Mohangarh (Jaisalmer) at Bikaner.

Azadirachta indica

Evaluation of 7 years old Neem progeny trial established targeting high azadirachtin at Govindpura, Jaipur revealed that very low rate of seed setting took place in a few progenies mainly due to frost during the past two years.

Cedrus deodara

The Seed Production Areas (SPAs) of Deodar, by enumerating 50 ha seed stands and marking lists of finally selected stands were prepared and submitted to the State forest department to obtain culling permission.

Medicinal Plants

- On the basis of index value of the four most important traits for the twenty seed sources of *Asparagus racemosus*, six sources viz. Panthnagar (Uttrakhand), Jodhpur (Rajasthan), Dehradun (Uttarakhand), Chandigarh (Punjab), Jammu (Jammu and Kashmir) and Solan (Himachal Pradesh), were found promising for root production at Dehradun, Uttarakhand.

- Out of the screening of fifty populations of *Acorus calamus* representing Uttarakhand, Himachal Pradesh & Jammu Kashmir, five sources have been identified bearing low β-Asarone content.

- A vegetative propagation centre has been established in College of Forestry, Ponnampet for propagation of *Dendrocalamus brandisii* and *Dendrocalamus asper* and to promote cultivation of these two species in Coorg District , Karnataka.

- *In- vitro* regeneration of plantlets and their genetic fidelity in a vulnerable medicinal plant species, *Saraca indica*, showed a

maximum of 35.2% sprouting of auxiliary buds in summer season in 2-3 years old plants.

Molecular Characterization for Breeding Programmes

- Simple Sequence Repeat (SSR) markers were developed for *Eucalyptus tereticornis* to assess the genetic structure in association mapping population targeting adventitious rooting traits.
- The genetic diversity estimates and relationship between the eight populations of *Cedrus deodara* with 10 chloroplast micro-satellite (cpSSR) markers were worked out.
- To identify genetic determinants of salt stress tolerance in Casuarina, 82 *Casuarina equisetifolia* clones were screened for highly salt tolerant and susceptible conditions.
- One hundred and fifty clones were profiled using RAPD markers. Four SSR target primers were developed from ISSR PCR product of the *Casuarina equisetifolia.*
- The clones of *Casuarina equisetifolia* were evaluated for their holocellulose and lignin content, which ranged from 75 to 80% and 24 to 54% respectively among the clones. Wood proximate chemical analysis (% ash, AB extractives, water solubility, NaOH solubility) and CCR enzyme activity was assessed. The results indicated consistent variation among the clones.
- Twelve isoenzymes (AAT, ADH, EST, PPO, POD, GDH, IDH, SOD, MDH, ME, LDH, G6PDH) were optimized in *Casuarina equisetifolia* clones. Casuarina young needles from 24 male and 23 female clones were screened for five distinct gender specific enzymes (AAT, IDH, ADH, LDH, POD). Peroxidase profiles were found to be very distinct in gender discrimination.
- Molecular characterization of 125 accessions of three important bamboo species viz. *Bambusa balcooa, Bambusa tulda* and *Bambusa nutans* was carried out.
- Molecular characterization of 28 clones of *Jatropha curcas* was completed using ten RAPD primers .

Gene Isolation and Functional Analysis

- Class I chitinase gene with approximate size of 1.4 kb was identified with ORF size of 867 bp, 3'UTR of 240 bp and 5'UTR of 293 bp encoding a protein of 289 amino acid with Glycoside hydrolase family 19 chitinase domain was characterized.
- Six transcript representing six classes of cellulose synthase were characterized from *Eucalyptus tereticornis.*
- For rapid functional analysis of genes involved in salt tolerance, parameters critical for development of *E. tereticornis* composite plants with transgenic hairy roots were identified.

Micro and Macro propagation

- To reduce the *Aegle marmelos*, developed cell culture protocol for the species and tested the efficacy of the metabolites produced in culture against pathogens.
- Enhancement of root-ability and planting stock production of selected high yielding *Eucalyptus* clones through micro and mini cutting technique was achieved. Rooting percentage of 13 clones was enhanced using mini cutting technique.
- In *Aquilaria malaccensis,* vegetative propagation protocol through *in-vitro* and *ex-vitro* techniques has been developed.
- In *Dipterocarpus retusus,* vegetative propagation protocol has been standardized.

- Developed basic protocols for *in- vitro* propagation of *Jatropha curcas* and *Commiphora wightii.*
- A demonstration plot (50ha) of *Dendrocalamus hamiltonii* was established using both Tissue Cultured (TC) and cutting raised plants.
- Extensive exploration was carried out to select 30 superior trees of Shorea from the whole lac producing region in eastern part of the country, represented by three states, West Bengal, Jharkhand and Orissa. Besides stem cutting, other macro-propagation methods like air-layering and grafting experiments were carried out. More than 50% rooting was observed through these methods. DNA extraction method from juvenile leaves of clones has been standardized with the aim to test the clonal fidelity.

Projects under the theme

Project	Projects Completed During the Year	Ongoing Projects	New Projects Initiated During the Year
Plan	17	39	19
Externally Aided	14	10	09
Total	**31**	**49**	**28**

2.3.2 Conservation of Forest Genetics Resources

Pinus roxburghii

Pinus roxburgii Sarg. an evergreen conifer species belonging to the family Pinaceae is known for its valuable timber and oleoresin. The oleoresin obtained from pine is an important source of revenue for the Northern Himalayan region of India. Considerable genetic variation exists within the *P. roxburghii* species for resin production across the growing region. It is difficult to identify high resin yielder at early stages of growth and development. In order to characterize and establish DNA marker association with high resin production, a total of 73 genotypes (high and low resin yielder) of *P. roxburghii* from (Uttarakhand, Himachal Pradesh and Jammu) were characterized using RAPD and ISSR markers. The number of polymorphic loci was 120 (82.76%). The total gene diversity was 0.289 and Shannon's information index was 0.431 for the analyzed genotypes. Within population gene diversity and proportion of total genetic diversity between populations was 0.273 and 0.053 respectively. Three RAPD loci (M-186-48, M- 186-49 and OPA-6-76) and one ISSR locus (ISSR – 7-108) showed significant association with resin yield. Of which, OPA-6-76 was in high occurrence (80.64 %) for high resin yielder (resin yield higher than 2.5kg/ annum using bore hole tapping method) and lower occurrence (38.09 %) in low resin yielders (less than 1 kg/ annum). The results indicated possibility of using these loci for development of molecular markers for high resin production.

Cedrus deodara

Cedrus deodara (deodar), also known as Indian cedar is the most important among the Indian conifers though the species is in great demand for its timber, has been subject to over exploitation for centuries. Natural deodar forests are under great pressure not only due to human impact but also due to the changing weather conditions. In order to study the genetic diversity and population structure of Himalyan deodar forests, twenty populations each with 50 individual trees covering Jammu & Kashmir, Himachal Pradesh and Uttarakhand were sampled for DNA marker based study. DNA extraction and

Trees Selected for Sample Collection in Deodar Forests of Manali

SSR fingerprinting techniques have been standardized. Polymorphic SSR markers screened and a total of 8 populations with each of 10 cpSSR markers were fingerprinted and genetic diversity estimates worked out. The genetic relationship between the eight populations was also established. The fingerprinting of other populations is under progress.

With the objective of establishing Seed Production Area and raising progeny trials of *Cedrus deodara*, marking lists of finally selected and enumerated 50 ha seed stands were submitted to SFD to obtain culling permission from the competent authority. The progeny trial was initiated in the nursery during January 2007 and, thereafter, these progenies were maintained in the nursery with one pricking done during August 2007. Progenies, thus, raised and maintained were planted out in the field using Randomised Block Design during August 2009 and growth data recorded periodically.

Seed Production Area (SPA) of Deodar

Asparagus racemosus

A field trial of 20 seed sources of *Asparagus racemosus* was established at the Forest Research Institute, Dehradun (Uttarakhand) to evaluate their performance based on different economic traits. Maximum genotypic and phenotypic variance was observed in shoot height among the shoot - related traits and root length among the root-related traits. The maximum genetic advance and genetic gain were obtained for shoot height among the shoot-related traits and root length among the root-related traits. Based on index values, six sources viz. Panthnagar (Uttarakhand), Jodhpur (Rajasthan), Dehradun (Uttarakhand), Chandigarh (Punjab), Jammu (Jammu and Kashmir) and Solan (Himachal Pradesh), were found promising seed sources for root production.

Acorus calamus

Acorus calamus is an important medicinal and aromatic plant used in several drugs of the Unani and Ayurvedic health care systems. The genetic diversity and population structure of fifty populations of *Acorus calamus* from different geographical regions of its range of distribution in India was studied through morphometric traits and DNA markers (RAPD and chloroplast micro-satellite). The collected sources were also evaluated for β-Asarone content. Five sources

have been identified bearing low β-Asarone content in their rhizome.

Rauvolfia serpentina* and *Tinospora cordifolia

Germplasm of *Rauvolfia serpentina* and *Tinospora cordifolia* were gathered from 39 locations across the country to provide a broad base of the gene pool. The germplasm is being maintained and multiplied by developing various propagation techniques. The multilocation trials were established at Raigarh (Chhattisgarh), Chandrapur (Maharashtra) and Jabalpur (M.P.), and revealed considerable variation. The growth performance was recorded and root samples collected and tested for active principal contents and, based on DUS characters, these have been marked to arrive at the most promising genotypes.

Pterocarpus marsupium

The morphological variations were categorized within and between the populations of *Pterocarpus marsupium* in Tamil Nadu and Kerala, 17 and 14 populations were short listed on Eastern and Western aspects of Western Ghats, respectively. Field surveys were carried out in the Eastern aspect (Tamil Nadu) of Western Ghats and 579 representative trees were tagged and their morphological and phenological parameters documented. Also 214 herbarium specimens were collected from the identified trees. From the short-listed sites in the Western aspect of Western Ghats (Kerala), 219 trees were tagged and their morphological and phenological parameters documented and also 115 herbarium specimens collected.

***Bruguiera* spp.**

Study on reproduction of mangroves constituting phenology, floral biology, pollination, and reproductive success were made in the RET species *Brugueira cylindrica*, *B. gymnorrhiza* and *B. sexangula*. Detailed studies were conducted in 6 locations across the East and West Coasts. In the West Coast, Kannur and Ernakulam districts in Kerala were surveyed and found that *B. cylindrical* in East Coast flower during April–May, whereas, in West Coast, it flower during October–November. Both sunbirds and insects pollinate *B. gymnorrhiza*. *B. cylindrica* pollinated by thrips shows the highest reproductive success. *B. sexangula* is exclusively pollinated by sunbirds and exhibits the lowest reproductive success.

Bird Pollination in *Bruguiera gymnorrhizha*

Sandal (*Santalum album* L.)

Produced 1.3 lakh seedlings of sandalwood during 2006-09 and provided to the SFDs, farmers, sandal based industries and NGOs from all over India. Four sandal stakeholders meeting programmes conducted in Murdeswar, Kolar and in Shimoga districts in Karnataka. Two on- farm demonstration trials of sandal-based agroforestry have been established in Mantralaya (A.P), Bevanahalli, Mudenahalli and in Chikmaglur (Karnataka).

Chloroxylon swietenia

Chloroxylon swietenia is an important species, which falls in vulnerable category as reported by IUCN. Regeneration status of this species was documented. Three seed stands and three candidate plus trees have been identified.

Canarium strictum* Roxb. and *Hydnocarpus pentendra

Trees of *Canarium strictum* and *Hydnocarpus pentendra* were identified and marked for periodic phonological observations. Both the species were sparsely distributed and very few trees were fruiting. Maturation of fruit is staggered. Natural regeneration was reported to be very poor in both the species of *Hydnocarpus pentendra* and *Canarium strictum*. Though germination was found to be good, field survival of seedlings at four months was less than 5%.

Bamboos

- Species-cum-clonal evaluation trials of *Bambusa tulda, Bambusa balcooa, Bambusa nutans, Bambusa pallida* and *Dendrocalamus hamiltonii* were established at 6 selected sites in Assam (2 sites), Mizoram (2 sites), Nagaland (1 site) and Tripura (1 site). Monitoring of survival, growth and performance of species-cum-clonal trial plantations established at all the 6 sites in different northeast states have been carried out. As per observation and data recorded till May 2009, *Bambusa balcooa* and *B. nutans* showed highest survival followed by *D. hamiltonii* and *B. tulda*. Height of *B. nutans* (166.5 cm) is recorded higher than others followed by *B. balcooa* (147.5cm), *B. tulda* (145.7cm) and *D. hamiltonii* (126.9 cm). Overall growth of new shoot recorded higher in *D. hamiltonii* followed by *B. nutans B. tulda* and *B. balcooa*. In Kamrup, *B. balcooa* performs satisfactory in all growth parameters and clone No.11 (C-11) showed better result. In Jalukie, *B. nutans* performs well and Clone No. 9 (C-9) is found to be better. In Teliamura, *B. nutans* performs well and Clone No. 11 (C-11) is found to be well followed by Clone 10 (C-10). In Aizawl, Kolasib and Hailakandi, *B. nutans* was found to be a better performing species. In general performance of trial plantation is best in Tripura (Teliamura) and West Kamrup (Assam), moderate in Aizawl and Vairengte. The growth parameters showed very poor performance in Nagaland (Jalukie) and Hailakandi. *Bambusa nutans* at Teliamura attained most vigorous growth. Among all species, survival of *Bambusa nutans* was found to be the highest.
- A germination trial on seeds of *Melocanna baccifera* collected from different provenances was conducted, which ranged from 42 to 95%. Seed from Agartala and Dharmanagar (Tripura) showed the highest germination, whereas, lowest germination was recorded in seeds collected from Kohima (Nagaland).
- Trial plantations of *M. baccifera* for staggered flowering were established on permanent plots in RFRI campus. These plantations comprised seedlings raised from the seeds of four flowering years i.e. 2001, 2003, 2007 and 2008. Hundred percent survival in all blocks of plantation raised from seeds collected in four different years was recorded. Among the plantations, saplings raised of the seed collected from flowering years 2001 and 2003 showed more vigorous growth.
- Study was undertaken to evaluate the accessions assembled in the bamboo (*Bambusa balcooa. Bambusa tulda* and *Bambusa nutans*) germplasm bank by marker technology to generate information related to management strategies like selection of a genetically distant accessions for mass multiplication, addition of new genotypes to increase genetic diversity, identification of duplicate accessions for culling etc, and also to generate accessions specific RAPD

fingerprints that can be used for planting stock certification purpose. Though the study is continuing, genomic DNA of 70 bamboo accessions has been extracted for reproducibility test and primer screening work.

- Germplasm collection of *Dendrocalamus strictus* was carried out from seventeen states. Various technologies on Bamboo species were developed for demonstration to the farmers and forest officers.Clonal material was developed in Clonal Nursery City Centre, FRI Dehradun and distributed to the six states i.e. Haryana, U.P., Punjab, Uttarakhand, Chandigarh and Delhi. Germplasm collection for hill bamboos was also carried out from all the parts of India.
- A brief account of two important species of Hill Bamboo viz. *A. falcata* and *T. spathiflorus* growing in the state of Himachal Pradesh was prepared/compiled. Germplasm from 22 locations was collected and established at Research Stations, HFRI at Baragaon, Shimla Hills and at Bruhandhar, Near Manali, Kullu valley, Himachal Pradesh.
- Survey, identification, collection and preservation of germplasm was carried out in *Dendrocalamus strictus, Bambusa bambos* and *B. tulda* in East and West Midnapore districts of West Bengal.

Moringa oleifera

Superior seed sources were identified in Jharkhand, West Bengal, Bihar and Orissa and 15 candidate plus trees were marked. Cuttings collected from identified CPTs/seed sources and clonally multiplied. Shoot cuttings planted employing auxin and non-auxin growth regulators in summer season.

Conservation of Medicinal Plants

Surveyed Darjeeling Hills and foot hills and collected germ plasm of 6 species of medicinal plants viz. *Rauvolfia serpentina, Withamia somnifera, Stevia rebaudiana, Asparagus racemosus, Gymnema sylvestre* and *Abolmoschau moschatus.*

2.3.3 Tree Improvement

Dalbergia sissoo

The Forest Research Institute, Dehradun has been working on the genetic improvement programme of *Dalbergia sissoo* since 1990. Though this species has a number of promising attributes, it exhibits poor stem form (crooked stem), forking, ramicorn branching and susceptibility to the dieback. In genetic improvement programme of the species, a number of plus trees from various locations have been selected and assembled in the gene/clone bank. Initially the selection of promising trees was carried out in the states of undivided UP, Rajasthan, Bihar, Nepal and other Shisham growing reasons, the genetic worth of these genotypes is being tested in the field. The field trial consisting of 49 clones has been established at three locations each at Bithmeda (Haryana), Pantnagar (Uttarakhand) and Hoshiarpur (Punjab) following lattice design. The evaluation of earlier trials consisting of 36 clones planted at Hoshiarpur, Ludhiana and Bithmeda were evaluated as per schedule on various morphometric and wood traits. The wood samples have been collected and are being tested for anatomical and wood properties.

Multilocational (4 locations) clonal trials of *D. sissoo* clones were also established in Gujarat. Significant variation has been observed between the clones for most of the growth traits across the locations.

Seven Years Old Clonal Trials of *D. sissoo* in Gujarat

The clones selected on growth performance were subjected to stress resistance and insect pest resistance studies. The genetic variation using isozyme techniques with five stable enzyme systems namely MDH, 6PGDH, IDH, SKDH and MNR was studied. The stress resistance of these 16 selected clones was studied by for water potential. Experiments were also laid out to test the insect pest resistance in the field and identified defoliators were studied in the lab. These selected clones were field planted at Jawalajee in the state of HP and at Basanterbela in the state of J&K during August 2009.

Melia

The natural forests and the plantations of *Melia composita* were surveyed. A total of 230 Candidate Plus Trees (CPTs) were selected from different geographical regions and analyzed for index value based on height, diameter at breast height, straightness, clear bole height, crown diameter and knots. The mean index value for CPTs was calculated to 44.39, however, the trees with index value of more than 75 (58 trees) were considered as plus trees with average index value of 81.81, an improvement by 82 % over the CPTs. Further, evaluation trials of 21 most suitable families was established applying lattice design with seven replications in six geographical locations of Indian states of Haryana, Punjab, Uttar Pradesh and Uttarakhand.

Ten plus trees, each of *Melia dubia* and *Melia azedarach* have been selected from Karnataka, Tamil Nadu and Andhra Pradesh. Seeds were collected and nursery rose. A progeny trial has been established for *M. azedarach* and *M. dubia at FRC, Hyderabad.* Morphological attributes and oil content of seeds of *M. azedarach* and *M. dubia* were studied and recorded. DNA extraction from leaf samples is in progress to study genetic variation among progenies of the selected plus trees.

Pongamia pinnata

The plantations of *Pongamia pinnata* were surveyed in the states of Punjab, Uttarakhand, Uttar Pradesh and Haryana and identified promising genotypes for higher seed productivity and oil content. Field trials have been raised with 49 selected families at Jhumpa (Haryana) and Pantnagar (Uttarakhand) for testing stability, adaptability and growth performance.

Maduca longifolia

Selected 40 CPTs of mahua from Uttar Pradesh, for qualitative analysis flowers and seed were collected for chemical analysis.

Casuarina

Second generation seed orchards were established with progeny raised from the promising trees of first generation orchards of *Casuarina equisetifolia* and *C. junghuhniana*. A 15 months old second generation progeny trial of *Casuarina equisetifolia* was established with progeny of the best 5% of the first generation breeding populations. Early growth data of

A 15 months Old Second Generation Progeny Trial of *Casuarina equisetifolia* at Karur, Tamil Nadu

second generation seedlets showed significant improvement over that of the first generation (Location: TNPL Campus, Karur, Tamil Nadu).

Short listed 10 best performing clones of *Casuarina equisetifolia* based on initial observations of multilocation field testing of 87 clones at (1) Mailladumparai, Karur district, Tamil Nadu, (2) a sodic site at Pugalur, Tamil Nadu and (3) at Sirugramam, Cuddalore, Tamil Nadu was established during 2008. Considerable variations were observed for growth and stem form.

Clonal Trial at Mailladumparai

In order to developing cloning techniques for raising high yielding clonal plantations of *Casuarina equisetifolia* L., coppicing experiments were conducted at various heights (15, 30, 45, 60, 100 and 150 cm from the ground level) and applied 3 treatments (Fertilizer, mulching and growth regulator application). Stumps cut at 45 and 60 cm. from the ground level were found to yield more coppice shoots. Cladodes and needles collected from these coppice shoots were kept for rooting studies. Significant variation was observed between rooting in cladode and needle explants. Needles recorded a maximum rooting percentage of 65 where for cladodes was above 90.

Coppicing Ability

Rooting Ability

Eucalyptus

A breeding arboretum of eucalypts was established in open pollinated mating design for production of inter and intra-specific hybrids. Two species viz. *E. pellita* and *E. urophylla* were taken up initially for the study of their breeding behavior and cross compatibility. *E. pellita* is a frost resistant and moderately resistance to stem cankers due to *Cryphonectria cubensis* and has fast growth. *E. urophylla* has higher productivity and adaptability but is susceptible to *Cryphonectria cubensis*. Both the species are used for pulp and paper. The reproductive biology of these two species was studied and controlled crossing between them was attempted. The F_1 hybrid of *E. pellita* x *E. urophylla* was produced and planted in the field, which show high degree of heterosis at the initial stage.

The clonal trials were evaluated and poor clones were culled to improve the quality of the seed orchards. After culling, seeds were collected from 60 selected clones and about 25000 seedlings were raised to establish progeny trials at Hyderabad and Puthukottai. The selected clones were also multiplied clonally and about 2 seed orchards were established at Salem and Nellore.

Progeny Testing of *Eucalyptus* Clones at Pudukkottai

Clonal Seed Orchard at Salem

The suitability of *Eucalyptus tereticornis* and *E. camaldulensis* clones was studied at four locations in Andhra Pradesh viz., Warangal, Rajahmundry, Hyderabad and Tirupati and one location in Karaikal. Multiplication of the clonal material is still under progress for further trials in Tami Nadu and Karnataka. Clonal multilocational trials of *E. camaldulensis* were also established in Gujarat, which revealed significant variation between the clones of both the species for the growth traits across the locations.

Eucalyptus Clonal Trial at Warangal raised by IFGTB

Vegetative Multiplication Garden of
Short listed *Eucalyptus* Clones

Acacia mangium

The advanced generation seed orchard of *Acacia mangium* were created based on biomass and wood density and evaluation of families in **S**eedling Seed Orchards (SSOs) in Nilambur and Karunya. Outstanding families have been delineated for seed collection.

Keeping in view the potential of the species to grow successfully in North-Eastern region of the country, 16 plus trees were selected following point grading selection method. Seeds of plus trees were collected and their half-sib progenies were raised in the nursery. After evaluation, two progeny trials were established at Satra and Melang Grant, Assam.

Tectona grandis

Twenty clones were studied for reproductive biology and tagged for hybridization. All the clones were assessed for flowering and fruiting behavior in three CSOs and one SSO (1500 trees). A clonal trial was established at Salem (TN). Clones KLN2 KLN 4 & TNT 20 were found to be superior performers in Nilambur progeny trial. A total of 56 superior teak trees were selected in different parts of Kerala, multiplied through coppice shoots and established in the Vegetative Multiplication Garden (VMG). The rooting performance of different clones was also studied.

In order to assess realized genetic gain from teak seed orchards, flower production and reproductive phenology of different clone and families in two clonal seed orchards and one seedling seed orchard were assessed periodically. Nursery experiments are underway to estimate germination and seedling vigour as an indicator of the extent of out-crossing in seed orchards.

Impact of continuous moisture on growth, flowering, seed production and wood characteristics of canal teak plantations in Tamil Nadu was studied. The canal teak showed outstanding growth and attained the harvestable size within 20 years. The percentage of fruit setting was 5% in canal areas, and generally, fruit setting in canal teak is late as compared to other natural teak growing areas. Thirty five superior teak trees were selected in Tiruvarur and Thanjavur areas for clonal multiplication. The damages and natural decay symptoms such as hollowness in different parts on the tree, top dying, early forking, illicit pruning, bulging,

rotten branches and presence of any fungal structures were also studied.

The flower induction was studied in two clonal seed orchards of *Tectona grandis*, two one each in Karnataka (Janganamatti, Dharwad) and Andhra Pradesh (Achuthapuram, Rajamundry). The effect of chemicals viz. Paclobutrazol, Chloroethyl-trimethyl-ammonium chloride, 2,3,5-triiodo benzoic acid (TIBA), Salicylic Acid, Succinic acid 2, 2-Dimethyl Hydrazide (ALAR-85), Napthylene Acetic Acid (NAA), Potassium Nitrate, Poly Ethylene Glycol 6000 (PEG) and 2, Chloroetheyl posphonic acid (ETHERAL) was studied in 36 different treatments on flower induction. Apart from cultural treatments like girdling, shoot training, shoot pruning and root pruning were also employed. A new method for stem injection of chemicals was devised during the experiment.

The magnitude, type of genetic variation and direction of association among different seed and fruit parameters was studied in dry teak (5A/C 1b & 5A/C 1a). The investigation revealed highly significant variation for all fruit and seed parameters in Gujrat teak. The stone length, treated stone length (mm), stone weight (gm), and treated stone weight were found to be highly heritable, whereas, stone width, treated stone width and number of unfilled chambers were moderately inherited.

Genetic analysis of eleven years old progeny trial (18 half-sib families) on inheritance of growth traits in Gujarat Teak was carried out. Individual and family heritability values ranged 4 to 26 and 12 to 43 per cent for apical dominance and Clear Bole Length (CBL), respectively. Height and CBL exhibited moderately high, Girth at Breast Height (GBH) and volume exhibited moderate and basal area and apical dominance showed low estimates of narrow sense heritabilities. Values of narrow sense heritability coupled with moderate to low estimates of genetic advance indicated presence of both additive and non-additive gene action.

Amongst the tested parents, seven parents showed positive General Combining Ability (GCA) for height and girth. Five parents exhibited positive GCA for all the traits. These parents with positive GCA values are expected to harbor constellation of desirable alleles, and expected to produce good progenies through recombination. It was recommended to use these parents for establishing advanced generation seed orchards.

Acacia auriculiformis

Genetic improvement program of *Acacia auriculiformis* through half-sib progeny selection is being executed at IFGTB, Coimbatore. Tree selection was carried out in two seedling seed orchards established by IFGTB, at Karunya and Panampally, one Seed production area established by Kerala Forest Department at Chettikulam in Kerala and two seed orchards established by Mysore Paper Mills Bhadravathi at Hosanagara in Karnataka. Altogether 132 trees were selected based on stem form, branching habit and growth in these orchards. Single tree seed collections from selected trees were made for raising half-sib progenies. Two progeny trials were raised one at Panampally and other at Pondicherry. Two more progeny trials of 1 ha each consisting 132 half-sib families of selected superior trees were established at Palode (Trivandrum division) and Vadakkancherry (Thrissur Division)

Thinning of Two and Half Years Old Progeny Trial at Palode

in Kerala during 2007. Significant variations were observed for growth and stem form among families and seed sources. Among the four seeds sources (Panamapally, Karunya, Behalli and Mumbaru), the families originating from Behalli and Panampally seed orchards were performing better. After evaluation the culling list was prepared. Thinning of inferior trees and families has been carried out in all these trials by removing. 50% of trees. The thinned trials can, now, be used as second generation seed orchards.

Ailanthus excelsa

Germplasm assemblage has been done by surveying different agro-climatic zones of Tamil Nadu and identified 200 phenotypically superior trees. Due to the polygamodiocious nature of the species, finally seeds have been collected from 92 individual trees (Tamil Nadu). Seedlings were raised in the nursery and the growth data of *Ailanthus excelsa* seedlings has been collected and analysed.

Three germplasm bank have been established, one in Tirupati (Andhra Pradesh), two in Tamil Nadu (TNFD lands) namely Salem and Kanchipuram districts. The analysis of 80 seed lots of Andhra Pradesh trial (Tamil Nadu, Madhya Pradesh, Rajasthan, Uttrakand and Andhra Pradesh) showed that the growth performance of Cauvery Delta Zone (Tamil Nadu) was good compared to other seed sources. Based on the one and half year biometric data, 40 individuals of *Ailanthus* have been marked for the future clonal propagation. Seed parameters have been studied for the seeds collected from different sources.

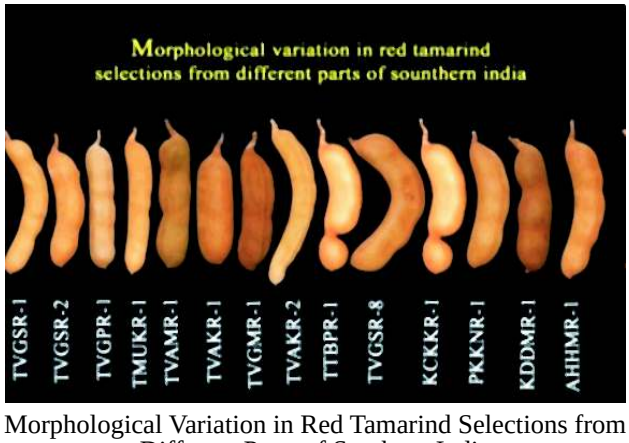
Germplasm Bank at Tirupati

Germplasm Bank at Salem

Germplasm Bank at Triupathi

Tamarind

Selection and conservation programme of red and sweet tamarind is being executed in southern India. Survey was concluded in different parts of Tamil Nadu, Karnataka and Andhra Pradesh to identify and select the red and sweet tamarind trees. As many as 52 different trees of red tamarind and 37 sweet tamarind were selected. Biochemical characterization of red and sweet tamarind was done by quantifying anthocyanin, total sugars, titrable acidity, ascorbic acid and anti oxidant properties. Vegetative multiplication of red tamarind was carried out through cleft grafting. The data were recorded on biometric characters, phenological and reproductive variation. The national germplasm bank of red and sweet tamarind was established at Kurumpapatti, Salem(RF).



Morphological Variation in Red Tamarind Selections from Different Parts of Southern India

Hardwickia binata

Survey was carried out in different parts of Karnataka, Andhra Pradesh and Tamil Nadu to identify the populations of *Hardwickia binata*. Preliminary morphological observations were recorded and core samples were collected from different aged plantations in these states to document the variability for tree traits. Studies on these core samples are being carried out. Variability in seed traits is also being recorded.

Tecomella undulata

Forty Candidate Plus Trees (CPTs) of *T. undulata* were selected after a vast survey in Jaiselmer, Barmer and Jodhpur districts of Rajasthan. Seeds were collected from 40 CPT's and seedlings were raised in AFRI nursery, Jodhpur. Progeny trials were established at Bikaner and Jodhpur during August 2008. The survival percentage was 91% at Jodhpur as compared to only 66% at Bikaner. The progenies from Chohtan (Barmer) and Mohangarh (Jaisalmer) gave best growth at Jodhpur (45 cm) and whereas at Bikaner, the progeny from Mohangarh (Jaisalmer) showed best growth.

Buchnania lanzan

A total of 33 phenotypically superior candidate plus trees were selected in Chhindwara, Gondia, Shahada and Raigarh Forest Divisions of Madhya Pradesh. Seeds were collected from 25 candidate plus trees and progeny trials were established at the Centre for Forestry Research and Human Development campus, Chhindwara.

Buchnania lanzan Seedlings

Gmelina arborea

Trials were conducted to know the reproductive biology in clonal seed orchards of *Gmelina arborea*. Periodical observations were made on vegetative and reproductive events. Data of flower and inflorescence recorded from randomly selected ramets and assessed. Out of 70 clones, flowering was recorded in 57 clones. Bud initiation stared in last week of March and reached to peak in mid of April. Thereafter formation of buds decreased and ended by April and fruit set occur in 22 flowers per branch.

Aquilaria malaccensis

Studies on selection of desirable genotypes has been undertaken to establish field gene bank of *Aquilaria malaccensis*. Germplasm collected from various places of Assam and SSO was established. Clonal multiplication protocol through rooting of shoot cutting was standardized.

Developing Strategies for Describing, Testing and Registering Varieties of Forest Tree Species

Studies were conducted in the base populations of different provenances for developing DUS descriptors and DUS test guidelines for *Eucalyptus* and *Casuarina*. Variation in morphological characters in leaf, stem, bark and reproductive structures was recorded. Studies were also conducted in replicated clonal trials for quantifying the

	Clone no. 14	Clone no. 19	Clone no. 94
Live bark	Light green	Yellow	Yellow
Dead bark	Gray	Brown	Green
Peeled bark	Brown	Dark brown	Brown

Variation in Bark Characters of Different Clones of *Eucalyptus*

uniformity and stability of the selected morphological traits. In *Casuarina*, the cladode, leaf, bark, branch and reproductive structures were taken as DUS characters based on the study conducted in 300 clones. About 49 different descriptors were given for discrimination of clones. Basic discriminating characters for *C. equisetifolia* and *Casuarina junghuhniana* are also given. In *Eucalyptus*, clones placed in two locations, namely Coimbatore and Sathyavedu were studied. The leaf, bark, branch and reproductive characters were taken as DUS characters. About 31 different descriptors were given for discrimination of different *Eucalyptus* clones. Detailed DUS descriptors and DUS test guidelines have been developed for these two species and submitted separately.

Plan of action for validation of the DUS characters have been developed and possible DUS characters of Eucalyptus and *Casuarina* have been finalized. Clonal plantation with known identity is selected in different locations for validation of the DUS characters. Scoring sheets are formed for recording the DUS characters in the field.

To improve the accessibility and affordability of improved seeds from breeding programs to benefit large numbers of small holder tree farms and rural communities, three community seed orchards were established involving farmers, traditional nursery operators and field staff of forest department. These orchards will be maintained as model orchards to spread awareness on the need for genetically improved planting stocks. Capacity building programms are underway to improve the skills of farmers, nursery operators and forest department staff in developing and managing seed/seedling production system. Quality seeds to the growers are being provided through seed bank at FRI Dehradun where seed of good quality with proven identity is collected and maintained.

2.3.4 Vegetative Propagation

- Vegetative propagation of *Dalbergia sissoo* and *Eucalyptus* clones was carried out. In *Dalbergia sissoo*, 75 clones were multiplied and about 15000 plantlets were produced. The propagated plants were established in clonal trials at different locations of Haryana, Punjab, U.P and Uttarakhand. Similarly in *Eucalyptus*, about 5000 plantlets were produced for experimental purpose.
- Rooting trials were conducted to study the response of productive clones of *Eucalyptus* using conventional two noded cutting methods. On the basis of rooting response, clones were categorized as good, moderate and poor rooters. Attempts were made for enhancing rooting and planting stock availability through mini cutting technique and micro cutting technique. Hedge garden with 22 clones was established and maintained using vegetatively propagated ramets. Propagules of eight clones produced by the tissue culture route were hardened and planted in beds to establish a hedge garden for the micro cutting technique route.
- As regarde fast growing species, twenty different combinations of growth hormones of *Melia dubia*, individually and in combination were tested for induction of shoots under *in-vitro* conditions. Benzyl Amino Purine singly or with low concentrations of Kinetin has been identified as the most suited growth regulators for bud initiation.

Multiple Shoot Induction in *Melia dubia*

- A Vegetative Propagation Centre (VPC) at CoF Ponnampet was established with capacity for raising 50,000 rooted cuttings of bamboo for commercial cultivation of bamboos.
- Genetic variation for *in- vitro* morphogenetic potential of *Dalbergia sissoo* clones studied.
- Significant seasonal/genotypic variation was recorded in endogenous auxin (IAA) level in

Adventitious Rooting in Shoot Cuttings of *Dalbergia latifolia*

Dalbergia latifolia trees from Jabalpur. IAA was minimum (1.742 µg g^{-1} fresh weight) in March and maximum (3.640 µg g^{-1} fresh weight) in July. Significant genotypic variation in endogenous auxin was also recorded among selected trees from Chandrapur (Maharashtra) and Jagdalpur (Chhattisgarh). Experiments conducted for testing rooting potential in selected trees of Jabalpur, Chandrapur and Jagdalpur. A basal dip treatment of 5mM IAA for 4 hours promoted adventitious rooting up to 11.33% compared to 1.33% in control in cuttings of selected trees of Jabalpur. Literature reveals only up to 5% rooting and categorized the species as "very difficult to root".

- *In-vitro* regeneration of plantlets in *Saraca indica* Linn. a vulnerable medicinal tree was carried out. Highly significant effect of seasons was observed on sprouting of axillary buds with maximum sprouting (35.2%) obtained in summer season in 2-3 years old plants. Sterilizing treatments also had significant effect on sprouting of buds with 0.2 % $HgCl_2$ treatment resulting in maximum sprouting (38.9%), which was at par with sprouting (27.8%) obtained with 0.1 % $HgCl_2$ treatment. Season and sterilizing treatments did not have significant effect on sprouting of terminal buds from 20 years old mature tree. B_5 medium supplemented with 2.2 µM BA was screened out as the most suitable medium for bud sprouting and elongation of regenerated shoots from nodal segments. On modification of KNO_3 in B_5 medium, the modified strengths of KNO_3 had statistically significant effect on sprouting of buds and number of shoots after four weeks of culture.
- Macro propagation studies were carried out for 23 selected genotypes of *Dipterocarpus retusus*. Rooting of coppice shoot cuttings has been found suitable method for macro-propagation of the species.
- Standardization of nursery techniques of *Bambusa pallida* through a media containing equal proportion of soil, sand and FYM was found to be suitable for propagation through culm cuttings. 20-25% survival was observed in case of culm cutting in the treatment 300 ppm of IBA solution. In the case of macro-proliferation technique, 75%-85% survival was recorded.

- Demonstration plots of three bamboo species viz. *B. balcooa, B. nutans* and *D. hamiltonii* at eight sites (20 ha X 8 ha) in North-East were established to demonstrate the field performance of tissue cultured plants.
- Grafting techniques was standardized for propagation of selected adult male and female plants of *Ailanthus excels.* Success rate of grafting increased up to 50% over the earlier method (where success rate was 10% only) developed by AFRI. The plants produced were also used for field evaluation.
- *In Scleichera oleosa***,** besides stem cutting, other macro propagation methods like air-layering and grafting were carried out. On an average more than 50% rooting was observed through these methods.
- Extensive trials were conducted on refinement of macro propagation of common bamboos of eastern India. The role of culm segments, rooting hormones, diverse propagating medium, shading etc. and diversity of rooting and rhizome genesis of different bamboo species was evaluated.
- Propagation of hill bamboos (ringal) was undertaken for mass multiplication through *in-vivo* and *ex-vitro* techniques. Offset planting of *A. falcata, T. falconeri* and *S. jaunsaurensis* revealed 90, 85 and 70% success. Macro-proliferation of Dev and Gol ringal were successfully performed. The species could be multiplied 8-10 times by these techniques in six months period.
- Tissue culture technology for *Swertia chirata* through two regeneration pathways namely, axillary bud proliferation and adventitious bud differentiation was developed.
- Inter and intra-clonal variations were studied with respect to age of the VMGs. Wide inter and intraclonal variations were observed in first coppice shoot production, number and length of coppice shoots. Clone C9 produced maximum shoots. The effect of age on shoot initiation, production, rooting, sprouting, root initiation, time of harvestable shoots was prominent. The best response was in 10 years old hedges. Subsequent growth of propagules was also affected by age of hedges. Older hedges depicted plagiotropy.

Orthotropic Shoot Production

2.3.5 Biotechnology

DNA Profiling

- DNA fingerprinting using SSR markers was carried out to understand the complex genetic structure of trees with particular reference to delineation of provenances and study of genetic diversity, molecular characterization of germplasm, inheritance pattern and establishment of genotype and species specific markers. Presently molecular characterization of Himalayan pines, *Cedrus deodara*, *Tectona grandis*, *Eucalyptus* and shisham germplasm is in progress.
- The genetic and molecular evaluation of 28 clones have been done in sandal. Oil content, carbohydrate, and protein estimation of seeds were completed of all the selected clones.

Some clones with as high as 42% content were recorded. Molecular characterization of all clones using ten RAPD primers (Bangalore Genie Ltd.) has been completed with high numbers of polymorphic bands.

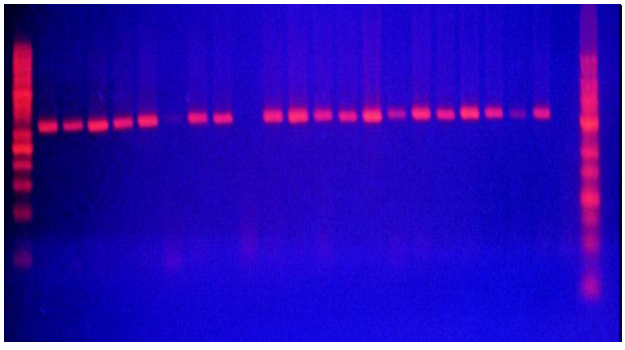
- Development of SSR markers and DNA profiling through Randomly Amplified Polymorphic DNA assay were carried out in *Casuarina equisetifolia*. RAPD assay was optimized and six polymorphic primers used for profiling one hundred and fifty clones of *Casuarina equisetifolia.*
- The short term trainings were provided to approx. 100 M.Sc. (Biotechnology) students of different universities and educational institutions on genetics and biotechnology during the year.

Use of Molecular Markers in Breeding Programmes

Association Analysis of Traits Using STS Markers

Attempts were made to identify potential STS markers for rooting in *Eucalyptus tereticornis* using association analysis approach. *E. tereticornis* exhibits rooting variability from 10- 90 %. Thirty three STS markers linked with rooting, 10 mapped Simple Sequence Repeat (SSR) markers and 10 Expressed Sequence Tag-Simple Sequence Repeats (EST-SSRs) were cross amplified in *E. tereticornis* 30 phenotypes with contrasting rooting potential. The linkage disequilibrium (LD) value (D') ranged from 0.49 to 0.80 and LD decay (r^2) varied from 0.02 to 0.13, which has provided the basic information to select candidate STS markers for identifying marker-trait associations in *E. tereticornis*.

Attempts are also in the process for the identification of molecular marker associated with wood quality traits in *Tectona grandis* L. for which PCR conditions have been standardized for STMS analysis.



STMS Amplification of Genomic DNA of Teak plus Trees withTg19 SSR (L-R): 50bp DNA ladder, APKEA-23, APNPL-9, AC-II, G+10,ST-17, ST-,KLK-1, PT-41, PT-3, MHSC-A3, MHSC-A1, ORBUB-11, ORPBU-6,TNT-8,TNT-10,UP-M,UP-A,WB, WB+4, AI-N, AI-1 and 25bp DNA ladder

Evaluation and Prediction of Oil-bearing Capacity of Sandal (*Santalum album* L.)

Nitrate reductase activity was determined in leaves of 27 selected trees from TP and 3 trees from TO plantation area. TP-1 from TP selection and TO-1 from TO selection had maximum enzyme activity. On the other hand, the lowest enzymatic activity was recorded in TP-6, TP-7 and TO-17 trees among their selections. Peroxidase activity was determined in leaves of selected 30 trees each from TP and TO plantation area. Trees from TP selection exhibited more enzyme activity than those from TO selection.

Quantitative Trait Loci (QTL) Mapping in Eucalypts

Controlled pollination leading to combinations of *E.camaldulensis* x *E. grandis* and *E. tereticornis* x *E. grandis* was completed to generate F_1 hybrids for the establishment of mapping population. Traits such as salt tolerance, adventitious rooting and wood property were chosen in this hybridization work to generate genetic linkage maps. Salt tolerance levels in *E. camaldulensis* clones were assessed at

different stages of sodium chloride treatment for various enzyme systems like super oxide dismutase, catalase, glutothione peroxidase and ascorbate peroxidase to ascertain tolerance/ susceptible levels. Ninety five microsatellite primer sets were tested for their transferability to *E. camaldulensis E. tereticornis* and *E. grandis*, which on successful amplification in parents and F1 hybrids will be used for linkage map construction.

Allelic Diversity of Cinnamoyl CoA Reductase Enzyme Gene in *Casuarina equisetifolia*

Lignin and holocellulose content in wood samples was evaluated in twenty five clonal accessions aged twelve years. The range of holocellulose was 75-80% and lignin was 24-54%. Wood proximate chemical analysis (% ash, Alcohol benzene extractives, water solublity, NaOH solubility) was also done. In twenty five clonal samples Cinnamoyl CoA Reductase **(**CCR) enzyme activity was assessed using Phenyl Ammonia Lyase assay where inconsistent variation was noticeable. Four out of the twenty two CCR (forward & reverse) primers yielded amplified products.

Sex Determination in *Casuarina equisetifolia*

Twelve Isoenzymes Aspartate Amino Transferase (AAT), Alcohol Dehydrogenase (ADH), Esterase, (EST), Polyphenol Oxidase(PPO), Peroxidase(POD), Glutamate Dehydrogenase (GDH), Isocitrate Dehydrogenase (IDH), Superoxide Dismutase (SOD), Malate Dehy Drogenase (MDH), Malic Enzyme (ME), Lactate Dehy Drogenase (LDH) Glucose 6-Phosphate Dehy Drogenase (G-6-PDH) were optimized in *Casuarina equisetifolia*. Twenty four males and twenty three female casuarina clones were screened for five distinct gender specific enzymes (AAT, IDH, ADH, LDH and POD). Peroxidase profiles were found to be very distinct in gender discrimination.

Salinity Tolerance in *Casuarina equisetifolia*

Efforts are on to identify suitable biochemical markers to enable screening of clones of *C. equisetifolia* developed and maintained by IFGTB. Based on the tests, clones suitable for saline and non-saline areas can be categorized. Experiment was conducted to identify the salinity range for exposing the *Casuarina equisetifolia* clones.

Gene Isolation and Functional Analysis

Identification of Secondary Xylem Specific Cellulose Synthase Genes from *Eucalyptus tereticornis*

In silico research was conducted to catalogue and assemble nucleotide and protein sequences of cellulose synthase (CesA) genes and primer pairs were designed and synthesized targeting the CSR II domain of the CesA. The primer pairs were screened and six transcripts representing the six families of CesA were identified in the developing secondary xylem tissues of *E. tereticornis*. Studies are in progress to identify the 3' downstream sequences of the CesA genes.

Differential Analysis of Transcript Expression in *Casuarina–Trichosporium* Interaction to Isolate Defense–Related Genes

Two pathogenesis related genes; chitinase and glucanase were cloned to *Casuarina equisetifolia*, and their expression during pathogen elicitation was studied. Further, major transcripts including cytochrome oxidase, proteasome, signal recognition particle and unknown transcripts with similarity to drought tolerant ESTs were demonstrated to be over expressed during pathogen elicitation.

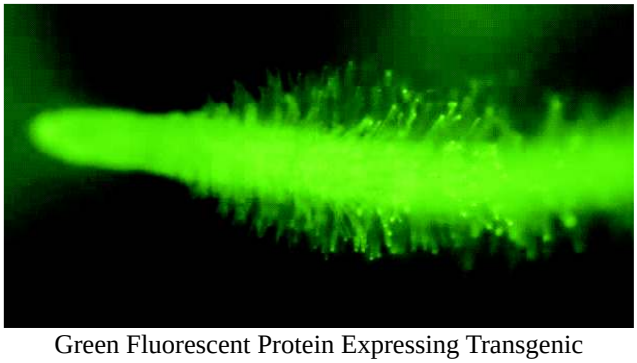
Web Enabled Database and Analysis of Gene Sequences Implicated in Abiotic Stress Tolerance for Screening Gene Homologues in Salt Tolerant Tree Species

To identify genetic determinants of salt stress tolerance in *Casuarina*, 82

Casuarina equisetifolia clones were screened to identify highly salt tolerant and salt susceptible clones.The most susceptible clone could tolerate up to 400 mM, while the most tolerant clone survived for 45 days post 550 mM NaCl stress. While the root to shoot sodium content was close to one in resistant clones, in the case of susceptible clones, shoots accumulated 2 to 3.6 times more sodium than in the roots. The clones will be subjected to differential gene expression analysis.

Development of Methods for Functional Analysis of Genes Involved in Salt Tolerance in *Eucalyptus*

For rapid functional analysis of genes involved in salt tolerance, parameters critical for development of *E. tereticornis* composite plants with transgenic hairy roots were analysed. Identified micropropagated plantlets as suitable explants for obtaining hairy roots and obtained GFP expression in hairy root cultures of *E. tereticornis* tissue cultured shoots. Suitable media for hardening of composite plants in lab environs was determined. Transformation experiments using *A. tumefaciens* harbouring the AtNHX constructs were continued.



Green Fluorescent Protein Expressing Transgenic Hairy Roots of *Eucalyptus tereticornis*

Improvement of White Rot Fungus Strains

Pre-treatment of destructured bamboo chips and non-destructured bamboo chips with different strains of white rot fungi (*Schizophyllum commune, Coriolus versicolor, Ceriporiopsis subvermispora and Flavodon flavus)* was completed. Best fungus *Coriolus versicolor (Tremetes versicolor)* and *Flavodon flavus* after ascertaining the optimum removal of lignin were selected for bulk inoculation and mass growth on chips and mechanical processed chips for further pulping experiments.

Development of Micropropagation Technique

- Tissue culture technology was developed for *Dendrocalamus hamiltonii* and *Gigantochloa atter* through axillary bud culture. In *D. hamiltonii* optimal rooting, i.e. 66.13% was obtained on MS medium supplemented with 25µM IBA and in *G. atter* 47.67% rooting was obtained on MS + 35µM IBA, in four weeks. Rooted plantlets of *D. hamiltonii* were successfully hardened and later transferred for field plantation. Studies were also undertaken to develop an efficient micropropagation protocol for clonal multiplication of *Bambusa tulda*. In spite of the best efforts the frequency of *in-vitro* root induction is very less. Experiments are in progress to enhance the rooting percentage. Experiments are ongoing to study the genetic fidelity of the micropropagated plants of bamboo-*Bambusa bambos* and *Dendrocalamus stocksii.*

- In order to develop tissue culture technology for multiplication of economically important desert plant *Salvadora persica* , surveys of natural stands of *Salvadora persica* were done and CPTs were selected as a source of explants from Jodhpur (Bilara, Caparda and Badi Khurd), Pali (Rohat, Sanderav and Ranakpur) and Jalore (Pandagara, and Suryashwar Mahadev Temple). About 70 per cent bud break and multiple shoot induction (2-3 shoots/explant) were obtained on MS medium supplemented with 4.0mg/l BAP + 0.5mg/l NAA.

- Studies were conducted to scale up the protocols for *in-vitro* propagation,

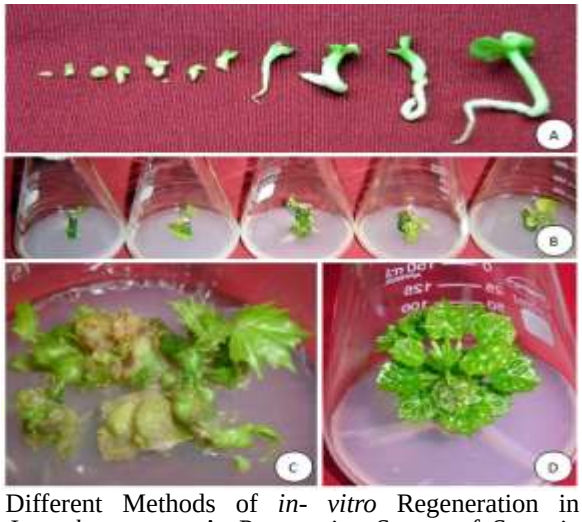
hardening, production of cloned plants and establishment of field trials of Sandal wood (*Santalum album* L). Studies were carried out on the effect of auxins and their conjugates on *ex-vitro* rooting from the *in-vitro* shoots. IBA along with conjugate was found better for *in-vitro* as well as *ex-vitro* rooting.

- For development of micropropagation protocols for production of superior germplasm of *Dalbergia latifolia* and *Pterocarpus santalinus*, aseptic cultures of superior germplasm of *Dalbergia latifolia* and *Pterocarpus santalinus* have been established. Experiments for axillary bud proliferation are in progress.

- Attempts have been made to induce essential oil/oil components of Agar plant under *in-vitro* condition using tissue culture techniques. So far, an efficient callus induction medium has been standardized using leaf tissue. Cell suspension culture has also been established using the callus. At present, experiments are in progress to induce essential oil in this cell culture.

- Attempts were made to develop micro propagation technique for *Aquilaria malaccensis*. Auxiliary buds, as explants have been found best for culture initiation through direct regeneration. Through this technique up to eight (8)-fold shoot multiplication has been achieved. Efforts are being made to increase the rooting frequency in the multiplied shoots**.**

- *In- vitro* plantlet formation *in Jatropha curcas* has been achieved from 3 pathways viz, through axillary bud break, adventitious shoot induction through callus phase and direct somatic embryogenesis.The procedures are being optimized for low cost options for economizing the technology.



Different Methods of *in- vitro* Regeneration in *Jatropha curcas*: A. Progressive Stages of Somatic Embryogenesis, B. Axillary Bud Break from Mature Nodal Segments, C. Adventitious Shoot Regeneration from Leaf Derived Callus and D. Elongated Shoot

Field Trials of Tissue Culture Raised Plants

- Field trials of tissue culture plants of *Bambusa bambos* and *Dendrocalamus strictus* were established at three places, two in Rajasthan and one in Gujarat during July-August 2006 at 5m x 5m spacing. Average height of *Dendrocalamus strictus* was 10 % higher at Dahod (about 4 m) than Kushalgarh (about 4.3 m). In case of *Bambusa bambos*, average height was 50% higher at Dhaod. Similar trends were also observed for number of new culms per clump. Dahod site favoured better growth in terms of number of culms than Kushalgarh site. *D. strictus* produced 16% more new culms and *B. bambos* produced 74% more new culms/clump at Dahod almost after three years.

- Demonstration plot of 50 ha of tissue culture raised and stem cutting raised plants of *Dendrocalamus hamiltonii* was established during 2006 to 2008 by HFRI, Shimla. The tissue culture raised plants were provided to IHBT, Palampur. The growth data for culm length, culm diameter, number of nodes and inter-nodal length were recorded periodically. The survival percentage of TC raised plants was 88% whereas those of SC raised Plants was up to 95%.

2.4 Forest Management

Overview

Field surveys have been conducted to lay out sample plots of commercially important tree species in semi-arid region of Rajasthan. Demand supply gap analysis of important tree species of Eastern U.P. has been conducted and the results of the study were communicated to the various stakeholders through extension material. Market price data of commercially important species of timber, fuel wood and bamboos was collected and brought out in the form of "Timber and Bamboo Trade Bulletin". Databases of gene sequences available in public domain can be exploited for applying bioinformatics for enhancing forest productivity. A lead in this direction is being taken by way of consolidating, categorising and classifying wood forming genes in Eucalyptus. Database on Red sanders (*Pterocarpus santalinus*) has been developed, while databases on deodar (*Cedrus deodara*), kail (*Pinus wallichiana*) and commercial timber information system are in progress. Work is going on for developing a computerised database for forest pathology herbarium, dynamic database for forestry discussion forum, web portal for forestry research extension and GIS/RS based information system on lac production. Besides this, information technology services were provided and maintained at all institutes. ICFRE website was continuously updated.

Projects under the theme

Projects	Completed Projects During the Year	Ongoing Projects	New Projects Initiated During the Year
Plan	02	04	01
Externally aided	00	00	02
Total	**02**	**04**	**03**

2.4.2 Forest Economics

Demand supply gap analysis of important tree species of Eastern U.P. was carried out covering 66 villages of Gorakhpur, 24 villages of Maharajganj, 45 villages of Deoria and 56 villages of Basti. Data were analysed for demand supply gap analysis and current growing stock by tree enumeration studies for all the four districts. The results of the study were communicated to the various stakeholders through extension material.

Market price data of commercially important species of timber, fuelwood and bamboos were collected from selected markets and SFD/Forest Corporation depots all over India. The collected data were compiled, published and disseminated as "Timber and Bamboo Trade Bulletin" to various stakeholders.

2.4.3 Forest Biometrics

A reconnaissance survey of the plantation areas was conducted in semi-arid regions of Rajasthan and 50 plots were selected for productivity and biometrics studies in Jaipur, Ganga Nagar, Sikar, Bikaner, and IGNP areas. Plots were also selected in Jaisalmer and IGNP area for *Prosopis cineraria* and *Ailanthus excelsa*. Permission for felling of required trees has been sought from the SFD. Work has been started on productivity study and growth & yield modelling for teak plantations in Gujarat state. Details of teak plantations in the state has been sought from the SFD.

2.4.4 Information and Communication Technology (ICT)

Information technology services were provided, website was continuously updated and maintained at all institutes. Education and Training in Remote Sensing, GIS and Information Technology was provided. For development of

information system on Deodar (*Cedrus deodara*) and Kail (*Pinus wallichiana*) work is in progress. Computerised database system for pathology herbarium of FRI is being developed.

With a view to using bioinformatics in the study of *Eucalyptus* wood formation, DNA sequences have been downloaded for the following wood formation genes: 4CL, C3H, C4H1, C4H2, CAD, CC0AOMT, CCR, CesA1, CesA3, COMT, EXPANSIN, F5H, GH17, GH28, IRX3, IRX5, LACCASE, PAL, SAM-1, SAM-2, TUBULIN, ACCASE, GH17, GH28, EXPANSIN, CesA2 and COMT. Identification of conserved regions and primer designing was carried out for the above genes.

Web database was developed for Red sanders (*Pterocarpus santalinus*). It contains information about the taxonomy, vernacular names, morphology, physiology, habitat, distribution, tree improvement, properties (anatomical, physical, mechanical and chemical properties), utilization, patent, project, durability, pest and diseases along with a bibliography. Classified information on national and international trade, government rules (import and export rules), illegal activities and availability of wood in depot are also included in the database.

Work was carried out on development of Commercial Timber Information System (CTIS). Model design of website has been prepared. Survey of Bangalore and Chennai markets was conducted to ascertain market price, availability of timber species and their source. In Chennai market, at present Beech wood, Sapplei Log, Ash wood, Dak wood, Cherry wood, Tali log, Gmelina log, Teak, Badak, Venteak, Rubber wood, Silver wood, Neem wood, Kongu, Venkai and Mansa kadambai are available. These are imported from Germany, Ivory Cost, Burma, Togo, Ghana, Ivory Coast, Costa Rica, El Salvador, Panama, South Africa and some other states of India.

The web portal for forestry research extension is being developed for Rajasthan and Gujarat. Training of staff has been completed and fields have been selected for database. Design and layout of website has been completed. Species wise information about the classification, ecology, silviculture, phenology, propagation and utilisation aspects is included in the database. Data of 60 trees species of arid region has been collected and data of 40 more trees species is under process.

A dynamic database is being developed for forestry discussion forum. Database structure has been finalised.

For monitoring of lac host belts in Chotanagpur area, application of GIS/RS is being studied. Distribution pattern of lac host areas is being examined based on host trees. Lac production data have also been obtained. Constraints in lac production have been identified through this process. In some of the areas, the lac hosts are not being used for lac production due to excessive heat or cold, non-availability of broodlac, lack of assistance, training on improved methods of lac cultivation, etc.

2.5 Wood Products

Overview

Aim of present research in the field of wood, its constituents and wood products is to utilize every bit of woody and lignocellulosic raw material available. Current research is focused towards using plantation timber; use of FT-NIR and ultrasonics for wood quality assessment; modification of wood surfaces for enhancing its stability, durability and surface qualities; development of new methods of timber drying; testing of exotics and imported species for their durability and treatability; developing surface coating systems, use of plant extract as preservative and lignin in various by products.

The testing facilities were developed for evaluating the performance/suitability of musical instruments made out of plantation timbers. Studies were carried out on tree-ring analysis (dendrochronology) of teak from Karnataka and Maharashtra which is an innovative research work which showed good potential to know drought years, flood years, insect attack, fire scars and adaptation of species with changes in climate.

The method of laboratory testing for the assessment of the durability of timbers against powder post beetles is standardized. Twenty different imported timber species evaluated for their durability against fungi and termites at Nallal, Palode, Hyderabad, Vishakapatnam, Jodhpur, Jabalpur and Dehradun. All species in the yard tests of different place of origin at Dehradun were moderately to badly attacked by fungi and termite except Australian teak.

Eight species of plantation timber were evaluated for their durability against decay by fungi and termites. *A. mangium* of 10, 15 & 20 years timber can be classified under Class I whereas 5 years comes under Class II. *Eucalyptus tereticornis* showed good resistance against decay by fungi (Class I) *Grewia robusta* belongs to class III and *M. dubia* falls under non-resistance class (IV).

Treatability evaluation is also being carried out of few imported wood species. Seven (*Tectona grandis, Shorea robosta, Shorea marcoptera, Shorea* sp., *Pterocarpus soyauxii, Dryobalanops* sp. and *Xylia dolabriformis*) timbers tested using accelerated tests were found more durable. Different treatment regimes were developed for the treatment of difficult to treat species to give appropriate retention of preservatives. Studies on Eco-friendly preservatives from natural products for durability improvement is also being carried out.

A two step temperature-vacuum schedule has been evolved for the range of 70 % to below FSP for poplar at FRI, Dehradun. The energy and cost saving is very high as for a four-run drying, one needs to run the kiln for just 29 hours. The reduction in moisture contents observed below FSP was of the order of 29 % of the initial value at the best temperature vacuum combination. In another experiment a three-step temperature vacuum schedule has been evolved for the range of 50 % to below FSP for Teak. The energy and cost saving is very high as for drying by this method, one needs to run the kiln for very short time compared to conventional steam heated kilns. The reduction in moisture contents observed below FSP was of the order of 33 % of the initial value at the best temperature vacuum combination.

A conveyor belt Micro Wave (MW) dryer system fabricated, installed at IWST, Bangalore was standardized. MW technique proved to be relatively faster method for drying wood upto fibre saturation point. It has no negative effect on mechanical properties and preservative treatment

of timber. A high quality of drying of bamboo species (*D. stocksii* and *D. strictus)* could be achieved using microwave dryer. The time of drying for bamboo is drastically reduced from several days in conventional kiln drying to few hours in MW drying.

Projects under the theme

Project	Projects Completed During the Year	Ongoing Projects	New Projects Initiated During the Year
Plan	6	13	8
Externally Aided	3	2	3
Total	**09**	**15**	**11**

2.5.2 Wood and other lignocellulosic Composites

Particle boards using lops and tops of poplar, eucalyptus and in combination (three different ratios) were prepared and tested. Experiments were performed at two pressure level, three resin content levels, three sizing agents (wax) %. Particle boards of poplar and eucalyptus were also prepared using 2% of thermally conductive filler with two pressure level and three resin content levels and tested for their various physical and mechanical properties.

Phenol Urea Formaldehyde (PUF) adhesive prepared with five different ratios of phenol: urea: formaldehyde and analyzed for their properties. Using these combinations plywood prepared and tested for glue shear strength.

Jute-Polypropylene and Bamboo–Polypropylene composites prepared and evaluated for mechanical properties and rheological properties. Coupling agent was synthesized by melt phase functionalization of polypropylene (PP) with m-Isopropenyl-dimethylbenzyl-isocyanate (m-TMI) using twin screw extruder. Polypropylene, m-TMI-grafted-PP and nanoclay (in the ratio of 1:1:2) were compounded on torque rheometer. The masterbatch, thus, prepared was compounded with pure PP so as to get PP composites filled with 2.5, 5, 7.5 and 10% of nanoclay. The samples were evaluated for their mechanical behaviour. Rheological properties of the blends were also studied.

Co-polymerization kinetics studies using filler supported catalyst system are undertaken. Design of reactor system including laying of gas feed lines and gas metering system, reactor automation and data acquisition using computers completed at IWST, Bangalore. Preliminary experiments on synthesis of composites using polymerization filling technique completed. Work on studying effect of various parameters like temperature, pressure and catalyst concentration on co-polymerization is in progress.

2.5.3 Wood Processing

An indigenously designed convection heating type vacuum kiln has been installed in the Wood Seasoning Discipline, FRI, Dehradun. Drying behaviour of chir pine timber was studied in this kiln. The drying time of chir pine timber reduced remarkably in the vacuum kiln compared to the conventional steam-heated kiln. The vacuum kiln is going to be a very useful tool for the wood processing industry for their need of seasoned timber.

2.5.4 Value Addition and Utilization

Studies on moisture blocking capacity of different traditional wood finishes with progressive layers of coating on wood surfaces are being undertaken at FRI, Dehradun.

Studies on finger jointing on Indian timbers are being undertaken at FRI, Dehradun with a view to reducing wastage of precious wood material and also to look at the possibility of adopting finger jointing for structural and semi structural uses.

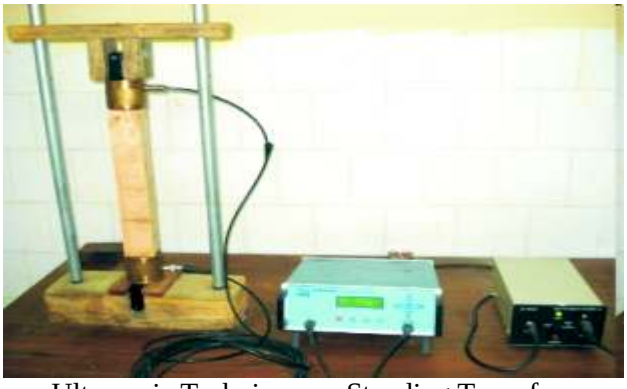
Red, yellow and white meranti were evaluated for treatability. White meranti was easily treatable and classified in class 'a' while red in class 'c' and yellow in class'd'. Douglas fir is easily treatable.

Different preservative treatment schedules were developed by varying treatment conditions like pressure, hot water dipping and diffusion etc., for the treatment of difficult to treat species. The methods of pressure treatment followed by diffusion gave adequate retention with different preservatives (four combinations).

Methanol and hot water extractives isolated from neem leaves gave maximum complexation i.e. 34.24%. Methanolic extractive exhibited 34.24% Copper (II) complexation while hot water exhibited 22% complexation of Copper (II) at 48 h. Malt agar bioassay results revealed efficacy of both the complexes at very low concentration i.e. at 0.002% against brown rot and white rot. Metal Hot Water Complex (CHWC) and Metal Methanolic Complex (MMC) were found very effective against wood decaying fungi i.e. brown rot and white rot in laboratory.

The effect of moisture content; grain orientation; defects (hollowness) on ultrasonic velocity in wood of *Acacia mangium, Grevillea robusta, Shorea robusta, Dalbergia sissoo* and *Tectona grandis* were studied and *Mangifera indica* and developed a relationship which will be helpful in future to detect defects were developed. The strength properties (MOE, MOR, FS at LP) of *Acacia mangium, Grevillea robusta, Shorea robusta, Dalbergia sissoo, Tectona grandis* and *Mangifera indica were studied* by conventional test method and were correlated with the values obtained by ultrasonic method. The ultrasonic technique was tried on standing trees for defect detection.

In another study for evaluation of wood and wood products in use by ultrasonic, three field visits were conducted and detailed survey was made for finding used wood and wood products, wooden logs and wooden structure fixed in market of Karnataka. (Timber Yard



Ultrasonic Technique on Standing Trees for Defect Detection

Survey – 6, Saw mill Survey - 6, *in-situ* structures survey - 6). Purchased the used wood and wood products. Identified *in-situ* structures/wood products (10). Samples prepared as per IS 1708 – 1986 for specific gravity (30) and static bending (30) tests.

Studies carried out on *Acacia mangium* procured from Orissa indicate the timber is dimensionally steady and grouped along with *D. sissoo* and *Adina cordifolia*. The timber was dried in dehumidifier kiln for 47 days to attain 18% moisture content from initial moisture content of 80%. Studies on anatomical properties for all the trees completed. Mechanical properties like Compression, Static bending, Hardness, Shear, Tension, Nail and Screw holding were evaluated in green and dry condition. Installation of preservative samples at

Chair Made Out of *Acacia*

Nallal for durability study completed. Periodic inspection was carried out to study the extent of damage. The timber was subjected to various handicrafts working quality and found suitable for carving, turning etc.

Sound absorption coefficient and effect of different wood parameters (grain orientation and thickness) in *Azadirachta indica, Eucalyptus tereticornis, Grevillea robusta, Melia composite* and *Tectona grandis* on sound absorption coefficient was determined. Also determined anatomical and strength properties of all species. Data generated on acoustical properties will help in selection of non-conventional timber species for utilizing as sound insulation material for paneling in the buildings. Generated data on commercially available 3 musical instruments (veena, violin and dholak). Studied the effect of anatomical parameters and strength properties on frequency spectrum generated by the commercially available musical instruments. Got fabricated veena and dholak from plantation species. Analysed the data obtained on frequency spectrum generated by musical instruments and found the suitability of species for musical instruments based on frequency spectrum and damping coefficients. Project completion report submitted to funding agency (CSIR).

Setup for Testing Musical Instruments

A Microwave dryer system was fabricated, installed and standardized at IWST Bangalore. Treatment of silver oak, eucalyptus, teak, rubber wood and *Gmelina arborea* with varying thickness and time was studied. Comparison of drying behaviour of microwave treated and untreated wood was analysed. Ray cell of silver oak and eucalyptus were found to rupture by MW treatment for 20 minutes. Dehumidification drying characteristics of MW treated and untreated wood was carried out for all the five species. Effect of microwave treatment on treatability of rubber wood, silver oak, teak wood and *Gmelina arborea* was evaluated. It is observed that rubber wood lost more moisture. Effect of microwave treatment on drying of wood has been studied on 2 inch thick planks. Mechanical and physical properties of MW treated samples have been evaluated. The technology of microwave drying was demonstrated and explained to wood exporter and importer at Mangalore and at VVK Bangalore.

The method of laboratory testing for the assessment of the durability of timbers against powder post beetles was standardized to include in the BIS standards. Adults and larvae of *Lyctus africanus* and *Sinoxylon conigerum* were employed as the test insects and studying the durability of plantation timbers against borers. Natural durability of *Mesopsis eminii, Hevea brasiliensis, Grewilia robusta, Acacia mangium, Melia dubia* and *Acacia auriculaeformis* against the beetles were tested. Wood treated with neem products, CNSL, extractives from *Dysoxylum malabaricum, Cleistanthus collinus, insecticides, C*hlorpyriphos and Imidachloprid and tree seed oils *were* tested by exposure of adults and larvae of *L. africanus* and *S. conigerum.*

Indian Wood Insect Database (IWID), a web based database for Indian wood insects was developed in collaboration with FRI, Dehradun. The insect museums in different research institutions, universities, national collections at ZSIs and BSI were visited and wood insects documented. The data pertaining to about 1000 wood species and 2500 wood insects have been entered into the database. The database is an open

ended one and it is accessible worldwide and facilities for registration and contribution are inbuilt in the database. The database was launched by Director General, ICFRE at IWST, Bangalore on 10th December 2009. The database has been uploaded on ICFRE server on 22nd December 2009.

An anatomical approach was applied to evaluate treatability of timbers. Specific gravity of *Acacia mangium* and *Hevea braziliensis* was *determined.* Samples were treated with 5% silver nitrate followed by 2% hydrazine hydrochloride and exposed to bright sunlight. Observed penetration of preservative to carry out qualitative analysis of absorption. Photomicrographs of the same were taken under stereo microscope. Specific gravity of the treated wood samples was determined and quantitative analysis of absorption was carried out. Sections were cut to see the impregnation of chemicals under microscope. Totally 5 species (*A. mangium, A. aurculiformis, H. brasiliensis, G. arborea* and *G. robusta*) were completed. Completed qualitative and quantitative analysis of wood samples treated with silver nitrate. Treatment of samples with red oil was started. Sections of the samples of all the 5 species were taken to find out the stains.

Effect of moisture content and diameter on the treatability using vacuum impregnation method was undertaken on *Calamus thwaitesii* (cane). Prophylactic treatment was given with 2% Boric acid. Green and dried cane specimens were treated with two different preservatives, (CCB and boric acid) by vacuum pressure impregnation method following three different treatment schedules. Absorption of preservative is calculated on weight gain basis. Qualitative analysis by spot test and quantitative analysis of 10 specimens for each set by chemical assay method was completed. Further work is under progress.

Under the study on tree ring analysis of certain species in Western Ghats to monitor climate changes and its relevance to wood quality, teak discs were collected from Madikeri, Mundagod of Karnataka and Thane, Chandrapur from Maharashtra. Collected meteorological data and information on sites from Karnataka and Maharashtra. Teak samples were prepared by using special technique to expose growth rings. Training provided to JRFs at IITM, Pune for handling COFECHA and ARSTAN programmes in tree ring analysis. Specific gravity, ring width and age of 36 discs completed from Karnataka and Maharashtra. Study on vessel morphology completed for all 36 discs.Cross dating and standardization of discs carried out using COFECHA and ARSTAN programme, respectively. Specific gravity, ring width and age by ring counting. Collection and sending to expose growth rings completed for 6 core samples of *Myristica* spp. Correlation and data analysis for chronology development and wood quality completed for all teak discs from Karnataka and Maharashtra. Determination of age of 6 cores of *Myristica* spp. completed. Among vessel morphology, only vessel density of *Myristica* spp. from Sirsi (Karnataka) is completed.

In the study on the permeability of selected imported timbers marketed in Karnataka, five species of imported timbers viz., *Xylia dolabriformis* (Pyinkado), *Instia bijuga* (Merabau), *Dipterocarpus* spp. (Gurjan) and two *Shorea* spp. (Red meranti and Balau) marketed in Karnataka were procured. One hundred fifty experimental samples from each species (size: 22mm x 22mm x 22mm) were made. After conditioning of these samples, flow measurements were being recorded. On the other hand, test stakes of all five species (size: 19mm x 19mm x 450 mm) were exposed under field

condition. Periodical observation was in progress to evaluate their service life under field condition.

In an effort to study the performance of coatings on modified wood surfaces work on reaction conditions of acetylation and benzoylation were standardized. Stands for natural weathering were designed and fabricated. The chemically modified wood panels (benzoylated and acetylated) of Rubber wood and *Pinus radiata* with average weight gains of 10-15% were prepared. Modified and unmodified wood panels were coated with a transparent and opaque polyurethane exterior paint. The coated and uncoated panels have been exposed to outdoor weathering and samples are being examined for weathering deteriorations. Screening and procurement of UV absorbers were completed.

In another study, chemical modification of wood using octanoyl and lauoryl chloride carried out and reaction parameters are being optimized. Basic experiments on chemical modification of wood using alkylene epoxides viz., propylene oxode and butylene oxide carried out. Esterified/etherified wood was characterized using FTIR and NMR spectroscopy.

For improvement of weathering properties of wood surfaces by chemical modification, basic experiments using phenyl isothiocyanate were carried out. Study of dimensional stability, decay resistance and light stability of phenyl isothiocyanate modified rubberwood was carried out. Modified wood samples exhibited good dimensional stability and fungal resistance but not effective in decreasing photo yellowing.

2.5.5 Pulp and Paper

Modified lignin product from mill I and mill II prepared by passing SO_2 gas at optimized conditions were analyzed for their chemical composition and tested for their performance as solvent for isolated lignin, as dispersing agent/emulsifiers and possible use as an oil well drilling additives. It was found that lignin as well as modified lignin products made from soda spent black liquor of both the mills are more stable at higher temperature upto 900^0C as compared to lignin from both the mills as the IPDT values are higher in case of modified lignin's of both the mills which shows slow decomposition at high temperature and can find application where the higher operating temperature is required. As far as their application as solvent for isolated lignin are concerned, lignin modified from soda spent black liquor from both the mills can find application as an additive for organosolv pulping particularly to overcome precipitation of lignin onto pulp fibres during washing but from mill II the results are better under the optimized conditions under which the product were prepared. Testing of modified lignin samples prepared from both the mills for application as dispersing agent/ emulsifier in terms of reduction in Standard Dispersion Number (SDN) indicates that these can find application as binder in rubber industry. Modified lignin from soda spent black liquor of both the mills passed the physical characteristics viz. Physical state, moisture content & water solubility as per the specification for oil well field chemicals. Although rheological properties in terms of apparent viscosity (cp) & yield point (lbs./100 sq.ft.) lowered in modified products prepared from liquor of both the mills but could not exactly match the required specification.

2.6 Non Wood Forest Products

Overview

Researches on medicinal plants focusing on survey, development of Organic cultivation technology, its post harvest processing including development of value addition processes, bioactivity evaluation, sustainable management and resource development through forest enrichment with natural species have been undertaken by various institutes of ICFRE. Research studies focusing on chemical profiling of wild edibles and other useful NWFPs have been undertaken. Researches have also been undertaken on Tree borne oil seeds including chemical analysis of fatty oils yielded thereof. National Multiplicational trials of different provenances and clones of *Jatropha curcas* in various states under jurisdiction of ICFRE institutes have been undertaken. Chemical analysis of various NTFPs have been undertaken to develop processes for their commercial utilization. Planting materials of various NTFP species including medicinal plants have been raised and supplied to farmers for encouraging their cultivation.

Projects under the theme

Project	Projects Completed During the Year	Ongoing Projects	New Projects Initiated During the Year
Plan	9	20	12
Externally Aided	5	17	1
Total	**14**	**37**	**13**

2.6.2. Resource Development of NWFPs

Organic Cultivation of tulsi *(Ocimum sanctum)*, shatavar (*Asparagus racemosus)* and sarpagandha (*Rauvolfia serpentina)* have been developed. As many as 65 diseases affecting 49 species of important medicinal and aromatic plants in Uttarakhand, have been identified out of which 28 are new diseases.

Development of Conservation Site

Rheum australe Transplantation

Berginia ligulata

Picrorhiza kurrooa

Valeriana wallichii

Extensive survey for identification of superior chemotypes and *ex-situ* conservation of *Podophyllum hexandrum* Royle from Himachal Pradesh and Jammu & Kashmir (Laddakh Valley) have been carried out.

Podophyllum hexandrum Study at Triloknath (H.P.)

Picrorhiza kurrooa Study Site at Tino, L&S (H.P)

Quality planting material of Atish (*Aconitum heterophyllum*) and Chora (*Angelica glauca*) were multiplied in different nurseries at HFRI. Out of the 3.6 lakh seedlings, around 2.70 lakh distributed to various end users for cultivation and further multiplication. The Institute and its network partners carried out extensive survey throughout North-Western Himalayas (Himachal Pradesh and Uttarakhand) to carryout population assessment and identification of superior genetic stock of *Picrorhiza kurrooa* Royle ex Benth and *Valeriana jatamansi* Jones.

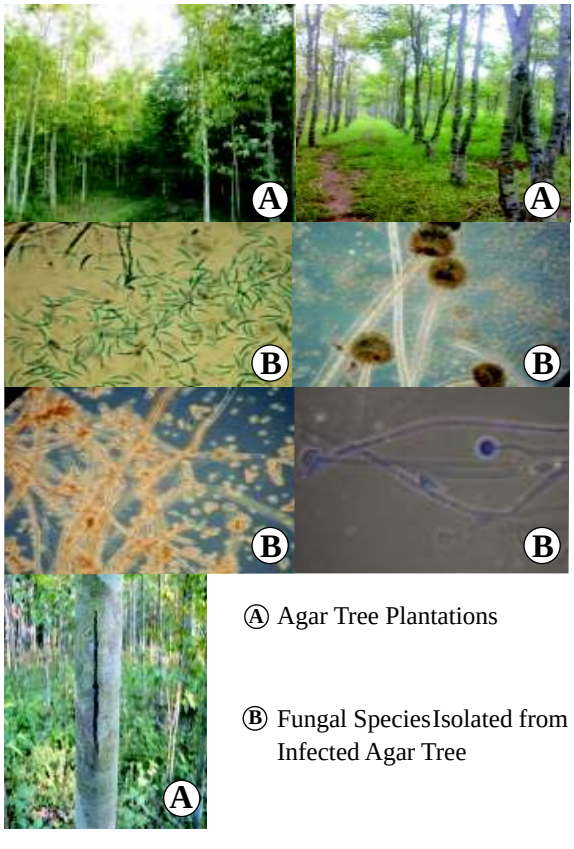
Atish Stock at Shillaru Nursery

Training Programme at Brundhar, Manali (H.P.)

Fatty oils from seeds of tree species *Givotia rottleriformis* Griff., *Madhuca insignis* (Radlk.) H.J.Lam, *Shorea tumbuggaia* Roxb, *Poeciloneuron indicum* Bedd, *Hopea parviflora* Bedd, *Mesua ferrea* L. and *Balanites roxburghii* Planch have been extracted. This is still in progress.

Aspects on propagation, agro-forestry models, protection, processing and utilization of major bamboo species, *Bambusa bambos, B. nutans, B. balcooa, B. pallida, B. tulda, Dendrocalamus asper, D. brandisii, D. hamiltonii, D. stocksii, D. strictus,* and *Guadua angustifolia* are in progress.

Identified the associated fungi and studied the impact of climate and soil factors in agarwood formation for standardization of artificial technique to promote agarwood in *Aquilaria malaccensis* in six districts (Jorhat, Sibsagar, Golaghat, Nagaon, Tezpur and Rural Kamrup) of Assam.



Ⓐ Agar Tree Plantations

Ⓑ Fungal Species Isolated from Infected Agar Tree

Effect of fertilizer application on growth and yield of ten years old *Salvadora persica* on arid salt affected soil, has been studied and zinc application has been observed to enhance the fruit yield. Performance trial and agritrial of guggal are in progress.

Exploration and documentation of indigenous knowledge of phyto resources among Mishing tribe of Assam was done. Documentation of 110 wild edible plants used by people of Kinnaur district of Himachal Pradesh has been done.

A total of 300 samples of NTFPs and medicinal herbs were collected from different markets and a database is being maintained showing the details of the markets from where the NTFPs were sold in Jharkhand state.

SUCCESS STORY

Cultivation protocols for three important medicinal and aromatic plants such as tulsi (*Ocimum sanctum*), shatavar (*Asparagus racemosus*) and sarpagandha (*Rauvolfia serpentina*) have been developed at FRI.

- Tulsi cultivation fertilized with organic compost (FYM) and Vermicomposts (V) mixture (@ 12.5t/ha & 6.25 t/ha, respectively, gave the highest herbage tulsi dry yield of 564 kg/acre. Techniques for harvesting of tulsi leaves for use in ayurvedic and as herbal tea can be done four times during its growing season.
- High yield of shatavar to the tune of 3000 kgs dry roots per acre can be achieved in 20 months by fertilizing the plantation site with organic compost FYM and vermicomposts @ 12.5 + 12.5t/ha.
- High yield of sarpagandha upto 372 kg dry root per acre from plants raised through root cuttings can be obtained in 20 months by applying FYM and Vermicomposts @ 12.5 and 6.25 mt/ha.
- Mulchings using leaf litters are effective in controlling weeds and also in conserving moisture. The technique developed is very useful to the small and marginal farmers in raising their income from small land holdings.

2.6.3. Sustainable Harvesting and Management.

Non-destructive harvesting technique of medicinal plant namely *Berginia ligulata, Picrorhiza kurrooa, Valeriana wallichii* and *Rheum australe* have been developed. Field trials for in-situ resource enhancement of *Microstylis wallichii* carried out in 3 natural forest areas of Uttarakhand state. The productivity studies are in progress.

Sustainable harvesting of medicinal plants viz. *Andorgraphis paniculata, Asparagus recemosus, Chlorophytum borivillianum* and Chironji fruits, *Buchnania lanzan* was studied. Harvesting of 80% *A. paniculata*, 60% *A. recemosus* and *C. borivillianum* was proved sustainable without affecting the regeneration. Regeneration of *B. lanzan* was found unaffected even on the harvest of 90% fruits.

Experiments have been initiated to standardize the various means of sustainable harvesting methods such as strip harvesting, alternate harvesting and opposite harvesting of barks from tree trunk, branch, twig, leaves,

flowers, roots, etc. of *Bauhinia veriegata*, *Holorrhena antidysentrica*, *Oroxylum indicum*, *Saraca asoka* and *Terminalia arjuna*.

Development of clump management practices for economically important bamboo species for enhanced production of quality culms and edible shoots.

Seed handling of important NTFPs of Tamil Nadu and Kerala states, seed handling of medicinal plants and post harvest techniques of *Jatropha curcas* were disseminated through posters, pamphlets and trainings.

Two pamphlets and a booklet in simple Hindi on cultivation of Atish and Chora for the benefit of end users were published and distributed among beneficiaries.

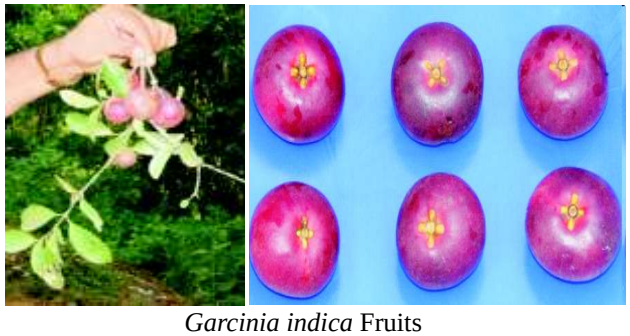
2.6.4. Chemistry of NWFPs, Value Addition and Utilisation

Active principle/ chemical analysis was undertaken for up to 12 months after storage under different storage conditions following both Ayurvedic and Modern analytical methods for medicinal plants namely *Asparagus racemosus*, *Rauvolfia serpentina*, *Withania somnifera*, *Aconitum heterophyllum* and *Picrorhiza kurrooa*.

Extraction of aromatic oil and its component are being studied from *Thymus serpyllum* at 3 stages of growth like before flowering, just at the time of flower initiation and during full bloom state. Initial result indicated that Oil percent is not much varied in wild and cultivated plant but the percentage of thymol & other compounds were highly increased in cultivated form compared with samples from wild.

Researches on Bioactivity of crude powder made from leaves, ripen and unripen fruit of *Aegle marmelos* on test organism has been undertaken at IFGTB, Coimbatore.

Fruits of *Garcinia indica* were collected from Subramanya and Puttur of Karnataka. Testing of two distinct fractions along with the crude extract for anti-diabetic property in mice by Streptozotocin induced model for Type-I and Type-II diabetes is in progress.



Garcinia indica Fruits

Processing and Drying of Fruits

L-DOPA contents in seeds of *Mucuna pruriens* Linn. from different areas of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu were estimated. It was observed that white seeds yielded less (3.12% w/w) compared to black mottled seeds (4.5% w/w).

Seeds of *Mucuna pruriens* Linn. from Different Areas

Physical and chemical properties of polysaccharides in the tubers of *Curcuma augustifolia*, *C. pseudomontana*, *Dioscorea bulbifera* and *D. hispida* and seeds and aerial parts of *Hyptis suaveolens* were studied.

Nutritive value of bamboo shoots was also investigated. Boiling shoots of *Bambusa tulda* and *Dendrocalamus strictus* in 1% NaCl solution in water for 15 minutes, *D. asper* in 5% NaCl for 10 minutes and *B. bamboos* in 5% NaCL for 15 minutes proved best for removal of anti-nutrients. Different products like bari, pickels, papad, petha, sauce and cruches were made from the shoots.

SUCCESS STORY

Products from Hadjor, *Cissus quadrangularis*

Cissus quadrangularis (Hadjor) plant samples were collected from Chhindwara, Bhopal, Jabalpur (Madhya Pradesh), Nagarjuna Botanical Garden, Akola, Nagpur (Maharashtra), Janjgir, Raigarh (Chhattisgarh) and NRCAF, Jhansi, and established in nursery beds of the Centre and are being maintained. Fresh stem samples were collected on monthly basis and analysed for total phytosterols, ascorbic acid, macroelements and trace elements content. Macroelements viz. calcium, magnesium, potassium were analyzed and trace elements viz. zinc, copper, manganese, iron and selenium content were estimated on AAS. All the parameters have a synergistic effect on bone fracture healing, bone related problems and general weakness. Analysis of active constituents viz. total phytosterols and ascorbic acid in *C. quadrangularis* fresh stem samples collected from various places were also done simultaneously. The sample collected from Chhindwara was found to be the best in total phytosterols content followed by Akola. The sample collected from Piparia was best followed by Raigarh in terms of its ascorbic acid content. The best harvesting time based on its active chemical constituents was found to be December to March. Survey was conducted in some places of Chhattisgarh and Madhya Pradesh viz. Rajnandgaon, Khairagarh, Kapsi, Tamia and Betul district and collected information from the tribals and traditional herbal healers regarding their knowledge on best harvesting time of *C. quadrangularis*.

Nutraceutical Food Products (squash, jelly, biscuits, cookies, chutney and pickle) Developed of *Cissus quadrangularis* Stem.

Stems (peel and core) *C. quadrangularis* were analyzed separately for moisture, yield, ash, phytosterols, ascorbic acid and phenols. Maximum amount of active constituents was found in peel as compared to pulp. Dehydration studies of stem were carried out from Department of Food Technology, Nagpur University, Nagpur which included solar drying, shade drying, oven drying and radio frequency drying treatments. Radio frequency drying method was found to be the best followed by shade drying in retaining maximum amount of active constituent. From economic point of view, shade drying could be recommended for large scale drying of the herb. Technology was developed for formulation of nutraceutical food products. Six nutraceutical food products viz. biscuits, cookies, jelly, squash, chutney and pickle were developed as per FPO (Food Products Order) & Prevention of Food Adulteration Act (PFAA) specifications in collaboration with Dept. of Food Technology, Nagpur. All the products were tested for consumer acceptance level by conducting the chemical and sensory evaluation of the finished products. The research results were disseminated to the user groups through training programmes. Brochures were published in English and Hindi.

An organometalic complex has been prepared by complexing Cu^{++} and Cr^{+++} ions with plant leaf extractives of *Prosopis juliflora* and *Cleistanthus collinus* as organic ligands. This complex is being evaluated as a wood preservative by measuring the anti-fungal, anti-termite and anti-insect activity. Initial results indicated strong inhibition of fungi by the extractive. Studies on anti-termite, anti-insect activity of the complex are in progress.

Tubers of *Asparagus racemosus* were sown in nursery beds and 70% sprouting was recorded at a depth of 2.5 to 5 cms. The data showed that size of the tuber grown in stress condition are comparatively bigger than the irrigated one. Chemical analysis of tubers for saponin indicated large variation at all the selected sites.

Studies on phyto-proteins from selected plants of North-East region for the production of protein concentrates with greater food value were undertaken.

Chemical constituents imparting durability to wood and pest resistance to leaves of Eucalypt hybrids were identified. Heritability and other genetic parameters for wood and foliage constituents and their genetic correlation were also established.

Quantitative variation of bioactive ursolic acid in foliage of different physiological stages was studied using HPTLC.

Chemical constituents from ethnobotanically important medicinal plants– *Pavetta indica* and *Scindapsus officinalis* were isolated and characterized.

Extraction of the seed kernel was done with solvents of elutropic series viz. petroleum ether, chloroform and methanol. Fractionation of the methanol extract was done in ethyl acetate and butanol fractions. A process is being optimized to prepare hederagenin from seed kernel extract. The extracts prepared were tested against 8 forest fungi namely, *Alternaria* sp., *Colletotrichum gloesporioides*, *Phoma* sp., *Phomopsis dalbergiae, Fusarium oxysporum, Ganoderma lucidum, Rhizoctonia solani* and *Trichoderma pilluliferum* at different concentrations i.e. 0.5, 1.0, 1.5 and 2.0 per cent.

Carboxymethyl Cellulose (CMC) was prepared from α-cellulose isolated from *Lantana camara.* Reaction conditions were optimized for grafting of alpha cellulose with acrylamide.

Petroleum ether, Chloroform and methanol extracts of *Malaxis acuminata* pseudobulbs, *Drymaria cordata* (whole plant) and *Mussaenda glabra* (bark) were prepared. Fractionation of the methanol extract was done in ethyl acetate and butanol fractions. Column chromatography of the petroleum ether extracts of *Drymaria cordata* (1:1) resulted in isolation of a pure compound. It was found to be β-sitosterol. Two more compounds were isolated from the above extract.

Fruits of *Diospyros peregrina* were fractionated to obtain 4 fractions i.e. chelator soluble pectic fraction, carbonate soluble pectic fraction, alkali soluble hemicellulosic fraction and cellulosic residue fraction and their chemical investigations were carried out. Variations in chelator soluble pectin fraction, carbonate soluble pectin fraction, alkali soluble hemicellulose and cellulosic residue with fruit ripening is in progress.

Water extract of roots of *Achyranthes bidentata* and two pure compounds isolated from A*chyranthes aspera* seeds exhibited 92% maturity of silkworm *Bombyx mori* L. in 18 hrs. While in case of control, only 69% maturity was observed in 28 hrs. Three formulations were developed namely ASM, ARW, ABRW and tested at Sericulture Research Station, Sahaspur on *Bombyx mori* L. at rearing house.

Generally spinning of silkworm of *Bombyx mori* L. takes 24 to 36 hrs. for completion. In our study, spinning completed in 15-18 hrs. Due to shortening of time period, consumption of mulberry leaf was less and uniform spinning was obtained. This will help at the time of scarcity of mulberry leaves.The above formulations will be useful to farmers in rearing of silk worm with very good cocoon quality. The main achievement of this project is reduction of spinning time period just half of normal time.

Significant yield of dyes were achieved from aerial parts of *Tagetes minuta* and fruit pericarp of *Terminalia chebula* under optimized conditions. Dyeing of textile samples (silk, wool and cotton) followed by mordanting and determination of colour coordinates have indicated good colourfastness properties of dyed fabrics using the dye isolated from both the plants.

Ten dye plant species were identified, collected/procured and processed for extraction of dye. Dyeing trials on human hair with the extracted dyes were also carried out.

Bacccaurea sapida (common name– Leteku) & *Aporusa dioica* (common name– Tamsir) and *Biscofia javanica* (common name– Urium) were identified for making dye. Plant material was collected & processed for extraction of dye. The plant material was extracted for material to liquor ratio & time for isolation of dye from two species has been optimized. Herbarium maintained & identified from BSI, Shillong.

2.6.5 Biofuels and Bioenergy

Multilocational trials of 9 superior accessions of *Jatropha curcas* were raised at TFRI, Jabalpur in 2008 and 19 accessions in 2009. On the basis of growth attributes, two accessions HAP-41 and HAP-44 (Garhwal, Uttarakhand) were recorded to give higher number of branches without prunning.

A national multilocation trial comprising of 36 accessions of Jatropha were established at TFRI, Jabalpur. Accession TFRI-2 performed better with respect to growth, number and size of fruits. Raised performance trial from 24 elite accessions, native trials from 160 accessions and spacing and pollarding trials of *Jatropha curcas*. Clonal trials and seedling seed orchard of *Jatropha curcas were* established Progeny trials of 30 CPTs of *J. curcas* selected from Rajasthan and Gujarat were also established.

Jatropha Plants after Pruning

Jatropha Fruiting

Demonstration - cum - experimental plantations of *Jatropha curcas* was established on 23 has. of area in Himachal Pradesh. Experimental trial with 10 superior accessions of *Jatropha curcas* has been established in Himachal Pradesh.

Rooted Cuttings Trial at Solag (Bilaspur)

Half-sib Trial at Jawalaji (Kangra)

Maximum reducing sugars was obtained 40.2 g/l (66.65 %) in *Lantana camara* and 33.9 g/l (56.20%) in case of pine needles.

Interesting results were obtained first under current study when lignocellulosic hydrolyzate obtained after hydrolysis was further heated under optimized conditions. After heating there was an increase in Total Reducing Sugars (TRS) content.

Pre-extraction of lignocellulosic biomass (*Lantana camara* and Pine needle) with different solvents resulted reduction in phenolic content (a measure of toxicity) after hydrolysis. *Lantana camara* after pre-extraction with solvent methanol reduced the phenolic content by 18.9% and Pine needle after extraction with solvent alcohol-benzene resulted reduction in phenolic content by 65.92% after hydrolysis.

Fermentation efficiency was increased by using different medium instead of conventional medium. Fermentation efficiency was increased from 77.27% to 80.72% in case of *Lantana camara* and from 78.93% to 79.75% case of Pine needle.

National trial comprising of 5 accessions and zonal trial of 17 accessions were established at institute campus in the year 2005 and 2006. TNMP-14 and RAK-5 are performing better in national trial whereas IGAU-1 and IGAU-2, JNKVV-29 and JNKVV-15 in zonal trial. A progeny trial comprising of 20 progenies was established at Balaghat. Kushmeli Chhindwara, Sikharpur, Chhindwara and Lalpur Satna were found most promising genotype among other progenies. The fruiting was observed in IGAU-3 accession of zonal trial.

Different type of wood wastes were collected from sawmills and its physical properties were studied. Calorific value, proximate and elemental analysis of collected wood waste were also analysed. Wood chips, bamboo chips and saw dust were oven dried for biomass gasification.

Gasifier

Producer Gas

2.7 Forest Protection

Overview

Research projects on insect pests and disease problems of forest plant species are being carried at ICFRE institutes. Integrated methods of management with special emphasis on host plant resistance against insect pests and pathogens have been worked out. Application of beneficial microorganisms for improvement of biomass production of the tree species and management of key insect pests and pathogens has been carried out.

Insect Pests

- Database was developed in MS-ACCESS with several tables, forms and queries for computerization of National Forest Insect Collection. Data entry of all the 18,000 species was done in the database along with their physical verification and photos. For putting this database on net, it was converted into My SQL, PHP form.
- One new genus and 13 new species of encyrtids were described as new to science and two new records from India.
- Acetone, methanol and petroleum ether extracts of Tagetes minuta at 2% concentration caused 30-50% mortality of larvae of major insect pests of shisham and poplar.
- Biology of the bamboo borer, *Phloeobius crassicollis* was studied in detail in the laboratory.
- Relative resistance in selected clones of *Casuarina equisetifolia* against the bark feeding borer, *Indarbela quadrinotata* was identified through analysis of biochemical and physical nature of the clones.
- One hundred clones of eucalypts at three different agro-climatic zones of Tamil Nadu, Andhra Pradesh and Kerala were categorized for resistance/tolerance and susceptibility against the gall insect, *Leptocybe invasa*.
- In all, 19 fouling and 11 wood boring species were found to be new introductions to Visakhapatnam port and, of these, the annelid *Hydroides operculatus* (Treadwell) and the mollusc *Siphonaria* cf. *kurracheenensis* Reeve were recorded for the first time from India.
- Test panels of *Bombax ceiba* and *Paraserianthes falcataria* treated with TBTM-MMA preservative undergoing marine trials at Visakhapatnam and Kochi harbours showed that a few panels at the latter harbour were attacked by sphaeromatid wood borers in 23 months.
- A wood boring gastropod, *Thais blanfordi* (Melvill) was recorded for the first time from the fouling assemblages along the east coast.
- Attack of stem borer, *Botocera rufomaculata*, which girdles the main tree bole was found to be controlled by injecting 10 ml water emulsion of 0.5% dichlorvos.
- Petroleum ether extract of seeds of *Annona squamosa* was recorded to exhibit 72.99 to 75.43% antifeedant activity against the larvae of *Eutectona machaeralis* and *Hyblaea puera*. Foliar spraying of 0.5% neem commercial formulation was recorded to inhibit 80% egg laying, besides 90% antifeedant effect on young larvae.
- Soil treatment with phorate or methyl folidal @ 300gm/bed (size 12m x 1.25m) in combination and alternatively with EPN juveniles @ 250-300/ bed proved effective

in reducing the seedling mortality by root feeding white grubs.

- Seedlings treated with monocrotophos (0.01%) and kept under canopy in exclusion trials, laid down at Rajasthan and Gujarat, exhibited the best average growth performance in almost all the parameters after a period of 48 weeks.
- Thirty seven insect species belonging to 5 insect orders viz. Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Hymenoptera and 24 families, Class Arachnida, were found to be associated with 5 temperate medicinal plants in the nurseries.
- *Polygraphus longifolia* appears in the chir pine forest earlier and attack the weak tree first, thereafter other insect stem borers made the tree their destiny for food, shelter and egg laying. Fire incidence and excessive resin tapping increased the susceptibility of the trees to the beetle incidence. Neem oil @ 5% acts as repellent and is effective in preventing the beetles attack.
- *Metarhizium* based mycoinsecticide product named PESTSTAT **(**in powder and liquid forms), is developed and is ready for release and application in the field.

Diseases, Pathogens and Beneficial Microbes

- Resistant and susceptible clones of *Dalbergia sissoo* have been identified against *Fusarium solani* causing vascular wilt.
- On the basis of DNA sequencing, two species of *Ganoderma*, *G. resinaceum* and *G. weberianum* have been separated from the collection. The latter is a new record for India. Fifty one ITS sequences have been submitted to Gen Bank, (National Centre for Biotechnology Information), USA and have been released at NCBI web site.
- Volatile effect of citronella oil, garlic oil, lemongrass oil and ajwain oil to inhibit growth and germination of spoilage fungi in stored medicinal plant produce was successfully established.
- Diagnostic kit was developed after standardizing protocols for DNA extraction of *Cylindrocladium quinqueseptatum* from soil, diseased plant parts and post-inoculation pre-symptomatic Eucalyptus plant samples infected with leaf, twig and seedling blight which will be helpful in identification of the pathogen and for disease forecasting.
- Fifteen 18S rDNA gene and twenty eight internal transcribed spacer region of nuclear rDNA gene of different isolates of fungus *Cordyceps sinensis* of Himalayan meadows were amplified, sequenced and submitted to NCBI and accession numbers were allotted.
- *Aspergillus flavus*, *Curvularia* sp. and *Fusarium* sp. were found infesting CCA treated timber wafers of *Anogeissus acuminata* (Yon) and *Mangifera indica* (Mango) even at a preservative retention of 27.6 $kg.m^{-3}$.
- Four genera and seven species of wood-decaying fungi have been recorded for the first time on sal and bijasal stored wood.
- Severe infestation of insect pest (*Achaea janata*) and charcoal root rot disease, caused by *Rhizoctonia bataticola*, have been recorded on mehndi (*Lawsonia inermis*) in Pali and Sojat in Rajasthan.
- Microbial inoculants, *Bacillus megaterium*, *Pseudomonas fluoresens*, *Azotobacter*

chroococum and *Azospirillum brasilense* inoculated to the stem cuttings of Eucalypts clones enhanced the rooting 40 % more than the IBA treated cuttings.

- Artificial inoculation of the six isolates of *Frankia* on *Casuarina* cuttings raised in inert media exhibited that the strain CjCbe1 produced higher nodules (7/cuttings) and nodule weight (55 mg/nodule).
- The microbes *Aspergillus* sp. and *Trichoderma* spp. were found to promote plant growth with soil amendments as they enhanced 10-20% survival and 43% height of sandal seedlings.

Projects under the theme

Project	Project Completed During the Year	Ongoing Projects	New projects Initiated During the Year
Plan	17	25	11
Externally Aided	10	10	04
Total	**27**	**35**	**15**

2.7.2 Insects Pests, Diseases and their Control

Butterfly Diversity in Garhwal Himalayas

Data on species richness, abundance, food plants/sources, mating, egg laying period and other baseline stand parameters of over 200 species have been collected from Ban Oak forests from 6 sites in Garhwal.

Biodiversity of Parasitic Chalcidoidea of Uttarakhand

Parasitic chalcidoidea were sorted out into 18 families of this group in the laboratory under stereozoom microscope. Family Eulophidae was the most abundant and species rich family followed by Pteromalidae, Encyrtidae, Eucharitidae, Mymaridae, Eupelmidae, Aphilinidae and Trichogrammatidae. Several new species have been identified and work on their description is in progress.

Database of National Forest Insect Collection (NFIC)

Database has been developed in MS-Access and also in My Sql and PHP formats. Data on taxonomic classification, collection records, host information, etc. of about 18,000 insect species of forestry importance has been incorporated. High resolution pictures of about 16,000 species of insects have also been incorporated to give identification about the species.

Database of Forest Insects of Some Important Tree Species and their Management

Data have been collected for nine forestry tree species viz. *Shorea robusta*, *Dalbergia sissoo*, *D. latifolia*, *Acacia catechu*, *A. nilotica*, *Albizia lebbek*, *Ailanthus excelsa*, bamboo and *Tectona grandis*, for the insect pests associated, distribution, host range, nature of damage, period of occurrence and management techniques. Different user interface forms have been designed and listed successfully. These forms are integrated to design complete user interactive system. Presently data of four species viz. sal, shisham, bamboo and teak related information has been entered in the software.

Taxonomy

One new species belonging to family Tanaostimatidae (Hymenoptera: Chalcidoidea), *Cynipencyrtus indicus* Singh has been described. This is the first record of the Genus *Cynipencyrtus* from India.

Proleurocerus litoralis Hayat and Kazmi (Encyrtidae) parsitizing egg masses of *Eurybrachys tomentosa* (Fulgoridae) from Doon Valley, Uttarakhand,were recorded. This is also a new host record for the species. Earlier this species was known from females only. Therefore, its males were also described.

First host Record of *Cotesia koebelei*, (Riley 1889) (Hymenoptera: Braconidae: Microgastrinae) on *Hyposidra talaca* Walker

(Lepidoptera: Geometridae) was recorded from Doon Valley.

Taxonomy of Braconid Parasitoids (Hymenoptera) from Central India

Survey of important forestry and adjoining agroforestry areas of Maharashtra, covering localities of districts: Akola, Washim, Hingoli, Parbhani, Wardha, Yavatmal, Nanded, Latur, Beed, Osmanabad, Solapur, Jalgaon, Nashik, Thane and Mumbai were carried out for collection of braconids. Over all, 176 samples of insect fauna were collected by sweeping method out of which 876 braconids were sorted out and preserved. Two hundred thirteen samples of leaf miners, defoliators, gall forming insects and larvae / pupae of insect pests were collected for emergence of braconids from various forest tree species. In all, 8 species of braconids were recovered. *Apanteles antipoda, A. machaeralis* from teak skeletonizer, *Eutectona machaeralis* and *A. hyblaeae* from the larvae of teak defoliator, *Hyblaea puera*; Dolichogenidea sp. and *A. tachardiae* from defoliator of *Acacia nilotica; Apanteles* sp. from an unidentified semilooper on *Bridelia retusa; A. caniae* from *Papilio demoleus* and *Apanteles tiracholae* from *Agrotera basinotata*, defoliator of *Lagerstroemia parviflora.* Four species viz. *Bracon jalgaonensis* sp. nov., *Chelonus wardhaensis* sp. nov., *Chelonus hingoliensis* sp. nov., and *Doryctes indicus* sp. nov. collected by sweeping method were recorded as new species to science.

Studies on Termites

Vials of termite species belonging to the family Termitidae were studied. In all, 33 species belonging to the family Termitidae have been studied. Apart from it, 7 speices belonging to the families Kalotermitidae (5species), Rhinotermitidae (1 species) and Stylotermitidae (1species) have also been studied. Correct geographical distribution of all the 40 species has also been given.

Microlepidoptera

A seed borer identified as *Cateremna tuberculosa* Meyrick is reported infesting the seeds of the Chilgozapine for the first time. Taxonomy of the same is updated by studying the wing venation and genitalia.

Insect Pest Surveys, Incidence and Biology

Bamboo Pests

In central India surveys on insect pests of bamboos in nurseries revealed 4 types of insects namely leaf rollers, grasshoppers, aphids and whitegrubs. The leaf rollers were identified as *Cryptisia coclesalis, Pyrausta bambucivora;* grasshoppers as *Hieroglyphus banian, Poecilecerus pictus* and *Schistocerea gregaria;* aphids as *Oregma bambusae;* and white grub as *Holotrichia consanguinea*. Similarly in plantations, 4 types of insects viz., leaf rollers, grasshoppers, aphids, culm borers and hare were recorded to damage the different species of bamboos.

Biology of Bamboo Borer, *Phloeobius crassicollis*

Phloeobius crassicollis is an important pest of bamboos and was observed to attack six different species of green standing bamboos namely; *Bambusa bambos, B. tulda, B.vulgaris, Gigantochloa aproviolacea, Dendrocalamus giganteus* and *D.strictus*. The incidence of attack of the borer in *Bambusa bambos* ranged from 7.18% to 11.2%.. The beetles emerge in the month of May-June and lay 40-45 eggs on the node of bamboo culm. Incubation period was recorded as10-12 days. Longevity of the female and male adults were 20-25 and 17-20 days, respectively. Larvae enter into the node and feed into the inner surface of bamboo. Larval period was observed 9-10 months. Mature larvae make an oval pupal chamber on the edge of the larval gallery at internodes and pupated in a crowded manner in a group of 2-11. The pupal period lasts for 15-20 days. Life cycle is completed in one year.

Insect Pests of Fast Growing Tree Species in Tamil Nadu and Kerala - *Ailanthus excelsa, Melia dubia, Gmelina arborea, Thespesia populnea, Morus alba, Bombax ceiba* and *Dalbergia sissoo*

About 55 species of insects were recorded damaging seedlings, saplings and young trees of these species in surveyed areas(six nurseries, eleven plantations and three natural forest locations in Tamilnadu and four nurseries, seven plantations and three natural forest locations in Kerala). They were categorized into major and minor based on their intensity of attack and nature of damage caused. Of the 55 species of insects recorded, 10 were new records. The natural enemy complex involving three larval and pupal parasitoids, seven predators and two microbes associated with the key pests were also documented. A pest calendar was prepared for benefit of end users.

Insects Associated with Fruits and Seeds of Selected Endemic Trees of Western Ghats

The incidence of occurrence in percentage in respect of coleopterans was 37.78, lepidopterans was 26.50 and dipterans were 36.22. Diversity of fruits and seeds insects was more in Subramanya (H= 1.8099) as compared to Makuta (H= 0.808).

***Myristica dactyloides* (Ramapathre) Mortality at Elimane, Karnataka**

Surveys revealed incidence of no minor or major insect pests associated with the tree. Dead branches from the upper canopy of *M. dactyloides* trees were chopped down for further investigation and were kept under cage condition for insect emergence. Two unidentified species of Coleoptera (Family Cerambycidae) were found to emerge from the pieces of dead branch. Unidentified Hymenoptera parasites were also collected.

Insect Pests of Cone and Seeds of *Pinus gerardiana* (Chilgoza)

Eight sites of Kinnaur and Chamba districts i.e. Pangi 2750m, Labrang 2915m, Jhangi (Akpa) 2742m, Kilba 1894m, Akpa FRH 2503m, Korathi 2753m, Bharmour 2143m and Rispa 2406m were surveyed for the insect pest infestation on cones and seeds. Cones were infested by cone borer *Dioryctria abietella* throughout the range of natural occurrence of Chilgoza pine but at Kilba 69% of cones were found to be damaged. A seed borer identified as *Cateremna tuberculosa* Meyrick is reported infesting the seeds of the Chilgoza pine for the first time. Symptoms of the seed borer attack start appearing during month of July and by August almost 50% of seeds were found damaged. Damage continued till December by which 94% seeds were found damaged.

Indarbela quadrinotata* Pest of Different varieties of *Emblica officinalis

Survey was conducted in Clonal Seed Orchard (CSO) of *Emblica officinalis* at Sonaghati (Research & Extension Circle, Betul) for monitoring the status of insect pests and diseases. Incidence of bark eating caterpillar *Indarbela quadrinotata* was recorded in seven different varieties viz. Krishna, Francis, NA-6, Chakaiya, Kanchan, NA-7 and local variety of *E. officinalis*.

Control

Chemical

Insect Pest Management in Selected Forestry Species Nurseries

Diseases and insect pests in *Dysoxylum malabaricum, Garcinia gummigatta, Myristica malabarica, Vateria indica, Azadirachta indica, Pongamia pinnata, Emblica officinalis* and *Sapindus emarginatus* in different nurseries were studied. Incidence of leaf blight and leaf spot disease was observed in all selected species.

About 35% Gall infestation and 100% defoliator infestation was observed along with scale insect in *Pongamia pinnata* seedlings. Infestation of leaves (100%) by *Meconellicoccus hirsutus* was observed in Sulikere nursery for *Emblica officinalis* seedlings.

IPM Model for White Grubs in Teak Nursery

Monitoring, observations and experimentations on *Holotrichia. rustica, H. mucida* and *Schizonycha ruficollis* revealed relationship of beetles emergence and rising relative humidity. Data indicate that rainfall 2- 3 weeks prior to the date of emergence did not induce beetle emergence, due possibly to the lower atmospheric relative humidity (< 50%). After the increase in RH, even moderate amount of rains induced the emergence of beetles. Spraying on *Ziziphus jujuba* and *Z. mauritiana* host-traps with monocrotophos or dimethoate 0.05% twice at the interval of 15 days proved effective in reducing the egg laying by the adults. Laboratory experiments with the EPNs against laboratory produced white grubs proved effective. Treatment of the teak beds within 1 week after the adult emergence with phorate/ methyl folidol @ 300g/ bed (size 12 m X 1.25m) in combination and alternately with the cadavars of EPN *H. indica* and *S. carpocapsae* @ 250 – 300 juveniles(ijs)/ bed in good watering conditions proved effective in reducing the incidence of seedling mortality. The ijs were also recovered after 1 month of the release proving their survival in the released soil. Based on the observations, a model guideline for the management of white grubs developed.

Control of Bamboo Borer, *Phloeobius crassicollis*

Dursban 0.04% was found most effective followed by endosulphan, whereas, cypermethrin and Deltamethrin were found least effective. Among systemic insecticides, imadacloprid 0.04% was found effective followed by monochrotophos and dimethoate.

***Pongamia pinnata* Galls and their Management**

Detailed surveys indicated the infestation of three gall inducers on *Pongamia pinnata* is attacked by three gall inducers viz., i) Leaf gall inducer- *Eriophyes cheriani* Massee (Eriophyidae: Acarina: Arachnida), ii). Ovary gall inducer - *Asphondylia pongamiae* Mani (Cecidomyiidae: Diptera: Insecta) and iii). Stem gall inducer - Agromyzid fly (Agromyzidae : Diptera: Insecta). Among these, the ovary gall inducer is most important as they directly affect the seed production upto the extent of 100% seed loss. Lopping of ovary gall infested branches and burning/burying them is ideal to manage the ovary gall inducer. In case of severe infestation, Chlorpyriphos or Imidacloprid may be sprayed at the time of bud formation.

Pests of *Ailanthus excelsa, Gmelina arborea* and *Dalbergia sissoo*

Chemical pesticides *viz,* Thiodicarb, Flubendiamide, Monocrotophos, Chloripyriphos at 0.025 to O.075% were effective in controlling the pests, *Atteva fabricilla,* and *Eligma narcissus* (*Ailanthus excelsa*) *Myllocarus discolor, M. viridanus* (*Dalbergia sissoo*) and *Eupterote geminata* (*Gmelina arborea*) in nurseries and in young plantation.

Management of Teak Heartwood Borer, *Alcterogystia cadambae* Moore

The pest incidences were recorded in the identified areas of Doginal and Kirwati in Yellapur division. Three light traps were installed (one is solar power) for the monitoring of the pests in the infested plantations. Adult activity was monitored from light trap collections from the infested plantations. Mechanical control by larval traps and soil taps were tested and role of bird predators documented. Biocontrol by nematode injections were tested at

Doginal plantations. Field observations and field trails on trunk treatments with nematodes and fumigants were conducted. A package of practices for management of the borer is developed.

Insect Pest Problem of Sandal under Cultivation and their Management

Five silvi-horticultural models of Sandal situated in Bevananahalli, Muddennahalli, Gottipura, Yelwala (Mysore) and Jarackbandae were continuously surveyed for insect pests and diseases. The common insect pests found in these models were sap-suckers (*Oxyrachis tarandus, Saisettia hemispherica, Parasaissetia nigrum, Ceroplastis actiniformis, Aonidiella orientalis* and *Paratachardina silvestrii)*.The defoliators recorded on sandal, were *Crotogonus* sp. and *Dasychira mendosa)*. Surveys on young sandal plantations grown with *Acacia auriculiformis* revealed the incidence of a notorious stem borer, *Purpuricenus sanguinolentus* (Cerambycidae: Coleoptera). This is the first report of this cerambycid beetle on sandal. The bark eating caterpillar (*Indarbela quadrinota*) was observed in almost all models. The Red coffee borer (*Zeuzera coffeae*) was observed in one of the sandal models. The blight symptoms were very few.

***Indarbela quadrinotata* Management in *Casuarina equisetifolia* Plantations**

Assessment of the bark eating caterpillar incidence in the *C. equisetifolia* plantations raised in different Agro-climatic Zones of Tamil Nadu was made and, altogether, 18 plantations have been studied so far. Impact of the bark eating caterpillars infestation on the growth of Casuarina trees is in progress and collection of periodical growth data and maintenance of plots being carried out. A few entomopathogens have been collected from the bark eating caterpillar. Pure cultures were developed from these specimens for studying their efficacy on the pest.

Insect Pests of *Buchanania lanzan*

Out of 7 chemicals viz. dichlorvos 0.5%, monocrotophos 0.07%, endosulfan 0.05%, dimethoate 0.05%, petrol, kerosene and para-dichorobenzene + kerosene- 10 ml each; water emulsion of dichlorvos 0.5% (10 ml) showed cent per cent killing of stem borer *Batocera rufomaculata* within 60 days in natural stand of *B. lanzan*. Out of 4 chemicals viz monocrotophos 0.05%, endosulfan 0.05%, bavistin 0.2% & alpha NAA (40 ppm); foliar spraying of combination of endosulfan 0.05% + bavistin 0.2% + alpha NAA 40 ppm proved best for maximum number and weight of fruit production of *B. lanzan*. Foliar spraying of monocrotophos 0.05%, endosulfan 0.05%, cypermethrin 0.03%, fenvalerate 0.03%, deltamethrin 0.002%, alphamethrin 0.003%, bipro super- *B. bassiana* 7 ml/lit, neemraj supreme- neem oil 0.5%, found significantly superior over control in killing of larvae within 72 hrs.

Management of Insect Borer Complex in Chir Pine Forests

Chir pine stem has been reported to be attacked by 12 species of insects. On the basis of population and nature of damage, 4 species - *Polygraphus longifolia, Platypus biformis, Cryptorhynchus rufescens* and *Sphaenoptera aterrima* were graded as serious. *Polygraphus longifolia* was observed as most destructive insect bark borer. Three plots of size 1000 sq m were marked at D-113, Sairighat Forest (Solan Forest Division) and Platoo Forest (Hamirpur Forest Division) and insect fauna of Chir pine and their natural enemies were recorded from randomly selected trees. To evaluate the effectiveness of tree trap for *Polygraphus longifolia* and other beetles, billets of two sizes (80 cm L X 70 cm GBH and 100 cm L X 90 cm GBH) were kept at 5 experimental sites and the data on insect activity and population abundance of *P. longifolia, Cryptorhynchus rufescens* and

Sphaenoptera aterrima were recorded along with moisture content of the logs. Trees with girth range of 90 to 180 cms were found to be highly susceptible to infestation in comparison to young (below 90 cms) and mature (above 180 cms) stands. Fire incidence and excessive resin tapping increased the susceptibility of the trees to the beetle incidence.

Frass Ejected by *P. longifolia*

Drying of Chir Pine by *P. longifolia*

Adult of *Polygraphous longifolia*

Hole Formation below the Bark

Hole Formation on the Bark

Polygamous Gallery Formation on Bast Layer

Biocontrol

Metarhizium Based Mycoinsecticide for the Insect Management in Forest Plantations and Nurseries

Twenty five *Metarhizium* isolates were maintained in the laboratory for studying the virulence and biocontrol potential against major pests on important forest tree species. The Teak defoliators, *Hyblaea puera*, *Paliga machoeralis* and insect pests of *Ailanthus excelsa* were found susceptible to all the collected *Metarhizium* isolates but pathogenicity varied among the isolates. Bioassay with Mahagony borer, *Hypsipyla robusta* reared using artificial diet revealed that 7 isolates were pathogenic to them. Pathogenicity of different isolates against arboreal termites, *Odontotermes* spp. was tested in the laboratory with different dosages/time and the LD50 and LT 50 were calculated. Field evaluation of selected isolates against *Ailanthus* pests showed mortality of 30-34%. Mass multiplication of fungus in grains, solid media and agro wastes was tested. A mycoinsecticide product named as PESTSTAT in two forms, as powder and liquid is ready for release and application in the field.

Microsporidia as Biocontrol Agents Against Lepidopteran Pests

A total of 94 lepidopterans were tested and microsporidian parasites were isolated from 29 species. Bio assay study was carried out on

Hyblaea puera, *Catopsilia*, *Papilio demoleus* and *Papilio polytes* larvae by inoculating different concentrations of spores isolated from their respective hosts. Morphometry of 29 species of microsporidia were studied. Studies on morphology, Pathogenicity, rate of multiplication and life cycle of microsporidian spores in *Hyblaea puera* are completed in major test species. TEM studies were carried out for selected species. Cross-infectivity studies were carried out using *H. puera* spores to other forest pests to examine the infection potential.

Natural Enemies of Teak Defoliators in Madhya Pradesh

Periodical surveys were conducted in teak forests of Madhya Pradesh for collection of natural enemies (parasitoids, predators and pathogens) of major insect pests of teak, *Hyblaea puera* and *Eutectona machaeralis*. The larvae of *H. puera* were noticed to be attacked by five species of parasitoids namely, *Echthromorpha notularia*, *Trophocampa indubia*, an unidentified species of *Brachymeria* and three unidentified species of *Sturmia*, three species of insect predators namely, *Calleida splendidula*, *Canthecona furcellata* and *Chrysoperla carnea*, one species of bird predator namely, *Corvus macrohynchos* and unidentified spiders, and a species of fungal pathogen namely, *Aspergillus flavus*. The larvae of *E. machaeralis* was observed to be attacked by eight species of parasitoids namely, *Apanteles machaeralis*, an unidentified species of *Apanteles*, *Brachymeria* and *Sturmia*, *Cremastus hepaliae*, *Trophocampa indubia* and *Xanthopimpla cera* and an unidentified species of nematode, two species of insect predators namely, *Canthecona furcellata* and *Chrysoperla carnea*, and unidentified spiders, and three species of fungal pathogens namely, *Aspergillus niger*, *Beauveria bassiana* and *Fusarium oxysporum*. Carried out laboratory culture of *A. flavus*, *A. niger* and *B. bassiana* and conducted pathogenicity tests against target pests. Rearing technique of a potential polyphagous insect predator, *C. furcellata* and its alternative hosts have been developed.

Termites and White Grub Management Using Entomopathogenic Nematode

Laboratory culture of waxmoth, *Galleria mellonella* was maintained round the year. The mature larvae of the same were periodically separated out of the culture and utilized as fictitious host. The culture of 2 exotic and 4 native populations of entomopathogenic nematode was maintained round the year on fictitious host, i.e., waxmoth larvae in laboratory. Experiments were laid out relating to improved parameters for economical and successful mass-multiplication of the native populations/ isolates from central Indian states. Experiments were carried out for bioassaying potentiality of native populations/ isolates of EPNs against termite and white grub pests. For isolating more populations from central India, surveys were carried out and 40 samples were collected from two sites comprising of teak plantation areas of Kundam Project (M.P. Forest Development Corporation, Jabalpur (Slimnabad, Jirri, Dhimarkheda) and Dindori Forest Division, Dindori, (Karanjia, Jagatpur, Amarkantak) in Madhya Pradesh. Investigation on insecticidal tolerance/ compatibility of EPNs to commonly used insecticides/biopesticides has been initiated.

Management of Indian Gypsy Moth (*Lymantria obfuscata*) in Himachal Pradesh

Two aspects of ecofriendly biological control measures, viz. using baculovirus (LONPV) as microbial insecticides and utilizing female sex pheromone to trap & kill male moth, were adopted in this project. Bioassay experiment using 5 dilutions from stock solutions of baculovirus has been conducted on 75 larvae

in each test. Ninty Percent mortality was observed. Pheromone was extracted and purified from the abdominal glands of 100 adult females using acetone solvent and stored. This would be applied during next breeding season.

Evaluation of Biopesticidal Products for the Management of Teak Defoliator and Skeletonizer in Forest Nursery

Planned and time bound use of a neem based biopesticide (0.5%) was found to cause 90% antifeedant effect to the larvae of teak skeletonizer. It was also proved to inhibit over 80% egg laying of teak defoliator. Spraying with biopesticides like, 0.05% of spinosad (Actinomycete) 45 % EC Actinomycete Biological Product; botanical combination agropest *bt* @ 0.05%; cigna 5.40% w/w (Insect Growth Regulator) for direct mortality with 3–7 days residual effects against teak defoliator and skeletonizer in forest nursery. EPNs *H. indica* and *S. carpocapsae* were reared and their bioefficacies evaluated for the first time against forest insect pests. EPN, *H. indica* in laboratory bioassay (dose-range 3 to 30 ijs larva^{-1}) in 72 hrs post-exposure caused mortality up to 76.47 % at 10ijs larva^{-1} 100% at 30ijs larva^{-1}. Leaf treatment method (dose-range 32 to 280 ijs larva^{-1} or 3.88ijs to 32.00ijs cm^{-2}) resulted in mortality range of 78.94% at 130ijs larva^{-1} or 15.53 cm^{-2} and 100% at 265ijs larva$^{-1,}$ or 32.00 cm^{-2}. Field spraying experiment indicated requirement of 5000 to 10000 infective juveniles/ litre for the mortality. First time 3 native EPN populations (1 *Steinernema* spp. and 2 *Heterorhabditis* spp.) were isolated and being maintained successfully, as no previous reports from the central Indian forest floor is available. PDBC strains of *H. indica* was found compatible with chemical insecticides, viz., imidacloprid, monocrotophos, endosulfan, chlorpyriphos and Thiamethaxam (actara), and biopesticides like neem product, agropest *bt* and derisome (botanical products), bioprahar (*Photorhabdus* bacteria), conserve (Spinosad actinomycete product) and signa (Insect Growth Regulator). Taking clues from tolerance of EPNs with chemical insecticides and biopesticides, combination with EPN @ 5000 and 10,000/ litres proved effective in presence of good amount of atmospheric relative humidity.

Biocontrol for Prickly Acacia: Exploration in India

The study sites were selected for survey and laying out of exclusion trials in Rajasthan (Jodhpur, Hanumangarh, Bharatpur and Pali) and in Gujarat (Bhuj, Nadiad, Junagarh and Gandhinagar). Regular and random samplings were carried out in different survey sites. Data on temperature, humidity, light intensity, longitude & altitude were recorded in each site. The samples collected during survey were identified. The rust fungus sample collected during survey from Verawal, Tarapur, and Nadiad in Gujarat was identified as *Revenelia evansii*. Two species of mites viz., *Amblyseius alstoniae* and *Pronematus* sp. were collected from Gujarat, while three species of mites pests viz., *Amblyseius alstoniae*, *Tenuipalpus* sp. and *Oligonychus* sp. were collected from Rajasthan. Rust and mites have been prioritised for host-specificity tests for *acacia* seedlings. Data of exclusion trials on plant height, number of shoots, number of leaves per plant, basal stem diameter, root length and total wet weight of seedlings (above ground and below ground) of 12 weeks, 24, 36 and 48 weeks old seedlings of *A. nilotica*, kept under observation for exclusion trials at Jodhpur, Pali, Hanumangarh and Bharatpur (Rajasthan) and Gandhinagar, Nadiyad, Junagarh and Bhuj (Gujarat), has been analyzed. Plant parasitic nematode species isolated from dead and dried trees of *A. nilotica* from Ratipar Forest Reserve in Gujarat were identified as

Hoplolaimus indicus, *Aphelenchus avenae* and *Helicotylenchus* sp. These nematodes were isolated and separated out from the soil samples collected from dried and diseased trees of *A. nilotica* at Ratipar and Bhuj (Gujarat). All the three species were found ecto- semiendo and endoparasitic in nature, which feed mainly on cortical tissues. In seedlings, neither necrosis nor stunting of root has been observed at Bhuj (Gujarat).

Botanicals

Pests of *Ailanthus excelsa, Gmelina arborea* and *Dalbergia sissoo*

Crude extracts of *Ailanthus excelsa*, *Lantana camara*, *Aegle marmelos* and Pongamia, Jatropha and Neem oil were tested for mortality, feeding deterrent and antifeedant effects on the targeted pests. None of the crude extracts of the said plant species was effective for any of the pests tested- *Atteva fabricilla*, and *Eligma narcissus* (*Ailanthus excelsa*) *Myllocarus discolor*, *M. viridanus* (*Dalbergia sissoo*) and *Eupterote geminata* (*Gmelina arborea*). However, the oils of Jatropha, Pongamia and Neem at 2-3% were found effective in controlling the *Ailanthus* and *Gmelina* defoliators in nurseries and in young plantation.

Biopesticidal Property of *Aegle marmelos* Seed Oil

Three compounds out of 13 extracted from fruit, pulp and seeds *of A. marmelos* showed biopesticidal effect and were found to be effective against teak defoliator *H. puera* with 70 % larval mortality. Field level biopesticidal evaluation of individual compounds and crude extracts against teak insects in State Forest Nurseries at Nilambur and Kulathupuzha, Kerala revealed that they are found to be very effective against *H.puera* in Nilambur teak nursery when compared to Kulathupuzha and also it was observed as a growth promoter.

Application of *A. marmelos* Seed Oil Pre Formulations against *H. purea* on Teak at Nilambur, Kerala

Biopesticides from *Annona squamosa* Against Teak Defoliators

Out of five solvents extract and one water extract of 0.05% *Annona squamosa* were evaluated for antifeedant activity against teak skeletonizer larvae. Petroleum ether extract exhibited 72.99% antifeedant activity ($P<0.005$), followed by 69.99% by ethyl acetate ($P<0.05$), as compared to other extracts. Further, confirmatory bioassays with concentrations/doses ranging from 25ppm to 3000ppm of each promising extract for the determination of optimum doses exhibited over 70% antifeedancy above 800ppm of crude ethyl acetate extract ($P<0.001$). These two extracts also inhibited feeding in teak defoliator larvae with antifeedancy being 75.43 and 78.84% over control ($P<0.001$, df. = 24, $F=14.00$, SE(d)± =10.85, LSD($P<0.05$)=22.40). Effective concentration for 50% antifeedant effect for ethyl acetate was calculated to be 524.80 ppm with upper and lower fiducial limits, respectively being 769.80 and 435.78. EC_{50} for petroleum extract was 220.80 with upper and lower fiducial limits being 357.78 and 114.52. Column Chromatography allowed isolation of three major

fractions from petroleum ether extract, as confirmed by TLC, time to time, codes 6a, 6b and 6c and four chromatographic fractions from ethyl acetate extract; codes 3a, 3b1, 3b2 and 3b, which exhibited antifeedant and growth regulatory effect. Results indicated 3b1 fraction at higher concentration of 0.08 to be effective with significantly superior ($P<0.001$, df. = 30, F= 8.34, SE(d)± =10.64, LSD($P<0.05$)=21.95) antifeedant activity over other treatments against teak skeletonizer, *Eutectona machaeralis*, with over 74.49% leaf protection. Nevertheless, concentration of 400ppm was statistically at par with 800 ppm with 47.83% leaf protection ($P<0.038$, df = 29, F= 2.94, SE(d)± = 17.92, LSD($P<0.05$) = 37.38). Lowest concentration of fraction 3b2 was at par with control with no significant antifeedant activity ($P>0.05$). Fraction 3b of ethyl acetate proved most promising with significantly superior antifeedant activity ($P<0.001$, df. = 30, F= 174.01, SE(d)± = 3.97, LSD($P<0.05$) = 8.10) at and above 0.05% (500 ppm) concentration (89.79% leaf protection). Increase in activity was noticed after increasing the concentration of the extract. The full grown larval weight after being, pre-pupal fed continuously on treated leaves and pupal weights were significantly affected with mortality at larval and pre-pupal stages, as compared to control ($P<0.05$). While there was statistically non-significant ($P>0.05$) difference in initial larval weights, concentrations above 400 ppm were significantly superior ($P<0.033$) in affecting the final larval weights. Similarly, pre-pupal weights were also affected. There was no development of pupae in treatments above 100 ppm. Similar results were obtained with ethyl acetate extract against teak skeletonizer, *Eutectona machaeralis* at and above 400 ppm. In this case, there was no pupal development, even at the lowest concentration tested.

Insecticidal Properties of Some Plant Extract Against *Heortia vitessoides*

Evaluation of insecticidal properties of some plant extract was carried out against *Heortia vitessoides* Moore (Lep: Pyralidae), a major pest of *Aquilaria malaccensis* Lamk, a world renowned Agar oil yielding tree. Bio-efficacy of locally available botanicals for the management of *Heortia vitessoides*- a major defoliator in nurseries as well as young plantations of *Aquilaria malaccensis* was studied. Results of bioassay test with botanicals viz., *Azadirachta indica, Melia azedirach, Acorus calamus, Adhatoda vesica* and *Clerodendron viscosum* (tested at 2.5%, 5.0% and 10.0% concentration) showed the maximum of 95.0% antifeedant activity in case of *A. indica* followed by 90.0% in case of *A. calamus*.

***Tagetes minuta* Extract Against Major Pests of Shisham and Poplar**

It was observed that after 72 hours of exposure of major pests of shisham and poplar at 1% concentration of different chemical extracts JGPE (Jungli Gainda in Petroleum Ether), JGA (Jungli Gainda in Acetone) and JGM (Jungli Gainda in Methanol) were found effective, whereas, J.G.W. (Jungli Gainda in Water). was observed not effective. The bioassay of effective chemical extracts (JGM, JGA and JGPE) was done and it was observed that at 2% concentration the mortality of larvae was observed 33.33-53 per cent.

Panchagavya and Dasagavya

The organic preparations Panchagavya and Dasagavya tested against key insect pests of *Casuarina* revealed that the organic formulations

not only controlled the insect pests but also enhanced the growth under nursery conditions. Application of 12 rounds of Panchagavya and Dasagavya at 15 days intervals at 13% controlled the infestation of mealy bug on casuarinas and increased the growth 20% compared to the control. Similarly the concentration of 5% reduced the gall formation to 40% on Eucalyptus and increased plant growth 14% while the concentration 3% exhibited 30% reduction in teak defoliator incidence and 12% increase in plant growth.

Toxins of Soil Actinomycetes Against Major Forest Insect Pests

Out of 340 soil samples collected from forests of Madhya Pradesh, Maharashtra and Chhattisgarh, 9 actinomycetes/ bacteria were isolated on potato dextrose agar plates following serial dilution technique and pour plate method. Among the 3 actinomycetes isolated, *Streptomyces* sp. was identified and confirmed at Institute of Microbial Technology, Chandigarh. Culture technique of soil actinomycetes was developed for production of toxins, protocol for extraction of antibiotics and its fractions for chemical characterization of toxins of isolated actinomycete, *Streptomyces* sp. Toxicity tests of its culture filtrate, isolated antibiotics and different fractions was conducted against major insect pests of teak, siris and mahaneem. Commercially available bioproducts (ivermectin and spinosad) of soil actinomycetes was evaluated against major insect pests of teak, siris, bamboo and mahaneem and worked out their relative efficacy and toxicity (LC_{50}) through Probit analysis. Field-cum-laboratory tests of ivrmectin and spinosad were conducted against the early last instar larvae of major insect pest of above noted species. Field trial in nursery stage at insectary of this institute was carried out to test the toxicity of ivermectin and spinosad. The results revealed that management of these pests may be achieved by foliar application of bioproducts (ivermectin and spinosad).

Insect Pests of Medicinal Plants

Management of Potential Insect Pests of Important Medicinal Plants Grown in Arid and Semi-arid Regions

A check-list of five species of insect pests and three species of diseases has been prepared. Severe infestation of *Achaea janata* (Noctuidae), a semilooper has been noticed on all mehndi (*Lawsonia inermis*) growing areas at Sojat road (Pali). Bio-ecology of the key pests viz. *Achaea janata* and *Aphid gossypii* have been studied. Soil treatment (10 g *Trichoderma* + 5-0 kg Vermicompost + 15 g Phorate) and foliar Spray (0.02% Pratirodh) was found to be the best against mehndi defoliator (*Achaea janata)* and aphid (*Aphid gossypii*) attack. The mean dry weight of the treated plot was recorded 2.47 kgs with a net return of ` 185 per metre$^2$ plot as compared to untreated control with mean dry weight 2.00 kg and net return of ` 150/metre^2 plot. Seed treatment using *Trichoderma harzianum* @ 10g/kg seed + soil treatment with *Beauvaria bassiana*-1 + Phorate granules was found to be the best against downy mildew and termites in Isabgol. The treated (5m x 5m) plot yielded 104.88 kgs stover/plot as compared to untreated 76.56 kgs stover/plot with net return of ` 3670.80/- and ` 2679.60/- per plot, respectively.

Control of Insect Pests of Important Medicinal Plants in Himachal Pradesh

In total, 37 insect species belonging to 5 insect orders viz. Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Hymenoptera and 24 families, Class Arachnida, were collected from selected 5 medicinal plants raised in the nurseries. The study on the biology of *Plusia orichalcea* Fab. on *Saussurea costus* infesting *Picrorhiza kurrooa* Royle ex Benth., *Acrtium lappa* Linn., *Heraclium candicans* Wall. ex DC, *Angelica glauca* Edgew., *Saussurea costus* Falc. and *Valieriana jatamansi* Jones revealed that the

insect was most active from second week of April to last week of June. Four overlapping generations were studied from March to June. There were 5-6 larval instars, 16.25 ± 5.4 days larval period, 10.75 ± 2.6 days pupal period and total lifecycle has been completed in 35 days in the laboratory. Three generations of the pest had been studied in the laboratory. The pest starts appearing in the field during March and its maximum activities recorded in May and June. In the laboratory, heavy larval (3^{rd} and 4^{th} instars) mortality has been recorded. The fecundity of a female varied from 113 to 228 eggs and the total life cycle was completed in 27 to 38 days during different months. Two species of larval parasitoids viz., *Apanteles glomeratus* and *Apanteles ruficrus* (Haliday) were reported and the extent of parasitisation by these species was 13.3, 21.2 and 25.0 per cent in April, May and June, respectively. Entomopathogen, which resulted in large scale mortality of larval and pupal population in field as well as in laboratory was identified as *Bacillus cereus* Var. Mycoides (Flugge) Smith, Gorden and Clark. The study indicated that these biological control agents can play an important role in eco-friendly management of pest. Different insecticides and biopesticides viz. Grownim @ 5.0 %, Monocrotophos @ 0.03%, Endosulphan @0.1%, Furadan3G @ 30 gm/m sq., Dursban @ 0.02% Rogar @ 0.05%, Neem cake @ 500 gm / m sq and Summer oil @ 5.0 % in *Valeriana jatamansi* were evaluated in the nursery and it was found that endosulphan @0.1% and Chloropyriphos@ .02 % was effective in controlling pest in nursery. Insecticidal residual analysis of treated plants were got done from UH&F Nauni, IHBT Palampur and IIIM, Jammu where the results revealed that Endosulfan @0.1%, Monocrotophos @.03%, Carbofuran@, Chloropyriphos@ .02 % have got the residual effect in the used part of plant. Hence, these insecticides are not a good option to control the insect pest in nursery.

Insect Resistant Germplasms

Screening Resistance in *Eucalypts* spp. for Gall Insect Pest

About 210 clones of *Eucalyptus* identified for high yielding were collected from 9 different organizations and assembled at nursery and Vegetative Multiplication Gardens (VMGs) of the Institute of Forest Genetics and Tree Breeding, Coimbatore . For screening these clones at a hot spot area at Satyavedu, Andhra Pradesh a trial was established and about 179 clones have been planted at the trial. Screening of these high yielding clones for the attack of gall insect, *Leptocybe invasa* at the trial at Satyavedu (Andhra Pradesh) and at VMGs at Panampally (Kerala) and Bharathiar University (Tamil Nadu) are in progress.

A total 100 *Eucalyptus* clones raised in clonal trials at three different locations of Tamil Nadu, Kerala and Andhra Pradesh were evaluated for pests and diseases problems importantly for the gall insect, *Leptocybe invasa.* Field data collected over a period of two years showed that about 25 clones were highly susceptible to the attack of the gall insect. Low to Moderate level of attack was observed on 71 clones. About 4 clones consistently expressed only ovipositional damage and no gall development was seen. Studies on life cycle of the gall insect, *Leptocybe invasa* varied between 82-95 days.

Casuarina equisetifolia Against the Serious Bark Feeding Pest, *Indarbela quadrinotata*

Relative resistance in 10 selected clones of *Casuarina equisetifolia* was identified against the serious bark feeding pest, *Indarbela quadrinotata* in terms of biochemical and physical compounds like phenols, tannins, free fatty acids and phenolic acids of clones imparting resistance. Behavioural response of *I. quadrinotata* on different *Casuarina* clones

further revealed the influence of phenols, tannins, free fatty acids and phenolic acids on the feeding and reproduction behaviour of the bark feeder.

Screening of 132 families of *Acacia auriculiformis*, 80 families of *A. mangium* and 64 germplasm collections of *Ailanthus excelsa* populations for insect pest resistance and selection of pest resistant candidates revealed varying levels of pest resistance nature of different germ plasm of these species for their key pests.

Characterization of the allelochemical profiles like phenols tannins, lipids, five fatty acids, phenolic acids and volatiles of selected germ plasm of teak, casuarina and eucalypts enabled to identify the influence of these chemicals with the attraction/deterrence of insect pests. Evaluation of behavioural responses of insect pests further confirmed the role of these allelochemicals in food and oviposition preference of the pests on their host species. A data bank constitutes 120 volatile chemicals responsible for insect pest resistance and susceptible clones/provenances of teak, casuarinas, and eucalyptus was also developed.

DISEASES AND THEIR CONTROL

Screening for Resistance Against Diseases

Twenty clones of *Dalbergia sissoo* were tested against four virulent strains of *Fusarium solani* by direct inoculation. Clone No. 14 and 6 exhibited stabilized resistant reaction. Experiment on flooding of different shisham clones followed by inoculation with *F. solani* showed that all clones exhibited wilt disease establishing that shisham plants become susceptible to fungal infection after water logging.

Blister bark disease resistance was tested in 150 clones of *Casuarina equisetifolia* against 3 isolates of *Trichosporium vesiculosum* and clone numbers TNIPT -7 and TNIPT -11 showed resistance against the disease under nursery conditions.

Acacia nilotica Mortality

The effect of biotic stresses, climatic change and physico- chemical attributes of soil in four agro-climatic zones each in Punjab and Haryana was studied to understand the mortality of kikar. Many factors attribute for the mortality major being injuries due to developmental activities like road widening, construction, laying of pipelines and electricity lines, drainage, etc.

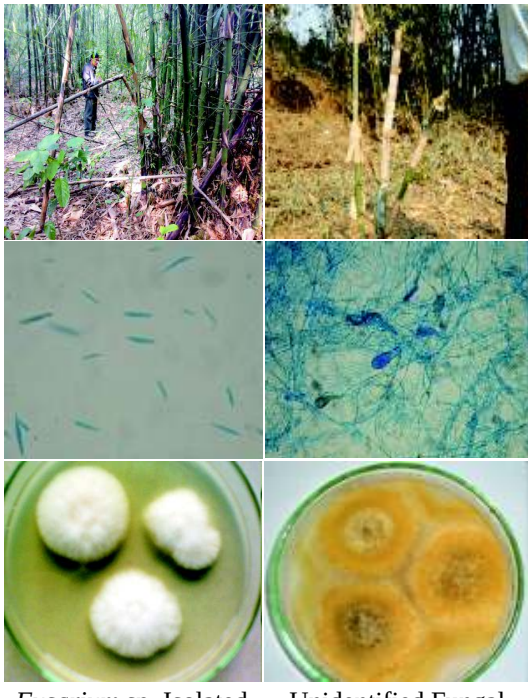
Blister Bark Disease in *Casuarina equisetifolia*

Etiology and histopathological aspects of blister bark disease of *Casuarina equisetifolia* were studied and found that temperature between 25ºC to 35°C was ideal for the growth of *Trichosporium vesiculosum* under laboratory conditions. In pathogenicity test conducted with artificial inoculation of *T. vesiculosum* at nursery revealed that 5 months old seedlings were susceptible for blister bark disease. Histopathology studies showed that the pathogen initially infect the root cortex zone and, thereafter, spread into cambium of shoot zone. It was also found that vertisol type of soil are more favourable for spread of disease than alfisol type soil.

Diseases of Bamboo

The samples of leaves infected were collected from seedlings, cultured and identified in laboratory as leaf rust, *Dasturella divina* and leaf tip blight, *Helminthosporium solani* in central India. Different species of bamboos in plantations were surveyed periodically throughout the year at 15 days interval. Leaf rust caused by *Dasturella divina* was recorded on leaves of different bamboo species from December 2009 to January 2010.

Studies were done on the incidence and management of culm rot and bamboo blight disease in Assam and the field tours conducted in Sibsagar, Dibrugarh, Tinsukia, Dhemaji, Goalpara, Tezpur and Bongaigaon districts of Assam exhibited the presence of bamboo blight



Fusarium sp. Isolated from the Diseased Sample

Unidentified Fungal Species

disease in all the surveyed sites. The per cent of blight incidence in new culms ranges from 21 to 61% in the surveyed districts and the highest disease per cent infection of culms was observed in Golaghat district (61.29%) followed by Tinsukia (29.18%) and the least was observed in Sibsagar district (20.93%). Studies on fungal culture from the collected diseased samples revealed the association of *Fusarium* sp. and one unidentified species with blight disease of bamboos in Assam. Pure cultures of these fungi are being maintained in laboratory.

Diseases and Pests in *Gmelina arborea*

To identify major diseases and insect pests associated with *G. arborea* and to assess the occurrence of disease and pest infestation in relation to soil and plant nutrient status with special reference to potassium, field surveys were conducted in 36 plantation sites and 5 nurseries within 8 districts of Jharkhand. Plant specimen of affected plant parts were collected for identification of the causal organisms. The severity index due to the pathogens and insect pests was developed. Soil and plant samples collected from all the sites were analysed so as to relate plant and soil K status with severity index.

Diseases of Important Medicinal Plants

Charcoal root rot disease caused by *Rhizoctonia bataticola* was found to cause severe damage to mehndi plants with an ultimate loss of mehndi yield at Sojat. Soil treatment (10g *Trichoderma* + 5-0 kg Vermicompost + 15g Phorate) and foliar Spray (0.02% Pratirodh) was found to be the best against mehndi defoliator (*Achaea janata)* , aphid (*Aphid gossypii*) attack and leaf blight disease. The mean dry weight of the treated plot was recorded 2.47 kg with a net return of `185 per metre$^2$ plot as compared to untreated control with mean dry weight 2.00 kgs and net return of ` 150/metre^2 plot. Seed treatment using *Trichoderma harzianum* @ 10g/kg seed + soil treatment with *Beauvaria bassiana*-1 + Phorate granules was found to be the best against downy mildew and termites in Isabgol. The treated (5m x 5m) plot yielded 104.88 kg stover/ plot as compared to untreated 76.56 kg stover/ plot with net return of ` 3670.80/- and ` 2679.60/- per plot, respectively.

Mehndi Brown Leaf Spot Disease Caused by *Alternaria* species

Pupal Density of White Fly on Mehndi

Full Grown Larva of *Achaea janata* on Mehndi Plant

Natural Decay Resistance of Imported Woods

Among the imported woods tested for natural decay resistance teak wood from Tanzania and Australia were found highly resistant against all test decay fungi, whereas beach wood from France and Belgium and Ash wood from France were not resistant.

Fungi Associated with Fruits and Seeds

A total 150 fungi isolated from the different fruit/seed samples were identified. Among these 40 were potential plant pathogens, reported for their pathological effects in several other hosts. Isolates included storage fungi like *Aspergillus niger, A. flavus, Rhizopus stolonifer, Rhizomucor variabilis, Mucor mucedo, Trichoderma viride, T. koningii, T. pseudokoningii* and *T. harzianum.* These fungi play a major role in causing the seed health problems like seed rotting, shrinkage, discolouration, and abortive and poor germination. *Beltrania rhombica* on *Poeciloneuron indicum* seeds is reported as new host record. 75-90% *Fusarium verticilloides* infection was found in *D. malabaricum* fruits and seeds. In *C. sulpharatum* and *H. ponga* seeds though there was fungal infection, viability was not affected. In *S. malabaricum* and *M. longifolia,* fungal infection was less.

Ten fungal species i.e. *Alternaria alternata, Aspergillus niger, Cephalosporium* sp., *Chaetomium globosum, Cladosporium* sp., *Fusarium equiseti, Fusarium oxysporum, Penicillium citrinum, Rhizopus stolonifer* and *Trichothecium roseum* were identified and stored seeds of *Pinus gerardiana*. *Penicillium citrinum* was the most predominant fungus affecting Chilgoza seed in storage. It was observed that 40% of seed rot was found at 25^{0}C and even 8% seed rot was observed at 0^{0}C due to *Penicillium citrinum***.**

Molecular Variability in Fungi

Morphological and cultural variation in 63 fruiting bodies of *Ganoderma lucidum* collected from Delhi (NCR), Haryana, Punjab, Uttar Pradesh, and Uttarakhand studied. Vegetative compatibility tests were performed between different isolates of *G. lucidum*. OPA3 primer has differentiated isolates of *G. lucidum* on the basis of host species. On the basis of DNA sequencing two species of *Ganoderma, G. resinaceum* and *G. weberianum* have been separated from the collection, the latter is a new record for India. Fifty one ITS sequences have been submitted to GenBank, (National Center for Biotechnology Information), USA and have been released at NCBI web site. The sequences were also incorporated and released by the other gene banks viz. European Molecular Biology Laboratory Nucleotide Sequence Database, UK (http://www.ebi.ac.uk/embl/) and DNA Data Bank of Japan (http://www.ddbj.nig.ac.jp/).

A combined dendrogram of 82 isolates of *Cylindrocladium quinqueseptatum was* generated after RAPD-PCR by primer OPE-2, OPE-3, OPE-5. Eight internal transcribed spacer region sequence of nuclear rDNA and six beta tubulin gene sequences of different isolates of fungus *Cylindrocladium quinqueseptatum* were submitted to GenBank NCBI (http//www.ncbi.nlm.nih.gov) and accession numbers were allotted. Diagnostic kit was developed after standardizing protocols for DNA extraction of this pathogen from soil, diseased plant parts and post-inoculation pre-symptomatic Eucalyptus plant samples infected with *Cylindrocladium quinqueseptatum* leaf, twig and seedling blight. It is helpful in identification of *Cylindrocladium quinqueseptatum* and can be used for disease forecasting.

Screening of 60 primers was done for RAPD (Random amplified polymorphic DNA) out of which, 32 primers showed consistent polymorphism. Out of 32 primers 18 primers were analyzed for polymorphism. A combined

dendrogram for all the isolates was constructed using UPGMA method. PCR-RFLP of 15 isolates was done. Fifteen 18S rDNA gene and twenty eight internal transcribed spacer region of nuclear rDNA gene of different isolates of fungus *Cordyceps sinensis* of Himalayan meadows were amplified, sequenced and submitted to NCBI and accession numbers were allotted.

Colony character, pigmentation, growth rate, spore type, size and germination in *Drechslera* sp. isolates causing leaf blight disease in poplars were studied on four growth media (PDA, CDA, MEA and SPA). Diversity of the isolates of *Phyllosticta/Phoma* sp. causing foliar diseases in poplars was studied through various cultural and morphological parameters namely colony type, colony colour, pigmentation, growth rate, spore type and size and germination.

Bioactive Principles in *Cordyceps sinensis*

Different isolates of *Cordyceps sinensis* were grown in Jhingora as per the protocol developed by FRI Dehradun. Twenty five isolates were powdered in liquid nitrogen after the growth of 6 months and were analyzed for their bioactive principles by HPTLC for the presence of cordycepin, adenosine and ergosterol contents. Presence of these bioactive principles indicates the medicinal value of the isolates.

Wood Decay in Stored Tropical Timber

Seven hundred forty five specimens of wood decaying fungi were collected on wood logs of 34 host species from 12 wood depots of Maharastra and 25 wood depots of Orissa. Twenty genera and 44 species of wood decaying fungi were identified. Of these, 4 generas viz. *Hapalopilus, Ceriporiopsis, Schizophora,* and *Postia;* and 7 species: i.e. *Hapalopilus nidulans, Ceriporiopsis merulinus, Trametes ochraceae, Postia placenta, Schizophora paradoxa, Pycnoporus coccineus* and *Pycnoporus cinnabarinus* were recorded for the first time from Orissa and Maharashtra on sal and bijasal. Twenty five cultures were also maintained for further studies. An experiment was conducted to test toxicity (*in- vitro*) at different concentration of urea and zinc sulphate against decay resistance of *Flavodon flavus*.

Marine Lignicolous Fungi in Traditional Wooden Craft

Fungal infested timber from catamarans made of *Anogeissus acuminata* was collected from the fishing villages, namely, Pedajalaripeta and Bhimunipatnam in Visakhapatnam district. Fungi in the samples collected were cultured and 13 isolates separated. Timber wafers of *Anogeissus acuminata* and *Mangifera indica* were treated with Copper Chrome Arsenic wood preservative to different gradients of absorptions and exposed to individual fungal isolates for their infesting activity. Among various fungi, *Aspergillus flavus, Curvularia* sp. and *Fusarium* sp. were found to be infesting the wafers even at a preservative retention of 27.6 kg m^{-3}.

Control

Chemical Control of Diseases of *Buchanania lanzan*

Out of 6 treatments viz. dithane 0.1%, 0.2%, bavistin 0.1%, 0.2%, redomil 0.1% & 0.2%, foliar spraying of redomil 0.2% followed by redomil 0.1% proved highly effective against wilt diseases caused by *Fusarium oxysporum* in nursery stage.

Biological Control and Botanical Fungitoxicants

Bagasse formulation of *Trichoderma piluliferum* and *T. viride* significantly increased the root biomass in treated *Asparagus racemosus* plants and controlled the root diseases.

Isolation of 15 antagonistic bacteria, a fungus and an actinomycete from the soil samples were collected from different localities of

Madhya Pradesh and Chhattisgarh. Identification and pathogenicity tests were conducted on plants of *Withania somnifera*, *Rauvolfia serpentina* and *Chlorophytum borivillianum*. Bioassay test against four fungal pathogens were confirmed with antagonistic microorganisms isolated from soils of different nurseries and with biopesticide (cow urine+*Azadirachta indica* leaves+*Ailanthus excelsa* leaves+*Calotropis procera* leaves). Four antagonistic bacteria/actinomycetes showed their effectiveness in controlling growth of pathogen *in vitro*.

Samples of *Balanites aegygtica* (root, leaves and bark), *Tephrosia purpurea*(leaves, root, seed),*Citrulus colocynthis* (leaves) were collected from the vicinity of Jodhpur (Rajasthan) and shade dried for preparation of ethanol and water extract. The extracts were used @50mg/ml/solvent for further studies. The pure culture of the fungal pathogens viz. *Rhizoctonia solani*, *R. bataticola*, *Fusarium solani* and *Alternaria alternata* were procured from Forest Pathology Division, FRI, Dehradun and maintained. The ethanolic extracts were tested against the four test fungi. Ethanolic extract of *Citulus colocynthis* (leaves) was found effective in inhibiting the growth of *Fusarium solani.*

Methanol extract of *Sapindus mukorossi* (Gyarahdevi) exhibited IC_{50} at all the concentrations against all the test fungi barring *Alternaria* sp., *Fusarium oxysporum* and *Colletotrichum gloeosporioides (*IC_{50} 2.0%*)*. Butanol extract of Gyarahdevi exhibited IC_{50} at all the concentrations against all the test fungi barring *Alternaria* sp. and *F. oxysporum.*

Volatile effect of citronella oil, garlic oil, lemongrass oil and ajwain oil to inhibit growth and germination of spoilage fungi in stored medicinal plant produce was successfully established. Volatile effect of combination of oils was also tested against spoilage fungi during storage of medicinal plant produce. All combinations of oils were found effective against all spoilage fungi for *Withania somnifera* stored roots. Combination of lemon grass and eucalyptus oils and citronella and eucalyptus oils were not effective in checking fungal infestation in *Stevia rebaudiana* stored leaves.

2.7.3 Mycorrhizae, Rhizobia and other Useful Microbes

Ectomycorrhizal (ECM) Fungi

Standardized suitable culture medium, ideal pH and temperature conditions for mass production of different isolates of two ECM fungi, *L. fraterna* and *P. albus* under *in- vitro* condition. Further the study on identification of suitable type of inoculum for growth improvement of the targeted tree species in nursery revealed that vegetative mycelial inoculum of *P. albus* isolate 3 for *A. auriculiformis*, *C. equisetifolia* and *C. junghuhniana* and *P. albus i*solates 2 and 4 for *A. mangium* was found suitable. Whereas the basidiospore inoculum *of P. albus isolate* 3 was found suitable for *E. camaldulensis* and *E. tereticornis.* Nodule population was found higher in seedlings grown in sterilized potting medium inoculated with vegetative mycelial inoculum of *P. albus* (Isolate 3), followed by same type of inoculum of *P. albus* (Isolates 1 and 2) in Casuarinas. While auscularll the types of ECM inoculum showed good number of ECM colonized roots (myco tips), interestingly the basidiospore inoculum of *P. albus* (Isolate 3) exhibited significantly very high myco tips in all the tree species.

Diversity of mycorrhizal associations with *Dipterocarpus* and *Shorea* species in Assam. Ectomycorrhizal fungi and rhizosphere soil along with mycorrhizal roots of *Dipterocarpus retusus*, *Shorea robusta* and *S. assamica* were collected and photographed in nature. Morphological

characters of fruit bodies like colour, shape, size, odour and number of gills per centimeter were recorded in field. Five different ectomycorrhizal fungi were recorded and out of which three were identified as *Russula, Lactarius* and *Amanita* sp. *Russula* was dominant species and reported to be associated with all selected species.

Arbuscular Mycorrrhizal (AM) Fungi

Rhizosphere soils were analyzed and *Glomus* species was found to be most dominant strain among the endomycorrhizal association with selected plant species. However, percent infection of *Glomus* species was very less. All species were preserved as wet and dried for future study and reference. Pure cultures of associated fungi were raised on potato dextrose agar and are being maintained in laboratory.

Surveys were carried out in Nongkhyllem Reserve Forest, Nongpoh, Meghalaya (Umtasor and Nongpoh) for collecting rhizospheric soil samples. A total of 80 rhizospheric soil samples from different plant species were collected and screened for endomycorrhizal qualitative and quantitative analysis. The two dominant and efficient endo-mycorrihizal strains (*Glomus* sp. and *Gigaspora* sp.) which were prevalent in these forest soils were isolated and are under further process for inoculum production and mass multiplication trial in lab.

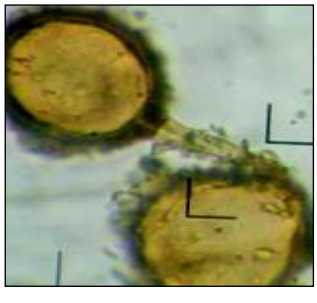
Roots and rhizosphere soil samples collected from the root zone of native tree species such as A*ilanthus excelsa, A. triphysa, Neolamarckia cadamba, Gmelina arborea, Melia dubia* and *Dalbergia latifolia* in different parts of Tamil Nadu and Kerala were processed and estimated percent root colonization and soil spore population of Arbuscular Mycorrhizal (AM) fungi. Twenty seven different AM fungi belonging to three genera such as *Acaulospora, Gigaspora* and *Glomus* were recorded from the rhizosphere of different native tree species. Among them, the genus *Glomus* was found dominant and followed by *Acaulospora.*

Survey was carried out for seeing the association of AM fungi for *Acacia auriculiformis, Tectona grandis, Casuarina equisetifolia* and *Eucalyptus camaldulensis* plants. Results showed high level of mycotrophy with AM fungi in all selected species Altogether 10 species of fungi belonging to 5 genera were recorded. Predominant species were Gigaspora, Glomus and Sclerocystis in Shimoga area and only Gigaspora and Glomus species were predominant in Sravanabelogola and Doddaballapura area. Efficacy of treatments with AM inoculum in nursery experiments revealed that if inoculum is provided at seedling stage, the growth of plants can be boosted tremendously. Overall, fortification of the root zone with AM fungi has yielded improved growth, biomass and survival of seedlings, and seedling quality index. The treatment is very economical and eco-friendly.

Five AMF of mehndi genera such as Glomus, *Gigaspora, Scutellospora, Sclerocystis* and *Acaulospora* and among the species of *Glomus* viz., *G. fasciculatum, G. aggregatum, G. mosseae, G. macrocarpum, G. microcarpum, G. intraradices, G. reticulatum, G. constrictum, G. multicaulae, G. geosporum* and *G. convolvulus* were recorded. *Glomus multicaulae*, first time reported on mehndi from Pushkar and Ajmer. *Sclerocystis indica* was recorded on mehndi and ashwagandha from Nagaur and Pushkar (Ajmer), respectively.The distribution of different AM species viz., *G. aggregatum* (35%), *G. mosseae* (15%), *G. fasciculatum* (20%), *G. macrocarpum* (10%), *Glomus* sp. (15%), *Scutellospora* (3%) and *Aculospora* (2%) were recorded in ashwagandha, whereas, in mehndi, distribution of AM fungi recorded as *G. fasciculatum* (55%),

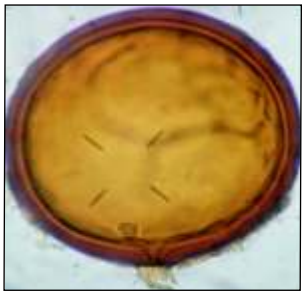
G. aggregatum (20%), *G. macrocarpum* (12%), *Glomus* sp. (8%), *Acaulospora* (5%), *Scutellospora* (3%) and *Sclerocystis* (2%) with the dominancy of *G. fasciculatum*.The maximum root infection was recorded (85%) from Sojat (Pali) and minimum (46%) from Pushkar, Ajmer. While, in ashwagandha, maximum root colonization (78%) was recorded from Harima Krihifarm (Nagaur) and minimum (34%) from Ajmer. Root infection was recorded 54 per cent, while, AM spores were found 210/100 gm soil. Both the species viz mehndi and ashwagandha were found highly mycorrhizal in nature. The root infection was found in the form of intercellular, intracellular hyphae, vesicles and arbuscular structures in the roots. In VAM inoculation experiments, the maximum (53.6cms) shoot length was recorded in seedlings inoculated with pure culture of *G. fasciculatum*. However, all the treatments were found effective in all parameters i.e., enhancing shoot height, basal stem diameter, number of spores/10gm of soil and percentage of infection in mehndi, whereas, in case of ashwagandha, the maximum shoot height, basal stem diameter was 70.5 cms and 10.5 mm, respectively in seedlings inoculated with consortium inoculums with dominancy of *G.aggregatum*. No. of spores/10gm of soil and percentage of infection were also recorded high as compared to other treatments.

AM Spores Collected from Mehndi & Ashwagandha

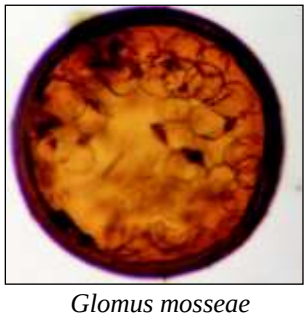


Glomus geosporum

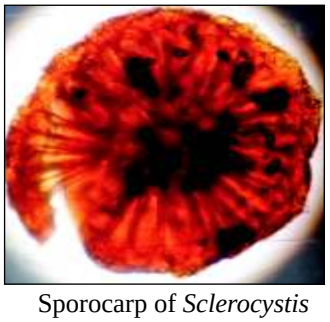
Glomus fasciculatum



Glomus sp.



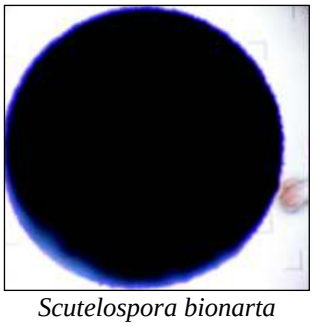
Glomus mosseae



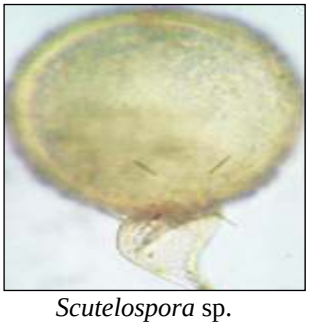
Sporocarp of *Sclerocystis*

Acaulospora sp.

Acaulospora sp.



Scutelospora bionarta



Scutelospora sp.

Microbial Inoculants

The Plant Growth Promoting Rhizobacterias (PGPRs) such as *Bacillus megaterium, Pseudomonas fluorescens, Azotobacter chroococum* and *Azospirillum brazilense* were tested on rootings of 30 Eucalyptus clones under nursery conditions. The PGPRs increased the rooting and growth of Eucalyptus cuttings equivalent to IBA treated cuttings. The clones C-14 and C-111 responded better for rooting when the cuttings were inoculated with *Pseudomonas fluorescens* or *Azotabacter chroococum* at the rate of 5 ml/cutting as compared to IBA (4000 ppm) treated cuttings.

Plant Growth Promoting Rhizobacterial (PGPRs) isolates were isolated from the soil samples collected from native tree species viz., *Ailanthus excelsa* (69 isolates), *A. malabaricum* (12 isolates.), *Anthocephalus cadamba* (33 isolates), *Gmelina arborea* (45 isolates), *Melia dubia* (28 isolates) and *Dalbergia latifolia* (27 isolates) and maintained in laboratory for further biochemical tests.

Population density of the PGPRs isolated from various soil samples of the selected native tree species was also estimated. Among them, the samples collected under *N. cadamba* trees had maximum colonies than other tree species.

Species level identification of the genera such as *Azotobacter, Azospirillum, Bacillus* and *Pseudomonas* isolated from the samples of *Ailanthus. excelsa, A. triphysa* and *Neolamarckia cadamba* were done. Identification of the PGPRs isolated from the samples of *G. arborea, M. dubia* and *D. latifolia* is under progress.

Frankia is the Nitrogen fixing actinomycete and particularly associated with *Casuarina* species. Six strains (Cj Cbe1, Cjkl, CjN1, Ce Py1, CePy2, CeSc1) of *Frankia* were isolated from the nodules of *Casuarina equisetifolia* and *C. junghuhniana* and were grown in artificial medium. The strain CjCbE1 exhibited better performance with the seedlings and cuttings of *Casuarinas* spp. as it produced higher nodule numbers (7/cutting) and nodule weight (55mg/nodule). Normally the cuttings of Casuarinas raised in inert media do not show root nodules. However, in the present study the nodulation was achieved in the cuttings of *Casuarina* spp by artificial inoculation of *Frankia* in the inert media.

Germplasm of growth promoting organisms were collected from 11 different localities of M.P. Experiments on *Gmelina arborea, D.sissoo* and *J.curcas* were conducted in root trainers and growth promoting organisms were selected for these species. Twenty different fungi isolated from rhizosphere soil were screened for plant growth promoting properties (germination% and height). Of them, *Aspergillus* sp. and four *Trichoderma* spp., were found growth promoting and selected for use in nursery. Application of plant growth promoting microbes (AM fungi, *Aspergillus* sp. and *Azospirillum*) and soil amendments (mix of *Lucaena,* teak leaves and FYM in equal ratio, v/v) increased 10-20% survival of sandal seedlings. When out planted in the field, it also increased plant height up to 43%.

Education Vistas

Introduction

The Directorate of Education of ICFRE is mandated to promote forestry education in Universities by providing financial support to Universities to strengthen infrastructure such as building, equipments, computer centre, library etc. In all, there are 26 Universities in India to which the Grant-in-aid is provided by this Directorate.

This Directorate also undertakes the Human Resource Development Programme such as organizing training on Basic Forestry Management Practices for scientists at the entry level and other training programmes for middle level Senior Scientists on "Research Methodologies" and "Research Management & Administration" with a view to sharpening their research skills & update their knowledge. In addition to these, recently two new thrust areas have been assigned to the Directorate of Education.

These are "Policy Research" and the "Disaster Management". The conduct of Policy Research in the arena of Forests, Wildlife and Environment is one of the important mandate of ICFRE. Recent events such as cyclone, tsunami etc. have triggered research interest in the field of disaster management to explore their mitigatory role in the event of occurrence of such disaster, generate information & create awareness on the same.

The Directorate has Policy Research Division to review and analyze the existing forest policies, statutes and their frame work.

- The Directorate of Education is providing Grant-in-aid to the Universities for promoting Forestry Education in the Country. Towards this end, ICFRE released Grant-in-aid to the tune of Rs. 450 lakhs to 15 Universities in the financial year 2009-10. Also obtained Utilization Certificates from 15 Universities and revalidations were issued for 12 Universities for the balances available with them.
- Encouraged Universities to get accreditation with ICFRE, as a new initiative of quality control in forestry education for the first time through Accreditation Board of ICFRE. The accreditation process completed for 9 Universities.

HRD Initiatives

- As part of the HRD initiatives for capacity building of scientific personnel, 13 training programme were organized in a number of training organizations of repute, in which 211 participants were trained in 8 institutions.
- In order to provide wide national exposure to the scientists, a total of 111 permissions were issued at Council level for participation of scientists in national level seminars, workshops, symposia etc.
- Facilitated 47 cases of foreign visits, which were finally approved from the Government of India with funding from a number of sources providing a much needed international exposure to the scientific cadre.
- Prepared Report of MoEF committee on "Capacity Building of other stakeholders and members of other services" and submitted to Ministry.

Mid - Career Training of IFS

- ICFRE successfully competed and prepared Mid-Career Training Project for IFS officers for phase III by providing best institutional

arrangement and partnership with Institutions like WII, Dehradun, FSI, Dehradun, IIM-Ahmedabad, Colorado State University (US) and Swedish University of Agricultural Sciences (SLU) Sweden.

- ICFRE also has the distinction of organizing first ever such programme as lead training provider from 14th December 2009 to 19th March 2010, which led to establishment of protocols for future trainings.

Policy Research

Organized third interactive meeting of policy research committee of MoEF on 29th January 2010 and a meeting of Sub committee on 10th February 2010 at New Delhi.

3.1 FRI (Deemed) University

Forest Research Institute, Dehradun was conferred the status of Deemed University by the Ministry of Human Resource Development, Government of India, New Delhi. After the conferment of Deemed University status, the University started three Masters degree courses and three Diplomas in the field of Forestry and allied sectors. Since then, the University is carrying out multi-disciplinary Forestry, R&D, Education and Extension activities aimed at creation and dissemination of scientific knowledge for sustainable development, management, conservation and utilization of forest resources and environmental management.

Academic Courses and Admission

The FRI University is offering M.Sc. in Forestry, M.Sc. Environment Management and M.Sc. Wood Science & Technology besides Post Masters Diploma in Natural Resource Management, Post Graduate Diploma in Aroma Technology and Post Graduate Diploma in Pulp & Paper Technology on a regular basis. The M.Sc. courses are of two years duration while, diplomas are of one year duration.

Admissions to all the courses are made on the basis of all India Competitive Entrance Test while, admission to PGD in Pulp & Paper Technology and PGD in Aroma Technology is on merit basis. During the year 2009-2010, 113 students were admitted in all the above six courses.

Special Lectures

Besides normal curriculum, the students are exposed to the views of experts on various topics by way of arraning exposure trips / tours, special lectures etc.

Students Attending Special Lecture

Trainings

- Forest Research Institute (Deemed) University Organized 10 weeks Induction Training of Scientists and Research Officers of ICFRE from 15th March to 23rd May 2010. The training included topics like Watershed Management, Soil and Water Conservation, Restoration of Mine lands, Forest Types of India, Sustainable Forest Management, Joint Forest Management, Extension Forestry, Research Writing, Climate Change, Forest Protection, Forest Certification, Wildlife Management, Environment Management and Environmental Impact Assessment were delivered by Internal faculties of FRI (Deemed) University as well as visiting faculties from IIRS, WII, IGNFA, SFS College, Meteorological Department etc and retired Scientists / Forest officials etc.

- Educational tour for induction trainees was conducted to Punjab, Haryana and Himachal Pradesh and also to Bangalore and Coimbatore.
- Visits were organized to various organizations like Indian Institute of Remote Sensing, Dehradun; Forest Survey of India, Dehradun; IGNFA, Dehradun and all division of FRI.

North Zone Vice Chancellors Conference was organized by FRI (Deemed) University with the Association of Indian Universities (AIU) from 22nd to 24th September 2009 in Convocation Hall of FRI.

Ph.D. Programme

1. Research Scholar registered during the period - 63
2. Viva - Voce held during the period - 66
3. Award of Ph. D. Degree - 68

Annual Sports Meet was organized by the University from 19th to 22nd March 2010. A number of events including cricket matches, volley ball matches, tug of war, various indoor games etc. were organized during the sports meet.

Tug of War during the Annual Sports Meet

Cultural Activities

- The University organized inaugural session with the officials of FFDC, Kannauj, officials of University and the students of Post Graduate Diploma in Aroma Technology on 11th August 2009 in Conference Hall of the University. The Director FRI inaugurated the session.
- Seminar on the topic "Parvatiya Kshetron Mein Audyogik Vikas aur Paryavaran Sanrakshan" was attended by the students of FRI (Deemed) University at FRI on 4th and 5th November 2009.

Attachments

- Industrial attachment was arranged for the students of M.Sc. Wood Science & Technology 3rd semester from 1st to 31st December 2009 to different wood based industries of India.
- Institutional attachment was arranged for the students of M.Sc. Forestry 3rd semester and M.Sc. Environment Management 3rd semester from 1st to 31st December 2009 to different research Institutions of India.
- Mill attachments were arranged for the students of PGD in Pulp & Paper Technology Students from 15th December 2009 to 15th February 2010 as a part of Industrial training.

Dissertations

- Dissertations were completed by the final semester students of all M.Sc., PMD and PGD courses from 1st March to 31st May 2009 and dissertation reports submitted for evaluation. The work was evaluated by experts.
- The students of Post Masters Diploma in Aroma Technology course went on six months industrial training and project work at

FFDC Kannauj, U.P. from mid December 2009 to mid June 2010.

Placements

- Campus Interview was conducted by different Organizations/Industries/Companies/NGO's and placement of over 35 students was carried out.

3.2 Trainings Organized

Indian Council of Forestry Research & Education (ICFRE), Dehradun

Five days training course for scientists and officers on "Carbon Sequestration" was organized by the Biodiversity and Climate Change Division at ICFRE, Dehradun from 5th to 9th October 2009.

Participants and Organizers of One Week Refresher Training Course for IFS Officers

Forest Research Institute (FRI), Dehradun

- Short term training on "Plywood Manufacture" from 24th to 28th August 2009.
- Training course on "Timber Grading and Timber Testing" was organized by Timber Mechanics Discipline, Forest Products Division, FRI, Dehradun for the officials of J & K State Forest Development Corporation from 6th April to 5th October 2009.
- Five days training programme from 31st August to 4th September 2009 on "Enterpreneurership Development Programme for Handmade paper through Sisal Fibre" sponsored by UCOST.
- Short term training on "Value Addition of NWFPs" was organized by Chemistry Division FRI from 14th to 17th July 2009.
- Training on "Isolation, Identification and Preservation of Fungi" sponsored by ICFRE, held in Forest Pathology Division, FRI, Dehradun from 18th to 23rd January 2010 for the Scientists and Research Officers of ICFRE institutes.
- Training of Officers of APSARA National Authority, Cambodia at Forest Research Institute, Dehradun for exposure to forestry research in the field of Silviculture, Forest Pathology, Forest Entomology, Forest Products, Botany, Nursery Techniques, and Research Management, etc. from. 10th to 26th February 2010.
- Training on Improved Seed and Nursery Technology from 21st to 25th September 2009.
- Training on Hi-Tech Nursery and Plantation Management" from 8th to 17th June 2009.
- Trainings on Plant Protection and Treatment of Diseases of trees to field staff of NDMC 3 batches on 14th to 18th December 2009; 1st to 5th February 2010 and 8th to 12th March 2010.
- Training on forestry for IT/Computer Scientists of ICFRE from 30th November to 11th December 2009 at FRI.
- Training on Afforestation techniques for Eco-task Force personnel of Territorial Army from 15th to 18th September 2009.
- Training on Afforestation techniques for Eco-task Force personnel of Territorial Army from 27th to 30th October 2009.
- Training programme on "Natural Disaster Management in Forestry Sector" in

collaboration with National institute of Disaster Management from 18th to 22nd January 2010.

- Cultivation and value addition of Medicinal plants from 6th to 9th December 2009.
- Training on "Eco-restoration of Wastelands".
- Training on "Bio-remediation and Environment Amelioration".
- Training on Arc info 9.3. 2nd to 6th March 2009 Organized by Bio-informatics and GIS Division FRI.
- Farmers Training on "Bamboo species Cultivation Harvesting and Sale" on 28th April 2009.
- Farmers Training on "Value Addition of Medicinal Plants for Better Yield and Profit" on 23rd June 2009.
- Farmers Training on "National Bamboo Mission Farmers Training at CSFER" from 15th to 19th March 2010.
- A Training Programme on "Trainers Training on Nursery Techniques and Raising Quality Planting Stock" from 24th to 28th August 2009. Organised at SFRI Kanpur under Van Vigyan Kendra of ICFRE.
- Farmers Training-cum-Extension Programme on "Age Suitability for Plantation of Tree species" at Demo Village Saidupur, Allahabad on 19th February 2010.
- Farmers Training-cum-Extension programme on "Agroforestry" under the CSFER, Allahabad at Badshahpur, Machhalishahar Tahsil, Jaunpur on 18th February 2010.
- Farmers Training-cum-Extension programme on "Eucalyptus in Agroforestry" under the supervision of Head, CSFER, Allahabad at Ram Sanehi Ghat , Barabanki on 5th March 2010.
- Farmers Training-cum-Extension programme on "Teak in Agroforestry" under the supervision of Head, CSFER, Allahabad at Kaudihar, Soraon Tahsil , Allahabd on 7th March 2010.
- Farmers Training-cum-Extension programme on "Poplar in Agroforestry" under the supervision of Head, CSFER, Allahabad at Khajani, Gorkhpur on 11th March 2010.
- Farmers Training-cum-Extension programme on "Aonla in Agroforestry" under CSFER, Allahabad at Berui, Allahabad on 26th March 2010.

Institute of Forest Genetics & Tree Breeding (IFGTB), Coimbatore

- A Training on Cultivation and Management of Casuarina and Eucalyptus for the farmers of Coimbatore District under the National Agricultural Innovative Programme Project Development of Value chain for Industrial Agroforestry in April 2009.
- A Training-cum-Demonstration was organised on Database of digitized Herbarium of IFGTB in April 2009.
- A five days Training on Bamboo Cultivation and Management for Horticulture officers of Tamil Nadu from 18th to 22nd May 2009.
- A five days Training Programme on Bamboo Cultivation and Management for Horticulture officers of Tamil Nadu from 25th to 29th May 2009.
- Training programme on Quality Planting Stock Production and Agroforestry for the Range Forest Officers of the Extension Wing of Tamil Nadu Forest Department was organised from 24th to 26th July 2009.

- Two days Intensive Hands on Training Programme on "Instrumentation Methods and Chemical Analysis-Extraction, Separation, Suitability of Solvent Ratio, TLC Elucidation and UV Characterization of Plant Metabolites" on 27th and 28th July 2009.
- Training on Industrial Agroforestry for farmers of Karur District on 30th August 2009 under the National Agricultural Innovative Project (NAIP).
- One day Technical Training-cum-Meeting on Descriptors of Eucalyptus and Casuarina sponsored by Protection of Plant Varieties and Farmer's Right Authority of India on 23rd September 2009 at IFGTB.
- Two days Intensive hands on training on "Instrumentation Methods and Chemical Analysis - Extraction, Separation, Suitability of Solvent Ratio, TLC Elucidation and UV characterization of Plant Metabolites" on 9th and 10th September 2009.
- Training on Tree Cultivation and Protection of Plant Varieties for Farmers on 6th October 2009.
- A two days training on Quality Planting Stock Production for farmers on 8th and 9th October 2009.
- A one day training on "Forest Botany and Herbarium Techniques" for the trainee Foresters of the Tamil Nadu Forest Academy (TNFA) on 23rd October 2009.
- Training on Bamboo Cultivation and Management for farmers of Karur District with the support of District Horticulture Department on 22nd October 2009.
- Training on Bamboo Cultivation and Management for farmers of Nagapattinam District of Tamil Nadu on 27th and 28th October 2009.
- A training on Plantation Management for the Assistant Conservators of Forests and Range Officers of the Extension wing of the Tamil Nadu Forest Department on 9th November 2009.
- Training on "Germplasm Characterization using DNA Marker Technologies" for researchers and lecturers on 3rd and 4th December 2009.
- Training on Plantation Technologies for Villagers of Kandiyur Demo Village on 8th December 2009.
- Two days training programme on Rust fungi in weed management on 4th and 5th January 2010 was organised under the Project on "New Biocontrol Opportunities for Prickly Acacia : Exploration in India".
- Training on "Phytochemical Analysis of Medicinal Plants using TLC, MPLC, UV, HPLC, and GC/MS/MS" for Chemists and Research Scholars of Tamil Nadu State Forest Department from 18th to 23rd March 2010.
- Training on Integrated Pest and Disease Management for officials of the Tamil Nadu State Forest Officials on 30th March 2010.
- Training on Biofertilizers and Biomanures for Farmers of Tamil Nadu on 31st March 2010.

Institute of Wood Science and Technology, (IWST), Bangalore

- Twelve training programmes under "Van Vigyan Kendra", FRC, Hyderabad. A total of 416 participants received training on topics covering Forest nursery, Tree improvement, Wood science, Biodiversity and Environment related issues and Disaster management, etc.

- A training to the officials of KFD on 4th March 2010.
- Training on Wood Seasoning and Preservation from 7th to 11th September 2009.
- Training on Field Identification of Important Timbers from 16th to 20th October 2009.
- Training on Sandal Seed and Nursery Practices from 23rd to 27th November 2009.
- Training on Classification and Grading of Timbers from 2nd to 4th December 2009.
- Training on Wood Protection from 4th to 8th January 2010.
- Training on Designing Green Landscapes to Provide Multiple Services from 4th to 8th January 2010.
- Training on Sandal Seed and Nursery Practice from 15th to 19th February 2010.

Tropical Forest Research Institute (TFRI), Jabalpur

- Training to progressive farmers under Nawan Range, Baranawapara Project Division, Raipur, Chhattisgarh on the benefits of adopting bamboo based agroforestry systems on the 13th and 14th May 2009.
- Training to progressive farmers on the benefits of adopting bamboo based agroforestry systems at Gwalior on 25th and 26th May 2009.
- Training on "Lac and Medicinal Plant based Agroforestry System for Maharashtra" to the selected farmers of different villages of Yeotmal and Chandrapur districts of Maharashtra from 27th to 30th October at Yeotmal and Chandrapur, Maharashtra in association with BAIF, Pune.
- Training on Harvesting and processing of Mahua to the forest officials of Orissa held in January 2010 at Tropical Forest Research Institute, Jabalpur.
- Training on medicinal plant based agroforestry system to the farmers and forest officials of Raipur and Dhamtari districts of Chhattisgarh on 24th and 25th February 2010 at Van Vigyan Kendra, Raipur, Chhattisgarh.
- Training for Trainers on "Mahua Collection and its Storage Practices" from 9th to 11th April 2009 at Chhattisgarh Minor Forest Produce Federation, Raipur.
- Training on bamboo based agroforestry system to the selected farmers of different villages of Yeotmal and Chandrapur, Maharashtra from 27th to 30th October at Yeotmal and Chandrapur, Maharashtra in association with BAIF, Pune.
- Training on Development of wasteland through agroforestry systems to the SFD officials, NGOs and farmers of Madhya Pradesh on 4th and 5th December 2009 at VVK, Jabalpur.
- Training on "Plantation, Agriculture and Climate Change" on 26th February 2010 at village Jamuniya, Jabalpur for farmers and tree growers.
- One day training programme on "Insect Pests and Diseases of Chironji, *Buchanania lanzan* and their Control Measures" for the SFD officials of at Batkakhapa, East Forest Division, Chhindwara on 8th January 2010.
- One day training programme on "Insect Pests and Diseases of Teak, *Tectona grandis* and their Control Measures" for the SFD officials at Belkund, Kundam Forest Project Division, (M.P. Forest Development Corporation), Jabalpur on 24th February 2010.
- One day Training Programme on "Insect Pests and Diseases of Aonla, *Emblica officinalis* and their control measures" for the

SFD officials at Wamandehi, Research & Extension Circle, Seoni on 10th March 2010.

- Training on "Application of Biofertilizers in Nurseries and Plantation" for the field personnel of Forest Development Corporation of Maharashtra, Nagpur on 16th and 17th November 2009.
- Training on "Nursery Techniques of Important Forestry Species of Central India " to the farmers and field functionaries of SFD, Madhya Pradesh on 11th and 12th August 2009 at Dindori.
- Training on "Nursery Techniques of Important Forestry Species" to the farmers and field functionaries of SFD, Orissa on 26th and 27th August and 16th and 17th September 2009 at Van Vigyan Kendra, Koraput.
- Training on "Nursery and Plantation Technology of Bamboo" to the farmers and field functionaries of SFD of Gujarat under BTSG of bamboo mission on 7th and 8th September 2009 at Tropical Forest Research Institute, Jabalpur.
- Ten training programmes on different aspects of forestry and environment related issues were organized during the year at CFRHRD, Chhindwara.

Training on "Soil Conservation and Watershed Management" on 4th June 2009 at CFRHRD, Chhindwara

Rain Forest Research Institute (RFRI), Jorhat

- Training on Nursery and Plantation Techniques of *Acacia mangium* from 22nd to 25th June 2009 to farmers.
- Training on Participatory Rural Appraisal (PRA) and Microplanning form 5th to 9th February 2009 for both the staff and villager participants.
- Training on Bamboo Nursery on 21st and 22nd February 2009.
- Training on Vermicomposting on 23rd and 24th February 2009.
- Training on Patchouli Agroforestry on 1st August 2009.
- Training on Awareness on *Acacia mangium* from 22nd to 25th June 2009.
- Training for participating farmers on "Legume Based Agroforestry for Sustainable production in Jhum land" held at Phumen Ingti Village at Rongmorgwe Block (Karbi Anglong)–18th December 2009 and Bey Killing Village at Nilip Block (Karbi Anglong) on 21st December 2009.
- Training on "Application of GPS technology in Land Resource Survey" from 14th to 16th September 2009.

Training on "Application of GPS Technology in Land Resource Survey"

- Training on Bamboo Pests and Diseases and their Management under the Van Vigyan Kendra of Nagaland from 25th to 27th July 2009 at Tuensang, Nagaland.
- Training to a group of Foresters & Forest Guards of State Forest Department of Tripura on 11th October 2009 held at RFRI, Jorhat (Assam).
- Training on Vermicompost production, Post harvest preservation and treatment of Bamboo for enhance durability and Nursery techniques for bamboos on 31st March 2009 to 50 Nos Forest Gaurds of State Forest School, Makum, Dibrugarh at RFRI, Jorhat.
- Training on 'Vermicompost production and its application in Bamboo and other crops' on Van Vigyan Kendra, Assam, at Makum Forest School, Dibrugarh on 13th March 2009.
- Training to a group of Foresters & Forest Guards of State Forest Department of Tripura on 11th October 2009.
- Training on bamboo to the Forest Officials of Mon District, Nagaland on 29th and 30th October 2009.
- Training on plantation management, nursery raising and bamboo value addition in the training under VVK, Tripura on 25th and 26th February 2010 at Agartala (Tripura).
- Training on “Bamboo Value Addition” and “Bamboo: An Opportunity for Livelihood Need” respectively at 10th Jorhat Trade Fair at Jorhat (Assam) on 12th February 2010.
- Training on Bamboo at Phek District, Nagaland under VVK Programme on 25th and 26th March 2010.

Arid Forest Research Institute (AFRI), Jodhpur

- One week compulsory training of IFS Officers on “Integrated Approach for Sustainable Development of Fragile Desert Ecosystem” sponsored by Ministry of Environment & Forests, Govt. of India, New Delhi, from 14th to 18th December 2009.
- Three days training for farmers and field functionaries from 13th to 15th February 2010 under VVK (Rajasthan) at Kisan Bhawan Bikaner, Rajasthan.
- Training on VAM technology from 7th to 9th September 2009 to forest officials, progressive farmers under VVK project at Gandhinagar, Gujarat.

Himalayan Forest Research Institute (HFRI), Shimla

- Two days Training-cum-Demonstration programme on “Inter Cultivation of Medicinal Plants: An Option for Augmenting Rural Income” on 26th and 27th May 2009 at Brundhar Nursery, Manali, District Kullu, Himachal Pradesh.
- One day training programme on "Forest Productivity: Enhancement Through Tree Improvement" on 17th September 2009 at Field Research Station Bir Plasi, Nalagarh.
- One day training programme on "Bee Keeping and Integrated Pest Management" to 80 farmers of Model village Lanabaka, District Sirmaur, Himachal Pradesh on 29th September 2009.
- One day training programme-cum-workshop on "Eco-restoration of Degraded Areas Through Forestry Interventions" at Dhaula Kuan (Poanta Sahib), District Sirmour on 22nd January 2010.

- A one day training programme on "Application of Technological and Research Interventions for Enhancement of Productivity" was organized at State Forest Research Institute, Jammu on 17th February 2010.
- One day Training-cum-Demonstration programme on “Commercial Cultivation of Patish and Chora” at Field Research Station, Bruhandhar (Manali) on 21st February 2010 under National Medicinal Plants Board (NMPB).

Institute of Forest Productivity (IFP), Ranchi

- One day farmers training on “Vermicomposting” at Forest Research Centre, Mandar, Ranchi on 20th April 2009 where 12 number of farmers were participated.
- Training on “Lac Cultivation Through Scientific Method” and Establishment of Broodlac Farms” at Khunti district of Jharkhand on 18th and 19th May 2009.
- One month training on “Molecular Biology” was conducted for the students of Marwari College, Ranchi on 04th October 2009 at "Molecular Biology and Tree Physiology Laboratory" of the Institute.
- One day training programme on “Lac Cultivation Through Scientific Method” at N.B. Farm, Hesadih and N. B. Farm, Chandwa on 30th October 2009 and on 27th November 2009.
- Two days Awareness Training on “Dissemination/Awareness Training on Cultivation & Marketing of Important Medicinal Plants” at Environmental Research Station, Sukna, W.B. on 23rd and 24th February 2010.
- Statistical Training was conducted at IFP, Ranchi from 8th to 18th February 2010.
- Two days farmers training on “Vermicomposting” under the NAIP (ICAR) funded project titled “Up- scaling Livelihood of Forest Communities through Enhanced Farm Productivity and Efficient Support Systems in Godda District of Jharkhand” at Forest Research Centre, Mandar on 22nd and 23rd February 2010.

Lectures and Field Training to the Farmers during Training on Vermicomposting under NAIP Project

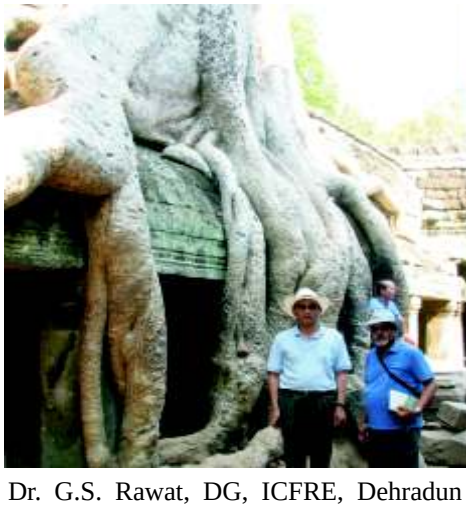
3.3 Visits Abroad

- Dr. G.S. Rawat, DG, ICFRE; Shri M.S. Garbyal, DDG (Admin.); Dr. Rabindra Kumar, DDG (Extension);

(From L to R) Dr. Dharmendra Verma, ADG (EIA); Shri M.S. Garbyal, DDG (Admin.); Dr. G.S. Rawat, DG, ICFRE; Dr. Rabindra Kumar, DDG (Extn.), in Bhutan

Dr. Dhramendra Verma, ADG (EIA) and Shri Sudhir Kumar, Scientist- E, EIA, ICFRE, Dehradun visited Bhutan to inspect the EIA Consultancy of Sankosh Hydro Electric Project from 7th to 11th September 2009.

- Dr. G.S.Rawat, DG, ICFRE attended APARI 5th Assembly on 4th October 2009 in Malaysia.
- Dr. G.S. Rawat, DG, ICFRE, Dr. S.S. Negi, Director, FRI, Dehradun, Dr. H.S. Ginwal, Head, G&TP Division, FRI, Dehradun and Dr. Madhumita Das Gupta, Scientist-D, IFGTB, Coimbatore attended International Symposium on "Forest Genetics Resources Conservation" from 5th to 8th October 2009 in Malaysia.
- Dr. G.S.Rawat, DG, ICFRE attended FAO SOW FGR Meeting on 9th October 2009 in Malaysia.
- Dr. G.S. Rawat, DG, ICFRE attended "III Meeting of Governing Board of the SAARC Forestry Centre" on 12th and 13th October 2009 in Bhutan.
- Dr. G.S. Rawat, DG, ICFRE, Dehradun inspected the pretreatment and preservation works being conducted by FRI, Dehradun at Ta Phrom Temple in Cambodia during 2nd to 7th March 2010. He alongwith the team of experts met with the Mr. Bun Narith, DG, APSARA National Authority and other senior officers and assured them of complete cooperation from the Council. He also met with Shri R.K. Sachdev, ambassador of India and appraised him on the works being done by the Council in Cambodia.



Dr. G.S. Rawat, DG, ICFRE, Dehradun along with Dr. N.S.K. Harsh, Scientist- F, FRI, Dehradun Inspecting the Preservation Work at Ta Phrom Temple in Cambodia

- Shri Sandeep Tripathi, Director (Research), ICFRE attended "8th Asia Flux Workshop-2009" from 27th to 30th October 2009 in Japan.
- Shri Jagdish Kishwan, DG, ICFRE and Shri V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, ICFRE participated in the thirteenth session of the SBSTA and SBI, sixth session of AWG-LCA and eighth session of AWG-KP at Bonn, Germany, from 1st to 12th June 2009 as part of the Government of India delegation.
- Shri V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, ICFRE participated in Climate Change Talks, from 10th to 14th August 2009 at Bonn, Germany as part of the Government of India delegation.
- Shri V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, ICFRE participated in Climate Change Talk at Barcelona from 2nd to 6th November 2009 as part of the Government of India delegation.
- Shri V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, ICFRE participated in 15th Conference of the parties to the UNFCCC / 5th meeting of the parties to the Kyoto Protocol at Copenhagen, Denmark, from 7th to 18th December 2009 as part of the Government of India delegation.

- Dr. N. S. K. Harsh, of FRI, Dehradun attended 18th Technical Session of International Coordination Committee of UNESCO at Siem Reap, Cambodia from 29th May to 5th June 2009 also attended field visit of Adhoc Experts of ICC at Ta Prohm Temple.
- Dr. S. S. Negi, Shri A. S. Rawat, Dr. N. S. K. Harsh and Dr. S. Nautiyal of FRI, Dehradun visited Siem Reap, Cambodia to conduct training on tree protection and conservation at Ta Prohm Temple and to attend 16th Plenary Session of ICC meeting from 09th to 12th December 2009.
- Shri Mohinder Pal, Director, HFRI, Shimla participated in the International Course on "Climate Change & Desertification Process-Assessment and Monitoring" from 22nd June to 10th July 2009 in Israel.
- Dr. S.S. Negi, Director, FRI; Dr. N.S.K. Harsh, Scientist-F and Dr. Subhash Nautiyal, Scientist-F, FRI, Dehradun visited Sri Lanka for comparing the Tree Conservation Practices from 9th to 16th September 2009.
- Dr. I.D. Arya, Scientist-F; Dr. Sarita Arya, Scientist-E, AFRI, Jodhpur, Shri Raja Muthukrishnan, Scientist- C, IWST, Bangalore and Dr. Abhinav Kant, SRF, FRI, Dehradun participated in the "VIII World Bamboo Congress" from 16th to 19th September 2009 in Thailand.
- Dr. H.S. Ginwal, Scientist–E, FRI, Dehradun; Dr. Modhumita Das Gupta, Scientist-D, IFGTB, Coimbatore participated in the International Symposium on “Forest Genetic Resources, Conservation and Sustainable Utilization towards Climate Change, Mitigation and Adaptation” held in Kuala Lumpur, Malaysia from 5th October to 8th October 2009.
- Dr. Modhumita Dasgupta, Scientist-D, IFGTB, Coimbatore; Dr. Ashok Kumar, Scientist-D, and Ms. Parveen, Scientist-C, FRI, Dehradun participated in the XIII World Forestry Congress held at Buenos Aires, Argentina from 18th to 23rd October 2009.
- Dr. (Mrs) Laxmi Rawat, Scientist-E, FRI, Dehradun participated in Sub-Regional Capacity Building Workshop on Forest, Biodiversity and Climate Change at Singapore from 2nd to 5th September 2009.
- Dr. Rashmi, Scientist-C, FRI, Dehradun carried out research work on "Phythochemical Analysis of Bioactive Compound" as a visiting researcher under DFRFP at Kinjo Gakuin University, Nagoya, Japan from 10th May to 10th November 2009.
- Dr. N. Senthilkumar, Scientist-C, IFGTB, Coimbatore as a Team member EIA, has visited Bhutan during from 11th to 20th May 2009 for the project on “Flora and Fauna for Bhunaka Hydro Electric Project”.
- Dr. A. Karthikeyan, Scientist-D, IFGTB, Coimbatore visited China for participation in International Casuarina meeting held at Haikou, China from 22nd to 26th March 2010.
- Dr. N. Krishna Kumar, Director, Dr. A. Nicodemus, Scientist-D, and Dr. V. Sivakumar, Scientist-D, IFGTB, Coimbatore undertook a study visit and training in advanced seed production systems in CSIRO, Australia and Royal Forest Department, Thailand from 20th to 30th November 2009.

- Dr. S. Viswanath and Ms. Dhanya, B (SRF), IWST, Bangalore atteneded II World Agroforestry Congress at ICRAF/WAC, Nairobi, Kenya on 24th August 2009.
- Shri Umesh A. Kabade, Research Scholar IWST, Bangalore attended World Bamboo Congress, held at Bangkok, Thailand from 18th to 20th September 2009.
- Dr. V.P. Tewari, Scientist-F, IWST, Bangalore visited China to participate in the 3rd GAForN International Symposium on "Academic Forestry Education: Development and Needs" organized at the Kunming Institute of Botany, Chinese Academy of Science, Kunming, China from 8th to 12th March 2010.
- Dr. S.A. Ansari, TFRI, Jabalpur attended 4th Bio Nano Tox and Applications Research Conference, University of Arkansas, Little Rock, USA, on 21st and 22nd October 2009 and Chaired Session VII : Plant Biology, Nano and Biotechnology for Agriculture Use.
- Dr. Nitin Kulkarni, TFRI, Jabalpur attended IUFRO Working Party 7.03.04: Diseases and Insects in Forest Nurseries held from 12th to 16th July 2009 at United States Department of Agriculture (USDA) Forest Service, Hilo, Hawaii, USA.
- Ms. Imtienla Ao, Conservator of Forests and Group Coordinator (Research) RFRI, underwent a compulsory mid-career training programme of eight weeks duration for phase–IV, from February to April 2010, in Finland and Russia.
- Dr. N.K. Bohra, AFRI, Jodhpur visited Copenhagen, Denmark to attend "The Copenhagen Climate Exchange 2009" conference from 2nd to 9th December 2009.
- Shri Mohinder Pal, IFS, Director, HFRI, Shimla participated in the " International Course on Climate Change and Desertification", which was organized by World Meteorological Organization, Israel from 22nd June to 10th July 2009.

3.4 Participation in Seminars/ Symposia/ Workshops/ Trainings

Scientists/Officers/Researchers of ICFRE (H.Q. and Institutes) participated in the following Seminars/Symposia/ Workshops/Trainings:

- Fourth National Forestry Conference F.R.I from 9th to 11th November 2009.
- Interaction of Doctorate IFS Officer with Shri Jairam Ramesh, Hon'ble Union Ministry of State for Environment & Forests on 11th January 2010 at ICFRE, Dehradun.
- Fourth Uttarakhand State Science & Technology Congress–2009 from 10th to 12th November 2009 at G.B.Pant University of Agriculture & Technology.
- The 97th Session of Indian Science Congress (Agriculture & Forestry) at Trivendrapuram, Kerala from 3rd to 7th January 2010.
- Conference on Analytical Science in Energy and Environment held at Indian Institute of Petroleum, Dehradun on 19th and 20th November 2009.
- International conference on 'Green Technologies for Greener Environment' from 27th to 30th January 2010 at Chaudhary Charan Singh University, Meerut.
- Second Rashtriya Yuva Vaigyanik Sammelan-2010 at Doon University, Dehradun on 6th and 7th February 2010.

- International conference on mountain biodiversity and sustainable utilization, Doon University, Uttarakhand from 13th to 15th March 2010.
- Biennial Conference on Recent Advances in Weed Science Research-2010 held at Indira Gandhi Krishi Vishwavidyalaya, Raipur on 25th and 26th February 2010.
- Eighth World Bamboo Congress from 16th to 18th September 2009.
- International Conference on "Nurturing Arid Zones for People and the Environment: Issues and Agenda for the 21st Century" organized by Arid Zone Research Association of India at CAZRI, Jodhpur from 24th to 28th November 2009.
- International Conference on "Recent Advances in Environmental Science and Technology" organized by Centre for Environmental Science and Technology, Banaras Hindu University, Varanasi from 2nd to 4th November 2009.
- National Conference on "Food and Environmental Security through Resource Conservation in Central India: Challenges and Opportunities FESCO-2009" organized by Indian Association of Soil and Water Conservationists, Dehradun at Central Soil and Water Conservation Research and Training Institute, Agra from 16th to 18th October 2009.
- Twelth Indian Agricultural Scientists and Farmers Congress, held at Bioved Research Institute of Agriculture and Technology, Allahabad on 20th and 21st February 2010.
- International Conference on Climate change and Bioresource from 9th to 12th February 2010 at Bharathidasan University, Trichy.
- International Conference on "Climate Change and Environment sustainability in India and Canada: Approaches and Strategies" held at University of Madras, Tamil Nadu (India) from 16th to 18th September 2009.
- National Conference on "Invasive Alien Insects: Threat to Agriculture, Horticulture and Forest Ecosystems" at University of Agricultural Sciences, Dharwad on 20th and 21st January 2010.
- Indian Science Congress, 2010 at Thiruvananthapuram from 3rd to 7th January 2010.
- National Consultation on "Advancing the Science of Taxonomy in India for Biodiversity Conservation" held at ATREE on 23rd February 2010.
- National Conference on "Productivity Enhancement and Value Addition of Bamboo" held at Institute of Forest Productivity, Ranchi on 9th and 10th March 2010.
- National Conference on 'Renewable Energy for Development of Under-Developed Areas with Particular Reference to North-East India" held at Department of Energy, Tezpur University, Tezpur, Assam from 23rd to 25th March 2010.
- "International Conference on Chemical, Biological and Environmental Engineering" held at Nanyang Technological University, in Singapore from 9th to 11th October 2009.
- National Conference on Biodiversity Conservation and Management of Bioresources held on 28th and 29th October 2009 at Andhra Pradesh University, Visakhapatnam.
- National Conference on Biotechnology for the 21st century: New Horizons held on 18th and 19th December 2009 at St. Aloysius College, Jabalpur.
- Fifth International Conference on Biopesticides: Stakeholders Perspective (ICOB-V-2009) held from 26th to 30th April

2009 at Tata Energy and Resources Institute, New Delhi.

- Second International Conference on Biopesticide held from 26th to 28th November, 2009 at St. Xavier's College, Palaymkottai, Tamil Nadu.
- Fifth International Conference on 'Plant Pathology in the Globalized Era', held from 10th to 13th November 2009 at IARI, New Delhi.
- First International Conference on New Frontiers in Biofuels held on 18th and 19th January, 2010 at India Habitat Centre, New Delhi.
- First International Conference on Conservation, Marketing and Patenting of Medicinal Plants (ICCMPMP) held on 14th and 15th March 2010 at Raipur.
- International Conference on Medicinal Plants and Herbal Drugs: Challenges and Opportunities in Cultivation, Sustainable Utilization and Conservation held from 4th to 6th March 2010 at Chennai.
- National Conference on Frontiers in Plant Physiology Towards Sustainable Agriculture, organized by Assam Agricultural University, Jorhat, Assam from 5th to 7th November 2009.
- National Conference on Emerging Trends in Chemical Sciences at Bundelkhand University, Jhansi (UP) from 24th to 26th February 2010.
- National Conference on "Renewable Energy and Trade Show" on 6th November 2009 at Vyas Institute of Engineers and Technology, Jodhpur.
- Twenty fourth Carbohydrate Conference, industrial polysacharides & biological significance of carbohydrates from 7th to 9th December 2009 at Lachoo Memorial College of Science & Technology, Jodhpur organized by ACC&T(India) and IGGMA, Jodhpur.
- National Conference on Forestry Solutions; Strategies for Mitigation and Adaptation of the Impacts of Climate Change in Western Himalayan Mountain States held at Peterhoff, Shimla from 19th to 21st November 2009 organized by Himachal Pradesh State Forest Department.
- "International Conference on Recent Trends in Life Science Researches vis-à-vis Natural Resource Management, Sustainable Development and Human Welfare" held from 27th to 29th June 2009 organized under the auspices of Vinoba Bhave University, Hazaribagh (Jharkhand).

International Conference on "Recent Trends in Life Science Researches vis-à-vis Natural Resource Management, Sustainable Development and Human Welfare"

- National Seminar on Responses of Eco-biological components to the phenomenon of global warming (NSREG- 2009) on 26th and 27th September 2009 in Department of Zoology at Kumaun University, Nainital.
- National Seminar on Climate Change: Data Requirement and Availability on 16th and 17th April 2009 at Indian Institute of Economic Growth, Bangalore.
- National seminar on "Productivity enhancement and Value Addition of Bamboos" Ranchi on 9th and 10th March 2010.
- National Seminar on "Ecological Economics: An Approach towards Socio-economic and Environmental Sustainability" organized by Institute for Social and Economic Change, Bangalore, India on 30th September and 1st October 2009.
- "National Seminar on Frontiers In Biotechnology- (NSFB-2009)" organized by Department of Biotechnology, Bharathiar University, Coimbatore, from 22nd to 24th July 2009.
- National Seminar on "Emerging trends in Plant Biotechnology" on 4th and 5th February 2010 at Government Arts College, Coimbatore.
- National Seminar on "Bioresources–Conservation and Management" on 8th and 9th January 2010 at PSGR Krishnnamal College, Coimbatore.
- National Seminar on the occasion of the Silver Jubilee Celebrations of Silent Valley National Park at Mundur, Palakkad, on 21st November 2009.
- Seminar on Wetland Conservation, organized by Social Forestry Division, Alappuzha under Vembanadu Lake Mangrove conservation project at Perumbalam Island, Alappuzha District, Kerala on 2nd February 2010.
- Third Indo-Korean Joint Seminar on Medicinal Plant Research at Avinashilingum University for Women, Coimbatore, on 3rd February 2010.
- Seminar on "Molecular Strategies in Insect Plant Interactions: Role of Chemical in Host Specialization" organized by Prof. T. N. Ananthakrishnan on 22nd November 2009 at Chennai.
- Water Technology Seminar on "Application of LC and MS Innovation" by Waters, Bangalore on 29th January 2010 at Coimbatore.
- Seminar on "Current Advances in Applied Genetics & Bioethics" at Nirmala College for Women, Coimbatore on 18th and 19th September 2009.
- National Seminar on Genetics, Breeding and Biotechnology organized by University of Calicut on 11th and 12th December 2009.
- National Seminar on "Recent trends in Structural Bioinformatics" conducted by Pondicherry University on 16th and 17th September 2009.
- "Tree Growers Mela" on 18th and 19th February 2010 organized by Institute of Forest Genetics and Tree Breeding, Coimbatore in collaboration with extension wing of Tamil Nadu Forest Department.
- Seminar on "Uses of Modern Technologies in Forests & Advancements in Wood Science" organized by Indo-Italian Trade Centre held at IWST on 19th November 2009.
- National Seminar on Current Trends in the Field of Biodiversity and Sustainable use of

Natural Resources, held at Mata Gujri Mahila Mahavidyalaya, Jabalpur, on 16th and 17th November 2009.

- Second Bhartiya Vigyan Sammelan & Expo-2009 on Green Technologies for Sustainable Development held at Devi Ahilya Vishva Vidyalaya, Indore from 1st to 3rd December 2009.
- National Seminar on Development, Environment and we at Institution of Engineers, Jabalpur on 4th July 2009.
- National Seminar on Designing crops for the changing climate of Birsa Agricultural University, Ranchi from 29th to 31st October 2009.
- National Seminar on Fungal Biodiversity and Bioprospecting in the age of Global warming held on 29th and 30th October 2009 at Department of Botany, Goa University, Goa.
- National Seminar 2010 on Plant Biotechnology: Advances, Impact and Relevance, at Botany Department, AMU, Aligarh on 20th March 2010.
- National Seminar on Rehabilitation of Degraded Lands held on 6th and 7th October 2009 at CSFER, Allahabad.
- National Seminar on "Global Climate Change: Frontier Research in Biological Sciences", held at Department of Life Science, Dibrugarh University on 12th February 2010.
- National Seminar on Emerging Trends in Biotechnology organized by Jodhpur National University on 1st October 2009.
- Seminar on "Water Quality Management" organized by the Marwar Engineering College and Research Centre, Jodhpur on 21st March 2010.
- Second Annual Conclave of High Himalaya Forum as organized by PRAGYA–A Gurgaon based NGO at India Habitat Centre, New Delhi on 9th October 2009.
- Two days Chief Ministers Conclave on Glaciers, Climate Change and Livelihoods at Hotel Peter Hoff, Chora Maidan, Shimla organized by State Council for Science Technology & Environment, in collaboration with Leadership for Environment and Development–India (LEAD) on 29th and 30th October 2009.
- National Seminar on Climate Change held at New Delhi on dated 6th and 7th November 2009 as organized by LEAD, India.
- International Symposium on Rhizosphere Biology of agriculture, horticulture and forestry: Present and future. G. B. Pant University Agriculture and Technology, Pantnagar, Uttarakhand from 25th to 27th February 2010.
- International Symposium on Environmental Pollution, Ecology & Human Health held at Tirupati from 25th to 27th July 2009.
- CIMAP Golden Jubliee National Symposium" on 50 years Research on Medicinal and Aromatic Plants in India" at CIMAP Bangalore on 26th June 2009.
- Workshop on Maintenance of industrially important cells and their molecular characterization, organized by the Deptartment of Biotechnology, PSG College of Technology, Coimbatore from 9th to 21st November 2009.
- Workshop on 'Low Carbon Future', organized by British Council, British Scholars Andhra Pradesh Environment Connect on 18th and 19th July 2009 .
- DST sponsored workshop on Quantitative analysis and modeling in animal science held

at Yeshwant Rao Chavan Academy of Development Administration, Pune from 6th to 11th October 2009.

- The IBISCA Workshop, held at IWST, on 30th October 2009 as a part of 5th International Canopy Conference.
- International Workshop on "Nocturnal Pollination: Patterns & Process" at IISc. from 23rd to 27th March 2009.
- Workshop on Clean Development Mechanism (CDM) held on 11th August 2009 at Bhopal.
- Workshop on Utilization of automatic weather station and agrometeorological station data for M.P. held on 7th October 2009 at SFRI, Jabalpur.
- National workshop on Agroforestry on 5th and 6th July 2009 at College of Agriculture, Nagpur.
- "Workshop on Sustainable Development and Management, Value Addition etc. of the Medicinal Plants of Nagaland"on 9th and 10th December 2009 at Dimapur conducted by Department of Forests, Govt. of Assam.
- "Review Workshop on Bio-Geo Database" organized by NERIWALM, Tezpur at OKDISCD, Guwahati (Assam) on 18th February 2010.
- National Workshop of Rattans (Canes) at Itanagar organized by CBTC, Guwahati from 24th to 26th February 2010.
- "Two days Sensitization Workshop on Common Guidelines" on 25th and 26th June 2009 at Jodhpur.
- Workshop for the preparation of state environment policy for Rajasthan at Jodhpur on 27th October 2009.
- Workshop on Statistical Application in Biotechnology at Dayalbagh Educational Institute, Agra on 30th and 31st October 2009.
- A National Workshop on "Intellectual Property Rights : Biodiversity to Biotechnology vis-a-vis Traditional Knowledge" from 22nd to 24th October 2009 at Dr. Shyama Prasad Mukherjee Govt. Degree College, Allahabad.
- Training Programme on Latest trends in Environmental Impact Assessment (EIA) - Process and Procedures as per MoEF guidelines. Engineering Staff College of India, Hyderabad from 14th to 16th September 2009.
- Training Programme on Comprehensive Landslide Risk Management National Institute of Disaster Management (NIDM), New Delhi from 1st to 5th February 2010.
- Training Programme on Wildlife Conservation: Issues and Challenges. Wildlife Institute of India, Dehradun from 8th to 12th March 2010.
- Training Programme on Dendroclimatology and climate change at IITM Pune from 30th November to 11th December 2009.
- International Training Workshop of "Bamboo as a Modern Construction Material" jointly organized by INBAR and Uttarakhand Bamboo & Fibre Development Board (UBFDB) from 5th to 14th October 2009.
- Training Programme on "Dendroclimatology and Climate Change" conducted by Indian Institute of Tropical Meterology, Pune from 7th to 12th December 2009.
- Training Programme on Eco-restoration of Wastelands at Forest Research Institute, Deharadun from 13th to 17th July 2009.

- DBT Sponsored Training on "Recent advances in EST Analysis & their Annotation" conducted by Indian Institute of Spices Research, Calicut from 20th to 22nd October 2009.
- Specialized Training Programme on Forestry and Information Technology at Forest Research Institute Dheradun from 30th November to 12th December 2009.
- Training on Bio-remediation and Environmental Amelioration at Forest Research Institute, Dehradun from 3rd to 7th August 2009.
- Training on "Plant Germplasm Conservation" held for Scientists of ICFRE, at NBPGR, New Delhi from 13th to 17th April 2009.
- Fifth Training on "Molecular Marker Technology for Crop Improvement" held at Centre for Excellence in Genomics, International Crop Research Institute for Semi Arid Tropics, Patancheru, Hyderabad from 16th May to 29th 2009 with funding from Department of Biotechnology, Government of India.
- Promotion linked advance forest management course for IFS officers of 2000 batch, held at Indira Gandhi National Forest Academy, Dehradun from 25th May to 12th June 2009.
- Planning and Implementation of Watershed Projects held at National Institute of Rural Development, Hyderabad from 27th July to 1st August 2009.
- Economic Analysis and Funding for forestry projects held at Forestry Research Institute, Jaipur on 27th and 28th August 2009.
- Collection, Compilation, Validation and Dissemination of Forestry Statistics held at Kerala Forest Research Institute, Peechi, Thrissur from 16th to 20th November 2009.
- Training Programme on Isolation, Identification and Preservation of fungi at FRI, Dehradun during January 2010.
- "Basic Forestry" for Computer scientist from 30th November to 11th December 2009 at FRI, Dehradun.
- "Isolation and Identification of AM Fungi" at Department of Agriculture Microbiology, Tamil Nadu Agricultural University, Coimbatore from 25th May to 5th June 2009.
- Animal behavior and chronobiology held in the animal behavior department of Madurai Kamarai University from 29th August to 11th September 2009.
- Training on Ecorestoration of Wastelands, Forest Research Institute, Dehradun from 13th to 17th July 2009.
- Training on "Innovation Management for Scientists and Technologists" conducted by Administrative Staff College of India, Hyderabad from 14th to 18th December 2009.
- Compulsory Training for IFS Officers on "Forest Research Methodolgy" at IIM, Lucknow as nominated by MoEF, Govt.of India from 1st to 5th June 2009.
- Training Programme on Ethnic issues of communities under DST programme held at IIFM, Bhopal from 18th to 22nd January 2010.
- Training on "Third Advanced Training Programme on Cyber Laws, Information Security and Computers for Scientists and Technologists" held at IIPA, New Delhi from 6th to 10th July 2009.
- Sixth Advanced Training Programme on Cyber Laws, Information Security, and Computers for administrative personnel of

S&T Department of Govt. of India held at IIPA, New Delhi from 25th to 31st May 2009.

- Ninth Foundation Training Programme for Scientists and Technologists at Indian Institute of Public Administration 9th November 2009 to 29th January 2010.
- Training on "Identification and uses of Mycorrhiza in Forestry", from 26th May to 5th June 2009 at Deptartment of Microbiology, Tamil Nadu Agriculture University, Coimbatore (Sponsored by ICFRE).
- Compulsory Training Course on "New Trends and Experiences in Human Resource Development" at Institute of Management Training & Research (IMTR), Goa from 15th to 19th February 2010.
- "Advance Training on Plant Molecular Biology" conducted by Birla Institute of Technology, Mesra, Ranchi from 11th May to 6th June 2009.

Learning Techniques in Lab

- Training on "Fundamental Principles and Techniques of Isolation and Identification of Insect Pheromones" at Indian Institute of Chemical Technology, Hyderabad from 8th to 13th February 2010.
- Training Workshop on "Molecular Biology and Biotechnology Techniques" during 10th to 20th December 2009 orga-nized by Central Institute of Fisheries Education (CIFE), Versova, Mumbai.

Participants of Training Workshop on "Molecular Biology and Biotechnology Techniques"with Faculty at CIFE, Mumbai

- National Committee on mangroves and coral reefs, Andhra University, Visakhapatnam on 29th and 30th September 2009.
- Training and awareness programme on the cultivation of *Gloriosa superba* at Andhra University, Visakhapatnam on 13th November 2009.
- Brain Storming Workshop on Utilization of Chemistry held at Home Science College, Jabalpur on 10th November 2009.
- Brainstorming Session held at IWST, Bangalore on 9th December 2009.
- State Level Awareness Programme for Tamil Nadu on National Certification System for Tissue Culture Raised Plants organized by Biotech Consortium India Limited (BCIL) at Coimbatore on 25th February 2010.

EXTENSION PANORAMA

Introduction

The Directorate of Extension endeavors to transfer simple technological packages including appropriate models to the intended target groups especially the farmers. It coordinates various extension activities of ICFRE Institutes and centres and evolves comprehensive extension strategies. It also provides consultancy services in the field of Environment Impact Assessment and other related areas.

Directorate of Extension aims at dissemination of useful research findings to various stakeholders through its nationwide network, different publications, workshops and training programmes. It also provides consultancies in EIA and related subjects.

The Directorate having Media & Publication, Statistics and Environmental Impact Assessment Divisions has the mandate of Forestry Extension through various publications like bulletins, brochures, pamphlets, newsletters, forest statistics and annual report, network of Van Vigyan Kendras and Demo Villages.

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 Newsletters of ICFRE 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. Work on establishment of Van Vigyan Kendras (VVKs) in collaboration with SFDs and selections of Demo Villages for adoption by ICFRE institutes have progressed considerably. Twenty six VVKs have been established in different states. Eight Demo Villages have been established in different eco-climate zones of the country. The division is also rendering services to promote Rajbhasha Hindi and evaluating the progress in implementation of Rajbhasha in the Council and its institutes. Quarterly progress report on the progress of Rajbhasha Hindi is collected from all the eight institutes and headquarters, compiled and submitted to the Rajbhasha Vibhag of MoEF. Division conducts trainings and workshops on the implementation of Rajbhasha Hindi.

Environmental Impact Assessment (EIA) Division established in 2003 under the Directorate of Extension, ICFRE acts as a nodal point to extend environmental expertise available in ICFRE to various stakeholders in the form of scientific services related to environmental protection and management. The Division carries out Environmental Impact Assessment (EIA) studies for a variety of developmental projects. It also prepares Environmental Management Plan (EMP) for the developmental projects with an aim to ameliorate the likely adverse impacts of development on local environment.

The EIA Division coordinates with the EIA Cells in the institutes of ICFRE and also collaborates with other institutions to render best services related to preparation of EIA and EMP for various development projects under different sectors including hydropower, mining and infrastructure development. The strength of EIA Division for extending best scientific services relies on the following:

- Availability of multidisciplinary expertise in the organization.
- Qualified and experienced human resource in forestry and environment related fields.

- More than 100 years rich knowledge base in the organization.
- Commitment to timelines of project related targets.
- Learning from best practices evolved in the past and innovation with new techniques.
- Emphasis on traditional knowledge, for human rights and encouraging stakeholders participation.
- Quality certified organization and procedures (ISO: 9001:2000).
- International experience.

Till date, the EIA Division has extended scientific services to the following sectors:

- River Valley Projects
- Mining Projects
- Seismic Survey for Oil Exploration Projects
- Industrial/Infrastructure Development Projects
- Monitoring & Evaluation/Post Development Auditing of Forestry Related Projects.

Till March 2010, the Division has undertaken 35 EIA/EMP studies worth ` 1440.10 Lakh.

Statistics Division is mandated to collect, process and disseminate information pertaining to the forestry sector of India. This mandate is fulfilled by bringing out the Biennial Forestry Statistics India and Auarterly Timber/Bamboo Trade Bulletin. The division also undertakes research projects with a statistical base to add to the existing information on various forestry parameters. The division has expertise to deal with huge amounts of data using advanced analytical software like STSTIATICA and SPSS. It handles the various courses of the FRI Deemed University and also provides expert advice to the various research projects being implemented in ICFRE and its institutes.

The Sustainable Land and Ecosystem Management–Country Partnership Programme (SLEM-CPP) is a joint initiative of the MoEF, GoI and the Global Environment Facility (GEF) and consists of seven projects being implemented in ten states in India with assistance from UNDP, FAO and the World Bank.

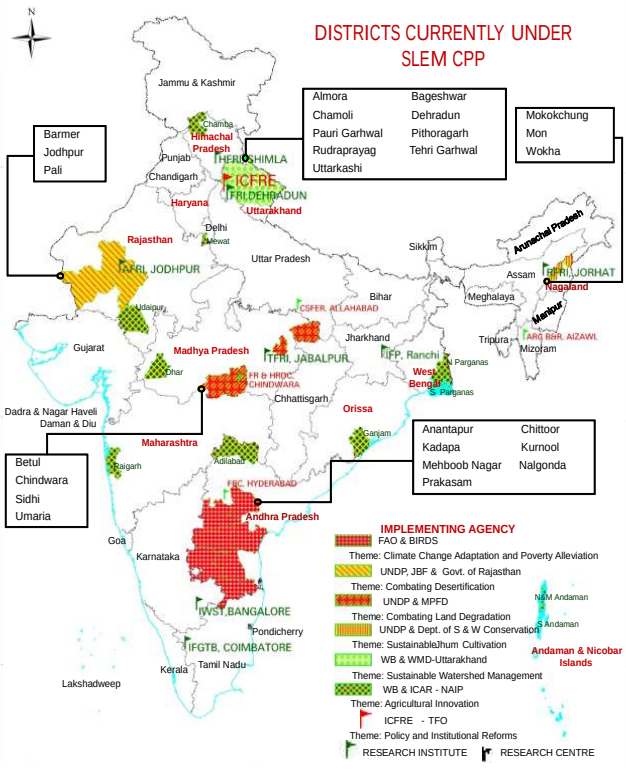
Technical coordination to the SLEM Programme is being provided through a Technical Facilitation Organisation (TFO) anchored at the Indian Council of Forestry Research and Education (ICFRE). The TFO has been instituted at the ICFRE under the World Bank led Medium Scale Project (MSP) entitled "Policy and Institutional Reform for Mainstreaming and Up-scaling Sustainable Land and Ecosystem Management in India". Various Divisions at the ICFRE Headquarters and its research institutes provide the requisite technical support as and when required to SLEM projects located in different parts of the country. The SLEM Project Implementation Unit at the ICFRE is headed by a Project Director under the Directorate of Extension at ICFRE Headquarters. The project became formally operational on 10th August 2010 and will end on 9th August 2012.

The project sites under SLEM-CPP cover diverse ecological zones including arid, coastal and mountainous ecosystems and address diverse aspects of land and ecosystem management including coastal agriculture, shifting cultivation, watershed management and groundwater management.

Objectives and Responsibilities of the TFO

The project aims at the harmonisation of institutional and policy framework, coordinating and monitoring interventions related to

agriculture and natural resource management that promote sustainable land management and enhance agricultural productivity while minimising environmental impacts and take account of climate variability and change. The



Location of SLEM Partners and ICFRE Institutes

overall objective of the SLEM Programme is to contribute to poverty alleviation in India by promoting enhanced efficiency of natural resource use, improved land and ecosystem productivity and reduced vulnerability to extreme weather events, including the effect of climate change. The SLEM partnership seeks to create synergy among the various SLEM project partners through sharing best practices/lessons learnt and by providing policy recommendations to scale-up the SLEM approach in India.

The responsibility of TFO is to support the realisation of the vision of SLEM at national and state levels. The TFO will ensure the collection of knowledge and learning of experiences from all of India and on that basis formulate recommendations for policy, strategy and approaches for sustainable land and ecosystem management for each sector. The TFO will also disseminate the learning to other agencies including the civil society in order to benefit them from the knowledge and incorporate them into their programs. The TFO derives lessons learnt from the projects participating in SLEM-CPP and provides the projects with technical backstopping when requested.

Activities of the TFO

The Project Implementation Unit (PIU) at the TFO has become fully operational. A number of activities have been carried out by the TFO to fulfill the mandate assigned to it. One of the first major activity carried out by the TFO was organising the Launch Workshop of the project under SLEM-CPP. The launch workshop was held in New Delhi on 8th and 9th February 2010 at

Launch Workshop SLEM-CPP

the National Agricultural Science Complex, New Delhi The workshop was organised by the ICFRE in collaboration with the Ministry of Environment and Forests. Shri R.H. Khwaja, Special Secretary, MoEF was the Chief Guest on the inaugural day of the workshop. The two days workshop brought together the SLEM-CPP project partners, experts on the thematic areas of

SLEM, scientists from the ICFRE Institutes and the funding agencies. A detailed brochure on the SLEM-CPP which included information on SLEM objectives, policy coordination, technical coordination, project partners, activities of the programme and districts covered under SLEM-CPP was also released. Copies of the "Project Operation Manual' of SLEM-TFO were also shared with partners in the workshop.

Another mandated tasks of the TFO is to carry out a comprehensive baseline analysis to analyse the underlying causes of land degradation, its impact on biodiversity and how land management is impacted by climate variability and change. The baseline study through secondary sources of information will seek to indicate the present status of land degradation, analyze the drivers, and provide an account of measures being taken to address the same. Through secondary sources of information and series of consultations, the study may reveal the impact of climate variability/change on land management practices, especially in vulnerable ecosystems. The draft "Terms of Reference (ToR) of the 'Baseline Study" has been finalized and follow up action initiated.

One of the mandated activities of the TFO was the development of an inter-institutional mechanism. To achieve the same, a National Steering Committee (NSC) for SLEM-CPP has been established. The MoEF vide its office memorandum 12/2009 BV (CD) dated 31st March 2010, has constituted the NSC with the Special Secretary, MoEF as the Chairperson. Director General, ICFRE is one of the members and DDG (Extn.) is the Member Secretary of the NSC.

Financials

The total approved cost of the project is US $1,985,267, of which GEF financing accounts for US $981,412, and the balance amount of US $1, 003,855 is by way of co-finance by the ICFRE. The TFO has incurred an expenditure of ` 33.37 lakh up to 31st March 2010.

National Forest Library and Information Centre (NFLIC)

The National Forest Library and Information Centre (NFLIC) is richest in document collection on forestry and allied subjects in South and South-east Asia. The NFLIC has been providing all types of library and information services viz. reference, referral, lending, reprography, current awareness, inter-library loan, retrieval of information form machine readable database, etc. to its users. During the year, a total of 29,339 books were loaned to the users for outside reading. Besides, 53,915 documents were consulted inside the library.

The document collection was enriched by the addition of 2,018 books and other documents out of which 654 books were purchased at a cost of ` 11.64 lakhs and 364 books sere received gratis. The NFLIC subscribed to 99 Indian, 118 foreign periodical titles. Besides, 14 E-journals were subscribes for all the institutes under ICFRE. A sum of ` 94 lakhs was spent on the subscription. It also received 265 periodical titles gratis.

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

Environmental Information System (ENVIS)

The Ministry of Environment and Forests, Government of India established an ENVIS Centre on Forestry at the NFLIC. The Centre, during the year enriched the following database 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, Participatory Forest Management, *Prosopis juliflora*, Poplars, Forests

and Environment in Press, Current Forestry Literature. Besides, the contents pages of journals, forest cover of India, state wise and then district wise, announcement of forthcoming national and international conferences, seminars, symposia, training courses were also put up on the website.

Publications: The ENVIS Centre on Forestry published two thematic issues of ENVIS Forestry Bulletin on Forest Insect Pests and Diseases and Climate Change and Forests. The Centre also published a bimonthly serial publications: Environment and Forests News Digest during the year.

4.1 Report on Van Vigyan Kendra (VVK) and Demo Village (DV)

Van Vigyan Kendras

The Indian Council of Forestry Research and Education (ICFRE) through its eight institutes with the active cooperation of State Forest Departments has established 26 Van Vigyan Kendras in different States/UTs. The basic objective of VVKs is dissemination of various technologies developed by the Council and its institutes and State Forest Departments (SFDs) to the user groups including farmers and forest based industries.

The Forest Research Institute, Dehradun has established 6 Van Vigyan Kendras at Hoshiarpur (Punjab), Pinjore (Haryana), Haldwani (Uttarakhand), Chandigarh (UT Chandigarh), NCT Delhi and Kanpur.

A total of 11 trainings were conducted during 2009-2010 under the VVK Programme on "Importance, Propagation and Utilisation of NTFP sp." and "Nursery and Plantation Techniques" to the farmers and foresters.

As for the model nursery under the VVK, the work on establishment at UT Chandigarh and Pinjore(Haryana) is in progress. The site at NCT Delhi is in progress of finalisation and the work will start after the codal formalities.

IFGTB, Coimbatore has established 03 VVKs one each at Coimbatore (Tamil Nadu), Kuthiran (Kerala), and Port Blair (A&N Islands). A Tree Information Centre has been established at Coimbatore as part of the VVK, Tamil Nadu. A model nursery has been established at VVK

Dr. G.S. Rawat, DG, ICFRE, Dehradun Inaugurating Model Nursery at VVK Coimbatore

Coimbatore, organised training programmes to farmers and forest officials. A total of 150 farmers and 30 Forest Extension Officers were trained through VVK on cultivation and management of

Tree Information Centre IFGTB, Coimbatore

important tree species used in tree cultivation in private land programme, quality planting stock production, bio-fertilizers, biomanures and clonal technology, etc.

Established the VVK at the Information and Extension Centre, Kuthiran. Organised the Karshaka Mela (Farmers Mela) in association with KFRI and Kerala Forest Department at Peechi in which 200 farmers participated. Organised a training workshop on cultivation and management of important tree species of Kerala.

A model nursery was established at VVK, Port Blair. Activities for raising of 15,000 seedlings for distribution in 2010-11 were initiated.

IWST, **Bangalore** has established 03 VVKs- one each in Karnataka, Andhra Pradesh and Goa. The institute designed and fabricated a portable distillation unit for extraction of essential oils from leaves of several aromatic plants. The unit is very easy to handle and can be operated at the plantation site instead of transporting bulky raw material. This reduces both time and cost. Three such units have been fabricated and supplied to VVKs of Karnataka, Andhra Pradesh and Goa for demonstration. Other items like ammonia fumigation chamber, audio-visual equipments, furniture, publicity material like posters and handouts in local language have been provided to VVKs. A nursery has been established and a poly house, shade net house, root trainers, waterline, watch and ward etc have been facilitated. A number of trainings and demonstration porgammes were organized during the period. Seedlings were also distributed to the farmers of Demo Village.

Altogether, 12 training programmes were conducted under "Van Vigyan Kendra", FRC, Hyderabad. A total of 416 participants received training on topics covering Forest Nursery, Tree improvement, Wood science, Biodiversity and environment related issues, Disaster management, etc.

TFRI, Jabalpur has established 4 VVKs one each at Raipur (Chhattisgarh), Nara Depot (Maharashtra), Jabalpur (Madhya Pradesh) and Koraput (Orissa). A number of trainings and demonstrations were organised at various places under VVKs.

RFRI, Jorhat has established 5 VVKs- one each in Assam, Arunachal Pradesh, Mizoram, Nagaland and Tripura. The institute organized Nodal Officers' Meet of Van Vigyan Kendras and Demo Village on 29th January 2010 for better coordination among the Nodal Officers of VVKs and for effective implementation of the various activities of VVKs. The Nodal Officers/ their representatives of all the five Van Vigyan Kendras attended the Meet and presented the progress of their respective Kendras.

A Model Nursery at Chessa was raised for development of seedlings of different forest trees, medicinal plants, bamboo and cane at Arunachal Pradesh. A small vermicomposting chamber has been constructed near the Modern Nursery, Chessa for production of organic manure. Training and demonstrations were held as per schedule.

A Model Nursery was established at VVK, Nagaland. Trials were conducted to raise seedlings of local firewood species Extensive training and demonstrations were imparted to Forest Department staff, Farmers, JFMC, NGOs at the different places.

A Model Nursery was established at Van Vigyan Kendra, Mizoram. Various facilities such as Shade House, Mist Chamber, Fencing, Irrigation system, Open shade with Store House, Permanent Cemented Beds, Sump and Composting unit were created in the Model Nursery. A number of training programmes were conducted for capacity building of stakeholders.

Dissemination of technology information through extension literature was done at Van Vigyan Kendra, Tripura. Trainings and Demonstrations were conducted as per schedule. A Model Nursery was established at Hatipara.

Various facilities such as Shade House, Permanent Cemented Beds, Nursery of important plant species of NER were created in the Model Nursery at Van Vigyan Kendra, Assam. Training and demonstration on various subjects were imparted to the stakeholders at different places.

AFRI, Jodhpur has established 3 VVKs in the states of Rajasthan, Gujarat, and at Dadra and Nagar Havelli, Daman & Diu (UT). At VVK Bikaner, Rajasthan, upgradation/renovation works were taken up at Hi-Tech Nursery Bichhiwal, Bikaner & Satellite Nursery, Mohangarh, Jaisalmer. Old Agroshed house was renewed at Bicchiwal nursery, Bikaner (2 Nos.) and Satellite Nursery Mohangarh, Jaisalmer

Training of Farmers & Field Functionaries at Kisan Bhawan, Bikaner

Renovated Polyhouse at Hi-Tech Nursery Bikaner

(2 Nos.). Polyhouse (mist chamber) was renewed at the nursery of Bicchwal, Bikaner (01set) and Mohangarh, Jaisalmer (01 set). Old root trainer stands (1200 nos) were repaired (cleaning, welding and painting). One compost chamber (permanent structure) was constructed at Bichhwal, Bikaner. Training was organized for farmers and field functionaries. High quality seedlings (10,000 nos) of *Prosopis cineraria* (khejri) were raised at Hi-Tech nursery, Bichhiwal, Bikaner for farmers/stakeholders.

Agronet House after Renovation at VVK Satellite Nursery, Mohangarh

Hi-Tech nursery upgradation/renovation works under VVK were taken up at R & D Centre of GFD, Gujarat, Rajkot. Complete sprinkler system set, four way fogger (24 Nos.) etc. were fixed and the Agroshed house and mist chamber

Fitting & Fixing of Micro-fogger in Hi-Tech Nursery at R&D Centre, Rajkot (Gujarat)

High Quality Seedlings Raised at Hi-Tech Nursery, Rajkot

were strengthened. UV Film of germination chamber was replaced and green net cover (300 sq. metres) also provided for repairing/ strengthening. Root traines, micro-fogger, iron root trainer stands, germination chamber stand, garden nylon pipe and nursery tools kit etc. were procured & supplied to strengthen the Hi-Tech nursery, VVK Rajkot.

Training of Farmers & Field Functionaries at GFRI, Gandhinagar

Training was organized for Farmers and field functionaries. Five Thousand nos. of high quality seedling of ten tree species raised at the Hi-Tech Nursery, VVK Rajkot for stakeholders.

VVK at Khanwel, Silvasa (Dadra & Nagar Haveli, UT) was under process Establishment.

HFRI, Shimla has established 2 VVKs, one at Sundernagar, Himachal Pradesh and another at Janipur, Jammu, J&K. The institute published the following literature- News letter, Edited book on 'Forestry Extension Strategy' and Pamphlets (3 Nos) on 'Chilgoza'; 'Beal' and 'Kashmal' respectively in simple Hindi vernacular language. Organized and imparted training on "Inter-cultivation of Medicinal Plants for Sustainability and Livelihood Options" and Awareness Programme on "Non-Timber Forest Products: Options and awareness". Similarly another exposure visit on "Agroforestry: Options and awareness amongst the stakeholders" was organised to the farmers from the state of Jammu & Kashmir from 27 th to 30 th March 2010. Farmers of the above state were taken to the States of Uttarakhand and Haryana. A total of seventeen farmers participated in the exposure visit. The farmers visited the famous agroforestry "Hara Farms" near Yamunanagar in Haryana and agroforestry systems near Haridwar for visualizing latest agroforestry technologies and interventions. The farmers also visited Model Village Shyampur, Van Vigyan Kendra, Dehradun and Museums of Forest Research Institute, Dehradun.

Establishment and Upgradation of the facilities of demonstration nursery at Field Research Station, Brundhar Jagatsukh (Manali). Organized and imparted training on "Application of Technological and Research Interventions for Enhancing Forest Productivity" at VVK, Jammu (Jammu & Kashmir) '. Established the nursery at Nagbani, Jammu under VVK Janipur, Jammu (J&K), in an area of 2250 m^2.

Demo Villages (DVs):

The proposal of establishment of demonstration village was conceptualized with an objective to transfer technologies developed by various ICFRE Institutes /Centres.

Demo Village, Shyampur, Dehradun

The Village Shyampur has been developed as Demo Village near Dehradun by FRI, Dehradun. In the village, a Model Nursery has also been developed in collaboration with Bagwan Gramodyog Samiti, Shyampur Village. The following structures are maintained and are being used for different silvicultural activities and are also being demonstrated to the people of nearby area:

- Low Cost Mist Chamber – One
- Propagation Unit – One
- Water Tank with Complete Pipe Fittings– One
- Motor House with 0.5 HP Motor – One
- Mounted Angle Iron Beds – Eight
- Shade House – One
- Seed Drying Platform – One
- Vermicompost Unit – One
- Root Trainers – 95 Blocks

Activities Conducted During the Period Under Report

- Supply of medicinal and forestry plants by Silviculture and NWFP Division of FRI to model village.

- Maintenance of medicinal and forestry origin species.
- Raising seedlings of various species of medicinal and forestry importance.
- Distribution of seedlings mostly *Aloe vera* and *Asparagus recemosus* to the farmers of Baniawala, Nayagaon, Ganeshpur, Selaquie, Ambiwala, Suklapar, Shyampur of Dehradun district for growing in their fields.
- Two Trainings on Forestry and Plantation technique of Medicinal plants have been done in the village as annual plan.

Demo Village, Kandiyur, Coimbatore

A status survey on the village to assess the demography, socioeconomic conditions, scope for plantation based economy, etc. was raising of a nursery initiated. Commissioned a bore well in the nursery for the use of nursery. Identified farm lands from 12 farmers for establishment of successful agroforestry models and model plantations. The Demo Village nursery formally inaugurated by the DG, ICFRE. Organized an interactive meeting of the villagers and farmers with DG, ICFRE. Conducted training programme on quality planting stock production, plantation management, production and use of biomanures and biofertilizers. Distributed seedlings to farmers for raising the same on field bunds. Commissioned a borewell in the tribal hamlet Irularpathi of Kandiyur Village and used the same for raising of tree crops in tribal lands.

Dr. G.S. Rawat, DG, ICFRE, Dehradun Distributing Quality Seedlings to the Farmers

Dr. G.S. Rawat, DG, ICFRE, Dehradun Inaugurating the Demo Village Nursery

Tree Growers Mela 2010

IFGTB, Coimbatore organised a Tree Growers' Mela on 18th and 19th February 2010 at Coimbatore. It was inaugurated by Shri Jairam Ramesh, Hon'ble Minister of State (Independent charge), Ministry of Environment and Forests, Government of India. During the function, he released four clones of Eucalyptus and four clones of *Casuarina equisetifolia*, that have been developed for dryland conditions.

Shri Jairam Ramesh, Hon'ble Minister of State, MoEF and Dr. G.S. Rawat, DG, ICFRE Releasing Quarterly Newsletter (above) and Clones of *Casuarina*

Demo Village, Byranahalli, Bangalore

IWST, Bangalore organized training cum-demo programme at Byranahalli (Demo Village) on plantation technique. A total of 2000 seedlings of Silver oak were distributed to farmers. A total of 26 farmers participated in the training programme on 1st July 2009.

Demo Village, Meleng Grant, Jorhat

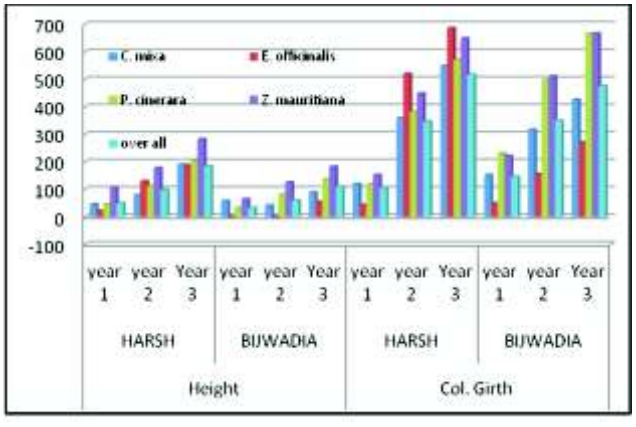
Meleng Grant, Jorhat, Assam was selected as the RFRI Demo Village. The village comprises of three hamlets viz. Bhogpur, Madhupur and Govindpur with a total of 220 households.

Demo Village, Harsh, Jodhpur

During 2007, two farmers namely Mrs. Sita Chaudhary, Bijwadia village and Mr. Rajendra Singh Chaudhary, Harsh village were identified and, accordingly, MoUs were signed and preparation of land for plantation and other formalities were initiated. Trials were established in August 2007. Four tree species namely *Prosopis cineraria*, *Emblica officinalis*, *Zizyphus mauritiana* and *Cordia mixa* were planted individually and in combination with each

Overview of Model Plantation after Planting

other. The demonstration was laid in randomized block design in three replications. Data on survival and growth were recorded every six months interval. Crop yield was also recorded. Initial survival at both the sites at three month was 90%. After one year, the survival was 55% and 58%, respectively, but it was 30 and 41% at



second year. In both the trials, *Zizyphus mauritiana* and *Prosopis cineraria* showed better growth as indicated by percent increase in height and collar diameter over initial level (Fig 1). *Zizyphus mauritiana* and *Prosopis cineraria*

Overview of Model Plantation after One Year Showing Cultivation of Crop

maintained better growth. The overall survival was 40% and 30%, respectively followed by *Cordia mixa* and *Emblica officinalis*. *Emblica officinalis* also exhibited poorest survival.

Demo Village, Lanabaka, Sirmour

Organized Camp workshop-cum-villagers meeting on "Bee Keeping and Integrated Pest Management (IPM)" at Lanabaka–Model Village. Also disseminated information on Bamboo Nursery Techniques and its Management, Eco rehabilitation of degraded sites /various nursery techniques on propagation of medicinal plants etc.

For promotion of medicinal and aromatic plants cultivation, processing and marketing on Exposure visit was organised to the farmers of

Model Village (Lanabaka) from 25th to 27th March 2010. A total of twenty farmers including four women of the Model Village participated in the exposure visit.

Established the demonstration plantation of *Dendrocalamus hamiltonii* in the area of about 1.5 ha. About 665 no of plants were planted at the spacing of 4m x4m.

On the demand of farmers of Model Village, saplings of *Dendrocalamus hamiltonii* (835 no.) have been distributed amongst the farmers to plant this species in their suitable field bunds/lands.

Operationalised the Polyhouse for demonstration to the various end users. Established the Vermicomposting unit to showcase the technology. Strengthened the irrigation facilities by preparation of storage tank and laying out poly pipes.

Raised the important medicinal plants species viz. Mushkbala, Gritkumari, Damabuti, Nimbu Ghas, Stevia, Harad, Beheda, Anola, Akarkara, Patterchata, Bach, Brahmi and Tulsi etc. in the nursery for demonstration and their subsequent adoption for cultivation to augment rural income. Raised important agroforestry species viz., Beul, Paulownia and Bamboo spp. etc., in the nursery for integration in the agroforestry systems.

4.2 Technology Transferred

An MoU between FRI and State Forest Department (SFD), Punjab was signed and technology for production of compost from water hyacinth (*Eichhornia crassipes)*, commonly known as Jal Khumbe, was transferred to SFD, Punjab on 15th and 16th February 2010. The technology was demonstrated before the forest officials in presence of Shri R.C. Nayyar, IAS, Finance Commissioner and Principal Secretary, Forests and Wildlife, Punjab, Shri B.C. Bala, IFS, PCCF, Punjab, Shri Jitendra Sharma, IFS, CCF (Hills), Punjab and the devotees of environmentalist Baba Balbir Singh Seechewal, Punjab.

Cultivation techniques of *Ocimum sanctum, Rauvolfia serpentina* and *Asparagus racemosus* have been developed using organic composts and manures for farmers.

Acacia mangium based agroforestry system has been developed and transferred to farmers of Tamil Nadu.

Agroforestry systems using tree crops of Casuarina, Teak, Mahogany, *Melia* and *Gmelina* with Agriculture crops like cowpea and ground nut were developed.

Plantation technologies for dryland farming were developed.

The package of practices developed on integrated methods for management of important nursery and plantation pests of indigenous tree species like Pongamia, Neem, Aegle, *Ailanthus excelsa*, *Melia dubia*, *Gmelina arborea*, *Thespesia populnea*, *Morus alba*, *Bombax ceiba* and *Dalbergia sissoo* were demonstrated to farmers and Forest Department employees.

IWST, Bangalore transferred technology on "Bamboo fibre filled thermoplastics composite" to M/S Konkan Specialty Polyproducts, Mangalore.

TFRI, Jabalpur organised a one-day demonstration programme for transferring of technology on silvi- medicinal system to the 50 farmers of four villages namely Padariya, Khamariya, Neemkheda and Saliwada of Jabalpur district on 1st December 2010 at TFRI, Jabalpur.

RFRI, Jorhat transferred following technologies to the Demo Village.

- **Establishment of Patchouli Nurseries**

  Two Patchouli Nurseries have been established in the village to fulfill the requirements for commercial cultivation.

- **Establishment of Bamboo Treatment Tanks**

  Two numbers of Bamboo Treatment Tanks have been installed and brought under operation. The bamboo culms are being treated with the techniques developed by RFRI. Performance of the treated bamboos

A Bamboo Treatment Tank

has been found very encouraging to the farmers by using it as fencing on the periphery of their household and homestead boundaries.

- **Establishment of Bamboo Nurseries**

  Two Bamboo Nurseries have been established with an expectation to fulfill the high demand of healthy and reliable quality of planting stock to the agencies in the region.

A Bamboo Nursery

- **Establishment of Vermicompost Units**

  A total of 21 Vermicompost Units have been constructed and operationalized. The villagers have been made technically capable so as to produce vermicompost by themselves. Participatory approach in execution of the programme has resulted in considerable production cost reduction and better quality of vermicompost achieved through.

A Vermicompost Unit

A Low Cost Vermicompost Unit

- **Establishment of Low Cost Vermicompost Units**

  Twenty number of Low Cost Vermicompost Units have also been established in the village.

- **Standardization of AF Practices**

  Established an agroforestry trial of patchouli by intercropping with three months old saplings of *Acacia mangium*. The performance of both the plants is found to be very much encouraging among the farmers and researchers.

- **Propagation and Multiplication Techniques of Commercially Important Species.**

  Established a Modern Nursery at RFRI Campus to facilitate Demo and Participatory Research on Nursery Techniques of various species with maintaining replications in the Nurseries established in the village.

Demonstration of Propagation and Multiplication Techniques of Commercially Important Species

Distribution of Beehives

With a basic aim to provide additional income to the families engaged in wood charcoal business, a total of 56 beehives have been distributed after giving them proper training and demonstration of the practice.

Annual litter production in *Eucalyptus* plantation along Indira Gandhi Nahar Pariyojana (IGNP) was modeled by AFRI, Jodhpur against plantation age and GBH using linear and non-linear procedures and best models for estimation of litter production developed.

Soil and water conservation technology developed to restore degraded hills of Aravalli by adapting and evaluating different gradient based rain water harvesting structures and tree plantation.

HFRI, Shimla imparted various trainings with respect to the already standardized technologies to the farmers, field functionaries of the state forest department and other stakeholders.

4.3 Research Publications

Researchers at ICFRE have published 305 research papers in various reputed journals including 78 research papers in foreign journals. One hundred ninty two research papers were published in proceedings of various symposia, seminars etc. while over 80 research articles appeared in the form of books/booklets/brochures and chapters in books etc.

Genes of Internal transcribed spacer of two isolates of fungus *Ganoderma weberianum* were assigned accession numbers by National Centre for Biotechnology Information (NCBI), USA.

Genes of Internal transcribed spacer of forty seven isolates of fungus *Ganoderma lucidum* were assigned accession numbers by NCBI, USA.

4.4 Seminar/Symposia/Conference/ Workshop Organized

Seminars

IFGTB, Coimbatore, Tamil Nadu Forest Department and Tamil Nadu State Planning Commission jointly organised, a Seminar on "Role of Carbon Management and Afforestation in Climate Change Mitigation in Tamil Nadu" at Chennai on 6th August 2009.

IFGTB, Coimbatore organized a Seminar on "IPR, PPV&FR and Biological Diversity Acts towards Conservation, Innovation, Protection, Management and Commercialization" at the Institute on 4th September 2009.

IFP, Ranchi organized National Seminar on "Productivity Enhancement & Value Addition of Bamboo". Ranchi with the collaboration of JSFDCL on 9th and 10th March 2010 at Ranchi.

Conference/Symposium

FRI, Dehradun organized IV National Forestry Conference form 9th to 11th November 2009. The Conference was inaugurated by Shri Harbans Kapoor, Hon'ble Speaker, Uttarakhand Legistative Assembly. Over 250 delegates consisting of researchers and scientists from various research institutes, forests officers from SFDs, Research Instituites and students from academic institutions actively participated in the conference.

Second International Conference on Bio-Wealth Management for Sustainable Livelihood (ICBMS-2009) held from 20th to 22nd November 2009 organized at IFP Campus under agies of Madhwai Shyam Educational Trust, Ranchi.

FRI, Dehradun organized International symposium on "Multipurpose Forestry" from 9th to 13th November 2009.

Workshops

Forest Research Institute, Dehradun organized two days workshop titled "Strengthening Institutional Capacity and Stakeholder Partnership for Implementation of Monitoring Assessment and Reporting on Sustainable Forest Management" on 22nd and 23rd April 2009. This workshop was organized under United Nation's FAO sponsored programme on strengthening Monitoring Assessment and Reporting on Sustainable Forest Management (MAR-SFM) in India.

Indian Council of Forestry Research and Education (ICFRE) in association with Coalition for Rain Forest Nations (CfRN) organized International workshop on "National Forest Inventory: The experience of Non-annex 1 countries" from 27th to 29th April 2009 at Forest Research Institute, Dehradun. The basic objective of the workshop was to discuss issues pertaining to Reducing Emissions from Deforestation and Degradation (REDD). On the final day, representatives proposed that ICFRE has the potential to train scientists so that Reducing Emissions from Deforestation and Degradation (REDD) could be checked in countries deficient in this technology. About 80 delegates from 34 developing countries and 6 international organizations like World Bank, FAO, GTZ, JICA were attending the workshop.

FRI, Dehradun in association with association of Universities organized the Northern Zone Vice chancellors conference from 22nd to 24th September 2009. The main theme of the conference was "Environmental Education: Issues & Challenges Before Higher Education." The conference was attended by the vice chancellors from the states of Himachal Pradesh, Uttar Pradesh, Punjab, Haryana, Uttarakhand, Chandigarh and J&K. The conference was inaugurated by Dr. Ramesh Pokhriyal Nishank, Hon'ble Chief Minister of Uttarakhand.

FRI, Dehradun and Hindi Vigyan Sahitya parisad, BhaBha Parmanu Anusandhan Kendra, Mumbai organized in Hindi two days' scientific seminar on "Industrial Development and Environmental Conservation in Hill Regions" on 4th and 5th November 2009.

Centre for Social Forestry and Eco-Rehabilitation (CSFER), Allahabad a research centre under FRI, Dehradun organized a National Workshop on "Rehabilitation of Degraded Lands" on 6th and 7th October 2009.

IFGTB, Coimbatore organized one day workshop on "Demonstration and Handing over of IFGTB Herbarium Database" on 23rd April 2009.

IFGTB, Coimbatore organized an Interactive workshop on 19th June 2009 with all its stakeholders to priorities and finalize the new research projects and programmes of the institute.

IFGTB, Coimbatore organized a Workshop on "Role of Women in Environment Protection" in association with Tamil Nadu State Commission for women on 24th July 2009.

Release of a Book on Two Decades of Research in IFGTB by Smt. Ramathal, Chairperson Tamil Nadu State Commission for Women

IFGTB, Coimbatore Organized a Workshop on Cultivation and management of Tree Crops as part of the Krishaka Mela in collaboration with Kerala Forest Department and Kerala Forest Research Institute on 3rd and 4th November 2009 at KFRI, Peechi.

IFGTB, Coimbatore in collaboration with TNFD organized a seminar on "Role of Carbon Management and Afforestation in Climate Change Mitigation in Tamil Nadu", in Chennai on 6th August 2009.

IFGTB, Coimbatore organized National Workshop to Formulate an All India Coordinated projects on Fast Growing Native Tree species on 10th February 2010 and on Improvement of Fast Growing Phyllodinous Acacia on 11th February 2010.

IFGTB, Coimbatore organized Workshop on Plantation Technologies for Dryland Farming as part of Tree Growers Mela on 18th and 19th February 2010.

IWST, Bangalore organized Wood Industry Meet on 15th April 2009. A total of 40 participants attended the meeting.

IWST, Bangalore organized Stakeholders liaison meet on 27th May 2009. Mr. B.K. Singh, IFS, Additional PCCF (EWPR& T) was the Chief Guest. A total of 58 participants ranging from Forest Department officials, wood industries, farmers, plantation companies participated in the meet.

IWST, Bangalore conducted Compulsory Training Course for IFS officers on "Advancements in Wood Production and Utilization with Special Focus on Climate Change Mitigation" from 17th to 21st August 2009. A total of 14 participants participated in the programme.

IWST, Bangalore organized one day Indo-Italian Seminar on "Use of Modern Technologies in Forestry and Advancements in Wood Science" on 19th November 2009. A total of 32 delegates from outside and 25 in-house delegates participated in the seminar. The seminar was inaugurated by Mr. S. Nagaraja, PCCF, Karnataka Forest Department. Dr. Lidia, Scientific Counsellar, Embassy of Italy; Mr. I.B. Srivastava, PCCF (EWPR&T); Mr. C.S. Vedant, PCCF & MD, KFDC; Mr. S.C. Joshi, Director, IWST were the Chief Guests. A total of 7 papers were presented in the seminar.

IWST, Bangalore organized brainstorming session of ICFRE on 9th December 2009. The session was chaired by Dr P. J. Dilip Kumar DG (F), MoEF. Dr P. B. Gangopadhyaya, ADG (MoEF), Dr. G. S. Rawat, DG (ICFRE) and Director (IWST) participated in the brainstorming session.

FRC, Hyderabad organized one day stake-holders' meeting on 24th June 2009 to prioritize research needs of the centre and finalize research proposals for 2009-10.

TFRI, Jabalpur organized one day workshop on "Traditional Knowledge of Medicinal Plants of Patalkot" on 30th June 2009 for traditional healers and Vaidyas of Chhindwara District.

TFRI, Jabalpur organized a one-day consultative workshop on development of criteria and indicators for sustainable NTFP management in association with IIFM, Bhopal on 12th October 2009.

AFRI, Jodhpur and Indian Institute of Forest Management, Bhopal jointly organized a one-day Consultative Workshop on "Development of Criteria & Indicators for Sustainable NTFP Management" on 29th August 2009. The main objective of the workshop was to provide a forum for linking various agencies, institutions and stakeholders dealing with dry and arid NTFP species and their ecological systems and to share experiences and knowledge, related to the development of C & I. The meeting was presided by the Chief Guest Mr. A.K. Singh, PCCF, MD, CGMFP Federation, Raipur, Chhattisgarh, and the Distinguished Guest, Dr. Ram Prasad, Chairman of steering committee and former PCCF, M.P.

AFRI, Jodhpur organized a one-day brainstorming workshop on Khejari (*Prosopis cineraria*) mortality on 16th November 2009. Dr A.S. Faroda, Ex Vice Chancellor Maharana Pratap Agriculture and Technical University, Udaipur chaired the one day workshop. Scientists/Officers from scientific institutes like; AFRI, CAZRI, Jodhpur, Agricultural research stations at Mandore, Fatehpur and Jalore, ZSI, Jodhpur, Ground water board, Jodhpur, Forest Department, Jodhpur and progressive farmers Sikar, Nagure and Barmer attended the workshop. A coordinated research project on integrated approach to tackle the problem of Khejari mortality in Rajasthan was prepared based on inputs received from this workshop.

HFRI, Shimla organized a stakeholder workshop for Identification and Prioritization of Research Needs for the state of Jammu & Kashmir at State Forest Research Institute, Janipur, Jammu on 29th June 2009. This workshop was attended by the forest officers, officers from the Pollution Control Board, Professors from the Universities and other stakeholders from the State of Jammu & Kashmir. This day long workshop was chaired by Sh S. Chug, IFS, Conservator of Forests (Research) J & K.

Stakeholders Meeting at SFRI, Jammu for Identification and Prioritization of Research Needs in the State of Jammu & Kashmir

HFRI, Shimla organized workshop on "Challenges & Opportunities for growth of Medicinal Plants Sector in North-West Himalayas" on 18th and 19th March 2010. Total 62 delegates participated actively in the workshop.

HFRI, Shimla organized a one-day workshop on "Network project on *Picrorhiza kurrooa* and *Valeriana jatamansi*" on 10th September 2009. During this workshop, details of the work done in the past and future strategies related to implementation of the project activities by the participating institutes were presented and discussed.

HFRI, Shimla organized one day interactive workshop-cum-training programme titled "Ecological and Socio-economic Significance of some Important Species of the Cold Deserts" on 25th September, 2009 at Field Research Station (FRS), TABO (L&S), Himachal Pradesh.

HFRI, Shimla organized one day interactive workshop-cum-training on "Wild edible and Medicinal Plants of Kinnaur District, Himachal Pradesh" on 5th November 2009 at Chhitkul, Kinnaur District. About 65 villagers, field staffs and other stakeholders participated in the workshop.

IFP, Ranchi organised a workshop on "Stress site Reclamation" under ongoing research project on 30th June 2009 with the participation of Progressive farmers, field functionaries of SFDs & NGOs and experts from BAU, DVC & other personnel.

IFP, Ranchi conducted a workshop on vermicompost on 8th September 2009 at Forest Research Centre, Mandar, Ranchi, Jharkhand.

Second meeting of State Level Monitoring Committee (SLMC) constituted to review and monitor the progress of the GoI-UNDP CCF-II project on "Biodiversity Conservation through Community based Natural Resource Management" in the State of Jharkhand was held at IFP, Ranchi on 16th January 2010.

Second Meeting of SLMC Chaired by Sri S. K. Sharma, IFS, Chief Conservator of Forests (Wild Life), Govt. of Jharkhand.

IFP, Ranchi organized fourth Meeting of the Empowered Project Steering Committee (EPSC) constituted to coordinate implementation of the GOI-UNDP CCF-II project on "Biodiversity Conservation through Community based Natural Resource Management" at Ranchi on 28th January 2010. The meeting was chaired by Shri Hem Pandey, Joint Secretary to the Govt. of India, Ministry of Environment and Forest, New Delhi and was attended by Shri R. Krishnamurty, Director, IFP and Shri Rameshwar Das, CF, IFP, Ranchi. The steering committee reviewed the physical and financial progress of unit wise project work being implemented in the states of Arunachal Pradesh, Orissa, Jharkhand and Chhattishgarh. A field visit to Khunti project site under Jharkhand State (Village: Janumpiri, Bari, Kotna) was also conducted on 29th January 2010.

Two days Inception Training Workshop was conducted at IFP, Ranchi under the consultancy project titled "Estimates of Kendu Leaves production in Jharkhand" on 26th and 27th February 2010 wherein 85 Officers/ Personnel of JSFDCL and IFP, Ranchi participated.

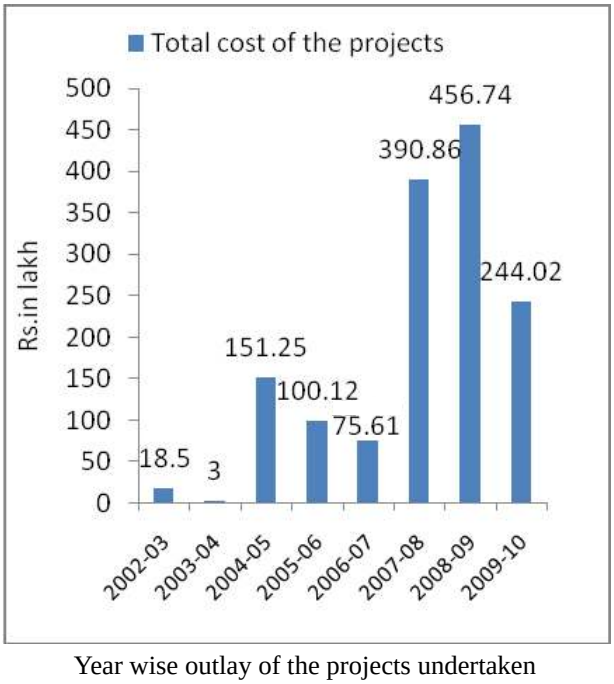
Training Workshop under Project "Estimates of Kendu Leaves Production in Jharkhand"

4.5 Consultancies

Environmental Impact Assessment (EIA) Division under the Directorate of Extension, ICFRE carries out EIA studies in various sectors like hydropower, mining, infrastructure etc. It

also prepares Environmental Management Plan (EMP) for mitigating the adverse environmental effects of the developmental projects.

The Division was established in 2003 at ICFRE headquarters and grown in work and expertise over the years. Recently, EIA Cell has



Year wise outlay of the projects undertaken

also been constituted in all the eight institutes of the ICFRE located in different parts of the country to provide interface with region based development agencies for carrying out EIA studies. The EIA Division coordinates with the EIA Cells in the institutes of ICFRE and also collaborates with project proponents for preparation of EIA and EMP for various developmental projects. Till March 2010, the Division has undertaken 35 EIA/ EMP studies worth ` 1440.10 Lakhs.

EIA Division has extended its services to a number of leading and established project proponents including: Jindal South-West Group of Companies, Reliance India Limited, Singareni Collieries Company Limited, Tehri Hydro Development Corporation Ltd., New Delhi

Public Hearing of Ankua Mining Project, Jharkhand

Municipal Council, Himachal Pradesh Power Corporation Ltd., National Thermal Power Corporation, Chandigarh Administration, National Medicinal Plants Board Ministry of Health & Family Welfare, GoI, Chhattisgarh State Electricity Board, National Hydro power Corporation, Andhra Pradesh Tourism Development Corporation, Andhra Pradesh Mineral Development Corporation Ltd., ESSAR Power Ltd., Jaiprakash Associates Ltd., National Afforestation and Eco-development Board, MoEF.

The list of clientele suggests that both public and private sector bodies have been utilizing the environmental consultancy services being provided by the Division. The team of officials looking after EIA related consultancies has been instrumental in evolving new standards in EIA studies and has contributed in setting up of good work ethics and environmental forecasting and suggesting mitigation measures.

During 2009-2010, EIA Division has completed 04 consultancy studies worth ` 239.13 Lakhs in the Hydropower and Mining sectors and received the following consultancies worth ` 244.02 Lakhs.

- Comprehensive Environmental Impact Assessment and Environmental Management Plan studies of Reservoir portion of Sankosh Multipurpose Project in Bhutan awarded by Tehri Hydro Development Corporation Ltd.
- Rapid Environmental Impact Assessment study for one season data for Bunakha Hydroelectric Project (180 MW), Bhutan awarded by Tehri Hydro Development Corporation Ltd.

Bunakha Project Site, Bhutan

- Biodiversity Assessment for Ganga Expressway from Greater Noida to Balia Project awarded by Jaypee Venture Pvt. Ltd., NOIDA.
- Preparation of Biodiversity Assessment study for Unnao Land parcel, Unchahar Land Parcel and Wetland study of Patiyali Land Parcel for infrastructural improvement awarded by M/s Jaypee Ventures Pvt. Ltd., NOIDA.
- Biodiversity Impact Assessment study for Kanera lift irrigation scheme in Bhind district of Madhya Pradesh awarded by Water Resources Department, Gwalior.
- Environmental Impact Assessment and Environmental Management Plan for Tosh Parvati (400 MW) Hydroelectric Project, District Lahul Spiti, Himachal Pradesh awarded by Himachal Pradesh Power Corporation Ltd.

During the year, following projects were accorded Environmental Clearance by Ministry of Environments and Forests:

- Environmental Impact Assessment and Environmental Management Plan (EMP) for Renuka Dam Project in Sirmour district of Himachal Pradesh Power Corporation Ltd., Shimla.
- EIA studies and formation of EMP for integrated Kashang Hydroelectric Project (243MW) in Himachal Pradesh Power Corporation Ltd., Shimla.

The EIA team of ICFRE has also participated in public hearing meetings

Public Hearing of Kuther HEP,
Himachal Pradesh

conducted by State Pollution Control Board (SPCB) for the following projects and replied to queries raised by the public representatives, local villagers and civil authorities for the purpose of Environmental Clearance: EIA and EMP report for Kuther Hydroelectric Project (KHEP) (260 MW) Chamba districts, Himachal Pradesh for JSW Pvt. Ltd. EIA & EMP with Catchment Area Treatment Plan (CATP), Hydrology and Drainage Studies for Ankua Iron Ore deposits in Jharkhand for JSW Pvt. Ltd.

FRI, Dehradun provided the following consultancies

Evaluation of X and XI five years plan of Central Pulp and Paper Research Institute, Saharanpur (Uttar Pradesh). Provided natural

dyes to Uttarakhand Khadi and Village Industries Board under a consultancy project on "Use of Natural Dyes".

To Bodhgaya Temple Management Committee, Bodhgaya for the maintenance and preservation of sacred Bodhivriksha.

To APSARA National Authority, Cambodia through Archaeological Survey of India at Cambodia.

Advisory Consultancy to M/s Ashok Timbers, Yamuna Nagar on "Expert Advice on Information regarding Fungus Problem on Wood".

To M/s Max Speciality Products, Max India Ltd., Railmajra (Ropar), regarding use of timber in wooden pallets on 22nd May 2009.

To M/s Hindustan Petroleum Co. Ltd., Mumbai regarding timber utilization for cooling tower during the period from 1st to 3rd December 2009.

To M/s India Tourism Development Corporation Ltd. (Common Wealth Games), New Delhi regarding inspection of quality timbers for furniture. Amount: `165000/-.

(Total revenue generated through consultancies: ` 3,71,061/-)

For preparation of "Forest Works Manual and Schedule of rates for Forestry related works in Uttarakhand under Mahatma Gandhi National Rural Employment Guarantee Act funded by UNDP through Ministry of Rural Development, Government of India.

To Govt. of Delhi for raising and supplying 3 lakhs potted plants for forthcoming Commonwealth Games to be held in Delhi.

To Govt. of Delhi for establishment of Bambusetum at Yamuna Bank, Delhi.

To Himachal Pradesh Power Corporation for Socio-economic baseline survey and impact assessment of Renuka Dam Project, Himachal Pradesh.

IFGTB, Coimbatore completed the consultancy project on "DNA Profiling of Eucalyptus and Acacia hybrids" for the Mysore Paper Mills, Bhadravathi, Karnataka.

IWST, Bangalore provided the following consultancies

Preparation of EIA/EMP for diversion of forest land for conveyer belt corridor for Iron Ore Deposits, Jharkhand in favour of M/s JSW Ltd., Jharkhand.

EIA/EMP studies of Sankosh Multipurpose Hydro Project, Bhutan (RHDC) in favour of M/s Tehri Hydro electric Development Corporation Ltd.

Updation of DPR of Bhunakha EIA and EMP studies of Hydro electric Project, Bhutan.

Biodiversity assessment for 2000 MW Pit Head thermal power station by M/s ESSAR Power Jharkhand Ltd. (EPJL) and Chakla Coal Mine of ESSAR power Jharkhand.

Biodiversity assessment report for Ganga Expressway from Greater NOIDA to Balia in favour of M/s Jaypee Ventures Pvt. Ltd., NOIDA.

EIA/EMP studies for Bodghat Hydro electric Project in favour of Chhattisgarh State Electricity Board, Chhattisgarh.

Advisory Consultancy to Bamboo Peckers, Bangalore regarding bamboo preservation.

FRC, Hyderabad provided the following consultancies

Consultancy to Andhra Pradesh Forest Department for evaluation of National Afforestation Programme implemented by Nandyal Forest Development Agency and Atmakur Forest Development Agency.

Consultancy to ITC, Bhadrachalam for "Estimation of Biomass from Agriculture and Pulpwood Plantations in Khammam".

TFRI, Jabalpur provided the following consultancies

Conducted survey of flora and fauna in Maihar (Dist. - Satna) for Reliance Cementation Pvt. Ltd.

TFRI, Jabalpur conducted assessment of green cover and its tangible and intangible benefits and tree cover management plan for NCPP-Dadri awarded by National Thermal Power Corporation, Dadri.

AFRI, Jodhpur

AFRI, Jodhpur Under the consultancy project entiled "Identification of Mycorrhizal and Rhizobial Association, Establishing Gene Bank and Technology Transfer to Farmers in Field" supported by the SFD Gujarat, imparted training to SFD Gujarat, established biofertilizer laboratory and trained manpower for isolation, multiplication and identification of biofertilzier strains.

HFRI, Shimla provided following consultancy services

Studies on Environment Impact Assessment (EIA) and Preparation of Environment Management Plan (EMP) for Integrated Kashang Hydroelectric Project (243 MW) in District Kinnaur, Himachal Pradesh to M/ S Himachal Pradesh Power Corporation Ltd., Shimla.

Preparation of Catchment Area Treatment Plan from Upstream Pandoh Dam to Largi Dam to BSL, Sundernagar, Himachal Pradesh.

Monitoring of Stipulations of Environmental Clearance Conditions in respect of Chamera-III (231 MW) Hydroelectric Project, District Chamba, Himachal Pradesh.

4.6 Technical Services

The Council through its institutes provide technical services in relation to identification of wood samples, insect pests, diseases and management of insect pests and diseases. The Council and its institutes also provide EIA consultancies and related services. The institutes issue phytrosanitory certificates for import/export of plant material and also the quarantine reports for insect import. Besides IWST, Bangalore provides technical services in identification of adulteration in a number of commercial products specially the sandal wood oil. IFGTB, Coimbatore provides technical services in Eucalyptus gall problem and various afforestation activites and clonal varities of Eucalyptus and Casuarina. FRI, Dehradun is providing technical services in essential oils, fragrance and flavor materials, conservation of trees, natural dyes, *Cordyceps sinensis.*

Ten numbers of steam-heated type kilns were modernized and re-installed at the premises of the U.P. Export Corporation Ltd., Saharanpur under the technical supervision of scientist of the Wood Seasoning Discipline. These kilns are being used commercially for timber seasoning by the Corporation.

FRI, Dehradun

The institute examined and identified about 160 wood samples (received from various Govt. departments like Railway, Defence, Bureau of Indian Standards, NTPC, Telecommunications, C.P.W.D., Punjab Police Housing Corporation, ONGC, also from Vigilance, Anti Corruption Bureau, Police/CBI and private timber merchants) and earned ` 8,00,000/- (approx.) during the period.

- Provided technical services to Centre for Cooperation in Science and Technology among Developing Societies (CCSTDS), Chennai through imparting three months (July-September 2009) training on "Essential Oils, Fragrance and Flavor Materials" to Mr. M.N.I. Bhuiyan, Scientific Officer, Bangladesh, Council of Scientific and Industrial Research (BCSIR) under RTFDCS Fellowship of the CCSTDS.
- Demonstration of "Isolation of Natural Dyes" to participants of training programme

"Capacity Building Communities Involved in sustainable forest management" on 25th June 2009 under DEFRA project.

- Eight Samples of *Cordyceps sinensis* sent by the Superintendent of Police, District Leh Ladakh (J&K) in December 2009 were identified.
- One sample of *Cordyceps sinensis* received from Chief Judicial Magistrate, Champawat, Uttarakhand was identified in February 2010.
- Identification of fungal degradation in wood samples for industry, Melfrank Engineers, Mumbai (12 samples, January, February and March 2010).
- For Plant Protection & Quarantine Department, Ministry of Agriculture, Govt. of India for eligibility of import of materials (5cases).
- Import of *Cordyceps japonica* by the Director, Central Sericultural Research & Training Institute, Srirampura, Mysore.
- Import of *Anagyrus loecki, Acerophagous papaya* and *Pseudleptomastix mexicana* by the Director, National Bureau of Agriculturally Important Insects, Bangalore.
- Import of insect, *Plutella xylostella* by the Director, Central Institute of Cotton Research, Nagpur.
- Import of cultures of *Azospirillum* sp. by M/s Punjab Chemicals & Crop Protection Ltd., Mumbai.
- Import of cultures of mites–*Amnlyseius swirskii* and *A. californicus* by M/s Namdhari Farm Fresh Pvt. Ltd., Bangalore.
- For issuance of Phytosanitary Certificates (06 certificates) – Exporters of seeds/planting material.

IFGTB, Coimbatore

- Provided Plant identification and plant referencing services to the Tamil Nadu and Kerala Forest Department, College and University students, researchers and farmers through Fischer Herbarium maintained by the institute.
- Provided advisory services on management measures for Eucalyptus Gall problem to KFDC, Kottayam.
- Provided advisory services on management measures for Teak pink disease problem to Kerala Forest Department.
- Provided technical services on mortality of a coppiced Eucalyptus clonal plantation at Satyavedu, Andhra Pradesh and Tirkukoilur, Tamil Nadu.
- Ninty kg of improved seeds of Eucalyptus and Casuarina from seed orchards established by IFGTB in different locations in Southern India were collected and supplied to the industries, farmers and State Forest Departments for raising plantation. The seed orchard seeds showed outstanding growth performance compared to local seed source.

IWST, Bangalore

- During the year, 102 enquiries for identification (231 samples) were attended. A number of technical inquiries on utilization of various Non-Wood Forest Products from Government Departments and public were attended to and advice given.
- Analytical services were rendered to Wildlife Crime Control Bureau, Southern Region, Chennai, Commissioner (customs), Chennai, Forest Department and public in analysis of essential oils from sandalwood samples, *Pterocarpus marsupium* extracts and *Pterocarpus santalinus* samples, other wood powders etc.
- Several enquiries were attended from Forest Department officials and NGO's with respect to entomological and pathological problems in nursery and plantations & timber-in-service and suitable remedial measures were suggested.

AFRI, Jodhpur

- Seed Certification and Testing.
- Soil and Water Analysis.
- Advisory Services to Stakeholders
- Urban Greening and Landscaping.

4.7 Activities of Rajbhasha

ICFRE and its institutes are continuously working in the direction of implementation of Rajbhasha rules and regulations in its day to day functioning with a view to promoting the use of Rajbhasha to the maximum. ICFRE, Dehradun organized a training workshop on Rajbhasha on

Training Workshop on Rajbhasha

26th March 2010. Over 250 Officers, Scientists and Staff of ICFRE and FRI attended the training workshop. The workshop was addressed by Shri S.P. Choubey, Director Rajbhasha, MoEF and Shri M.R. Saklani, Deputy Director Rajbhasha and Secretary NARAKAS, Dehradun. To ease the work in Rajbhasha, a new software 'Saransh' is being tried with. We are conducting Rajbhasha Karyanvayan Meetings on regular interval at the institutes and the headquarters. Quarterly Progress report is being compiled and sent to the Official Langugae Depatement of the MoEF. We are also observing Hindi Divas on 14th September and regularly organizing Hindi Week/Fortnight.

With a view to promoting the Rajbhasha Hindi, ICFRE is regularly publishing its in-house magazine Taruchintan and Biannual Newsletter and Vaniki Samachar in Hindi.

IFGTB, Coimbatore nominated 27 employees (Group A, B and C) for the hindi training during the year 2009-2010. Shri V.K.W.Bachpai Nodal Officer (official language) attended a special training programme from 25th to 26th May 2009 at Kanyakumari (Tamil Nadu) conducted by Centre for Training and Development (CENTAD) Bangalore. Hindi week was celebrated in the Institute from 14th to 19th September 2009. Competitions were organized for all the staff of the Institute. A meeting was organized on 17th September 2009 which was chaired by Shri A.S. Jafry, IFS, Director, TNFA, and attended by Dr. C. Jay Shankar Babu, Member Secretary of Town Official Language Implementation Committee (TOLIC) in which prizes were distributed.

IWST, Bangalore conducted the Hindi Workshop for Ministerial Staff of the IWST on 12th August 2009 attended by 21 employees. The Hindi fortnight and Hindi Day celebrations were organized in the Institute in the month of September 2009. Various Hindi competitions were conducted during the Hindi fortnight celebrations and prizes were distributed to the respective winners. One of the English Stenographer was nominated for Hindi Stenography training course conducted by Hindi Teaching Scheme, Bangalore during the session of August-December 2009. A Workshop on Hindi Saransh Software was conducted in the Institute on 12th March 2010 for Ministerial Staff in which 17 employees participated. The inspection of the Implementation of Official Language of the Institute was carried out by the Joint Secretary (In-charge, Official Language), Ministry of Environment and Forests, Govt. of

India, New Delhi on 5th March 2010 at FRLHT, Bangalore. During inspection the In-charge officer (Hindi Cell), IWST, Bangalore presented the activities and progress of the official language implementation work done by the institute as under:

- All the Name Plates and Notice Boards have been made in Trilingual Language.
- All Rubber Stamps have been made in Bilingual.
- Subjects on all Files are being written in Bilingual i.e. Hindi & English.
- Reply to the Letters received in Hindi are being given in Hindi only.
- Position with regard to Notings in Hindi on files is 85%.
- Percentage of Letters sent in Hindi by the Office in Region A is 69%, Region B is 73% & Region C is 72%.
- Saransh Hindi Software has been loaded in all the computers available in the Institute.
- All Formats/Forms are Translated in Hindi & are available as bilingual.

FRC, Hyderabad, organized a one day Workshop on "Implementation of Hindi as an Official Language", on 29th January 2010 .The centre organized and celebrated "Hindi Divas" on 12th October 2009.

TFRI, Jabalpur along with regular activites in the direction of implementation of Rajbhasha Hindi organized Hindi week and also organized training/workshop in Hindi for the ministerial and technical staff of the institute.

RFRI, Jorhat organized various activities like Hindi week (September 2009) and A Workshop (8th January 2010) at RFRI, Jorhat. Total 14 no. of Officials from the Institute appeared & passed with good marks in the Hindi Examination Prabodh/Praveen/Pragya conducted by the Hindi Teaching Scheme, Department of Official Language, Govt. of India.

AFRI, Jodhpur along with regular activites in the direction of implementation of Rajbhasha Hindi organized quarterly meetings, Hindi week, annual workshop and invited lectures.

Many activities were organized by HFRI, Shimla for the publicity and expansion of official language Hindi. Hindi Review Committee of the institute has encouraged the scientists and staff members for working in Hindi. Regular training has been imparted by the scientists in the institute and training material was also provided in Hindi. A meeting was conducted by the Review Committee under the chairmanship of Shri Manoj Bhaik, IFS, head of office on 12th January 2009. Another meeting was conducted under the chairmanship of Chief Income tax Commissioner and Chairperson of Town Official Language Implementation Committee on 11th June 2010. Hindi Officer, Shri R. K. Sharma, and Dr. Rajesh Sharma-Scientist of participated in the meeting. In order to promote Hindi as an official language, a seminar on Hindi was conducted in office on 3rd November 2009, in which emphasis was given on different issues related to promotion of Hindi.

On behalf of Town Official Language Implementation Committees (Nagar Rajbhasha Karyanvayan Samiti, Shimla) “Prashna Manch” was conducted by HFRI, Shimla on 25th August in which officers and staff members of the institute and representatives from various Departments of Central Government, Nigams, Banks of Shimla etc. participated. The team of the HFRI got first prize.

“Hindi Divas” was celebrated by the institute on 14th September 2009. On this occasion, Dr. Vijayendra Panwar read the message issued by Hon'ble Union Home Minister

Shri P. Chidambaram. "Hindi Pakhwara" was celebrated by the institute from 14th to 26th September 2009.

During this year, for promotion and extension of science, pamphlets on Kashmal, Bil, Chilgouza, Attish and Choura were printed in Hindi only.

4.8 Award and Honours

FRI, Dehradun

- Dr. Rashmi, Scientist C, Chemistry Division, FRI, Dehradun was awarded "Young Women Scientist Award" for best oral presentation on the topic 'Phytoecdysteroids and their effect on Economic Traits of *Bombyx mori* L. in 2nd Rashtriya Yuva Vaigyanik Sammelan 2010 held at Doon University, Dehradun.
- Madhusudan Chamoli, Research Scholar, Chemistry Division, FRI, Dehradun was awarded 3rd Prize in Poster Presentation category for the paper titled "Estimation of Andrographolide Content in *Andrographis paniculata* intercropped with *Morus alba*" by Madhusudan Chamoli, V.K. Varshney and P.K Srivastava in National Forestry Conference held at FRI, Dehradun from 9th to 11th November 2009.
- Ms. Anita Tomar was awarded "Women Scientist Award" for best Oral Presentation on topic A Rhizomatus Study of *Gentiana Kuroo*- Endangered Medicinal Plant Paper Presented by Anita Tomar in 2nd Rashtriya Yuva Vaigyanik Sammelan 2010 on 6th and 7th February 2010 under theme Basic Science.
- Dr. Deepti Verma, FRI, Dehradun was awarded "Women Scientist Award" for the best Oral Presentation 2009 on the title "Carpinus Viminea: an Important Component of Oak Forests Struggling for its Existence in Western Himalayas" under the discipline Environment Science and Forestry in 4th Uttarakhand State Science and Technology Congress 2009 conducted at G. B. Pant University of Agriculture and Technology, Pantnagar.
- The Research Paper on "Allelopathic Influences of Litter and Humus on the seed Germination of *Abies pindrow*" by Vidya Rattan, Ombir Singh and S.C. Biswas has been awarded 2nd prize in Poster Presentations in IV National Forestry Conference from 9th to 11th November 2009 held at FRI, Dehradun.
- Young Scientist Award in Basic Science and Cutting Edge Technology was received by Research Scholar Mr. Kshitij Malhotra who carried out work on "A New Technique for Vegetative Propagation of *Jatropha curcas* Linn.: A Promising Plant for Biodiesel Production and Sustainable Development".
- Shri A.K. Pandey, IFS, Head, CSFER, Allahabad received "Bioved Fellow Award 2010" at Ishwar Saran Degree Collage, University of Allahabad. Award on 20th February 2010.
- Dr. B.K. Pandey, Scientist C, CSFER, Allahabad received "Bioved Distinguished Service Award 2010" on 20th February 2010 at Ishwar Saran Degree Collage, University of Allahabad.

IFGTB, Coimbatore

- Shri R.S.C. Jayaraj, IFS, Head, FLUCC Division, Dr. B. Gurudev Singh, Head, GTB Division, Dr. K. Palanisamy, Head, Seed Technology Division, Dr. A. Balu, Head, Forest Protection Division, Dr. B. Nagarajan, Head, PBT Division, Dr. K.R. Sasidharan, Scientist D, Dr. A. Nicodemus, Scientist D, Dr. V. Sivakumar, Scientist D, Shri Maria Dominic Savio, Scientist C,

Shri D.R.S. Sekar, Scientist C, Shri V.K.W. Bachpai, Scientist B, Dr. N. Ravi, Scientist B RFRI Jorhat, Shri. C. K. Jayachandran (Retired RAI), Shri. M. Salarkhan (Retired RO), Shri G. Ponraj, R.A. (SG), Shri A. Durai, R.A. I, Shri B. Deeparaj, R.A. I, Shri Arumugam, Forester, Shri T. Anthonisamy, R.A. II, Shri M. Ganesan, R.A. II, Shri S. Shanmugam, T.A. III and Shri K.T. Murthy, Forest Guard received an award from the Hon'ble Minister for Environment and Forests, Shri Jairam Ramesh, for their contribution towards tree improvement programme and development and release of clones of *Eucalyptus* and *Casuarina*.

- Shri S. Saravanan, Scientist C, and Dr. Rekha Warrier, Scientist C received an award from the Hon'ble Minister for Environment and Forests, Shri Jairam Ramesh, for extension of agroforestry technologies to farmers of Tamil Nadu and in the Demo Village and outreach activities respectively.
- Karpaga Raja Sundari, Scientist B and Modhumita Dasgupta obtained "Best Poster Award" in the National Seminar on frontiers in Biotechnology held at Bharathiar University, Coimbatore from 22nd to 24th July 2009 for the poster titled "Differential Expression of Cellulose Synthase Genes in Secondary Xylem Tissues of *Eucalyptus tereticornis*".
- Radha Veluthakkal, Yasodha R., Mohan V. and Modhumita Dasgupta was awarded third prize under poster category for the poster titled "Expression Profiling *Casuarina equisetifolia* response to *Trichosporium vesiculosum* toxin Reveals up– Regulation of Defense– Related and Signaling Genes in Pathogen Defense" in the National Forestry Conference held at FRI, Dehradun from 9th to 11th November 2009.

TFRI, Jabalpur

- P. B. Meshram awarded Applied Zoological Research Association (AZRA) Award 2009 for outstanding research contribution in the field of plant protection on 28th October 2009 at Department of Zoology, Andhra University, Visakhapatnam .
- Dr. R.K. Verma, Scientist D, Dr. V.S.Dadwal, Scientist C and Shri A.K.Thakur, RA-II received BRANDIS PRIZE in the field of Silviculture for the year 2008 from the Indian Forester for the research paper entitled "Economics of Biofertlizer Application on Production of Planting Propagules of Teak in a Commercial Nursery" Indian Forester Vol.134 (7):923-931, July 2008.
- Shri Suneesh Buxy, Deputy Conservator of Forests was awarded "Certificate of Excellence" for his contribution on ecotourism and documentation of medicinal plants of Tamia and Patalkot, Madhya Pradesh.
- Dr. D.K.Mishra of AFRI, Jodhpur was awarded Brandis Prize for his best paper published in Indian Forester.
- Dr. Sanjay Singh, Scientist D, IFP, Ranchi received "Prof. K. K. Nag Foundation Chair Young Scientist Gold Medal" for contributions in the field of Physiology and Molecular Biology by International Consortium of Contemporary Biologists on 20th November 2009 at Ranchi.

4.9 Special Activities (Such as Van Mahotsava, Forestry Day and Other occasions)

Forest Research Institute, Dehradun established the Photo Gallery at Shatabdi Van Vigyan Kendra Dehradun on 10th January 2010. The photo Gallery was inaugurated by Shri Jairam Ramesh, Hon'ble Union

Minister(I/C) for Environment & Forests. Dr. Ramesh Pokhriyal Nishank Hon'ble chief Minister of Uttrakhand graced the occasion alongwith Shri P.J.Dilip Kumar, Principal Secretary, Environment and Forests Minister, Dr. G.S.Rawat Director General, ICFRE, Dr.S.S.Negi, Director, FRI, CCF, Dr.R.B.S.Rawat, Principal Secretary Anup Wadhawan and other dignitaries, VIPs, students and other respectable citizens.

The Union Minister for Environment and Forests, Shri Jairam Ramesh inaugurated on INSAT unlinked Micro Meteorological Tower in Forest Research Institute Campus on 10th January 2010. The Tower 13 metre high, part of FRI-ISRO climate change study programme, will gauge and model the physical and biological process controlling mass and energy exchange between tree canopy and the atmosphere.

During the visit of the Hon'ble Minister of Environment & Forests & Deputy Chairman Planning Commission to Forest Research Institute, Dehradun i.e. 10th August 2009 a ceremonial Tree Plantation was done. Shri Jairam Ramesh Hon'ble Minister of Environment & Forests, GoI had planted the sapling of *Elaeocarpus sphaericus* (Gaertn.) K.Schum (Rudraksh) in the Mango groove area of the institute. Dr. Montek Singh Ahluwalia, Deputy Chairman, Planning Commission planted the sapling of *Anthocephalus cadamba* (Roxb.) Miq (Kadam) in the Mango groove area of the Institute. This Ceremonial Function was attended by Shri Vijay Kumar, IAS, Secretary, MoEF Govt. of India, Dr. P.J. Dilip Kumar, Director General (F) and Special Secretary, MoEF, Shri Jagdish Kishwan, DG, ICFRE, Dr.S.S.Negi, Director, FRI, Dehradun and Officers of ICFRE and FRI.

Dr. Montak Singh Ahluwalia, Deputy Chairman, Planning Commision, GoI Planted a Seedling of "Kadam" at FRI, Dehradun. Shri Jairam Ramesh Hon'ble MoS, EdF and other High Rank Officers were Present on the Occassion

Director General ICFRE, Dehradun, Dr. G.S. Rawat, visited AFRI, Jodhpur from 13th to 15th January 2010. He visited the Labs and experimental areas of the Institute. The Director General also inaugurated the Bio-control laboratory-cum-culture room of the Forest Protection Division on 13th January 2010.

Dr. G.S. Rawat, DG, ICFRE, Dehradun Inaugurated the Biocontrol-cum-Culture Laboratory

Indian Science Congress 2010

Institute participated in the Indian Science Congress 2010 held at Tiruvananthapuram from 3rd to 7th January 2010 and participated in the Pride of Hall Exhibition organised as part of the congress. Institute put up the stall of ICFRE.

Indian Science Congress 2010 Trivandrum-Exhibits of ICFRE

Vaniki Mela

Forest Research Institute organized a "Vaniki Mela" on 12th October 2009 at Shatabdi Van Vigyan Kendra, Dehradun. The Mela also aimed at providing information to the public, so that they could help themselves in becoming self-reliant and self employed through these technologies. The Mela also exhibited activities and research work of various Departments of the FRI, Handicraft products of various government and non-government organizations, farmers from Malhan, Ratanpur, Ganeshpur participated in the Mela organized as a joint venture of FRI and Bagwan Gramodhyog Samiti. The Herbal and Medicinal Plants produced by the farmers of Adarsh Gaon at Ambiwala, established by the institution and the Samiti were also exhibited. The participant included Nandadevi Biosphere Reserve, Navadanya, Mamta Nari Uthan, STEP, Mahila Vikas Samiti, Aranya, Uttarakhand Khadi and Village Industries Board and Uttarakhand Bamboo Fibre Development Board Sea Rock Samaj Sevi Sanstha, Eco Tourism Uttarakhand.

Farmers Mela at Tamil Nadu News Print Ltd., Karur

IFGTB, Coimbatore participated in the farmers mela organised at Tamil Nadu News Print Ltd. (TNNPL) on captive plantations and participated in the exhibition organised at TNNPL.

Participation of IFGTB in Farmers Mela Organized by Tamil Nadu News Print Ltd.

IFP, Ranchi participated in the Regional Agriculture Fair 2010 sponsored by Directorate of Extension, Department of Agriculture & Cooperation, Ministry of Agriculture, GOI and organized by Indian Institute of Natural Resins and Gum (ICAR), Namkum, Ranchi (IINRG), Ranchi during the period 22nd to 24th February 2010. The IFP's stall was adjudged the best and was awarded 1st Prize.

IFP, Ranchi Participating in Regional Agriculture Fair 2010 at Ranchi

RFRI, Jorhat Participated in Kaziranga Elephant Festival held from 3rd to 6th January 2010 at Kohora, Golaghat. The institute also participated in the "Farmers Fair" at Regional Agricultural Research Station, Titabar under Assam Agricultural University, Jorhat on 3rd November 2009.

RFRI, Jorhat participated in the "State Level Agri-Horti Show" jointly organized by Department of Agriculture, Govt. of Assam and Assam Agricultural University, Jorhat from 25th to 27th February 2010 at Golaghat, Assam. RFRI Stall was adjudged 3rd position amongst 58 participants.

RFRI, Jorhat participated in the Exhibition for Technology Demonstration for Entrepreneurs organized by Assam Science Technology & Environment Council, Guwahati (Assam) from 3rd to 7th February 2010 at the Assam Engineering Institute's Play Ground, Chanmari, Guwahati.

AFRI, Jodhpur participated in one day Kisan Mela organized by Agricultural Technology Management Authority (ATMA), Jodhpur in colloberation of Shri Marudhar Bagwani Krishi Utpadan Vikas Samiti on 22nd February 2010 at Beraie, Bhopalgarh, Rajasthan.

International Biodiversity Day (IBD)

FRI, Dehradun observed the IBD on 22nd May 2009. More than 500 visitors from the India and foreign countries visited FRI on this International Biodiversity Day.

IWST, Bangalore observed IBD on 22nd May 2009. Prof. Balakrishna Gowda, UAS, Bangalore delivered a talk on "Biodiversity and Allien Species**.**

AFRI, Jodhpur observed IBD on 22nd May 2009. Neem trees were planted by Director, AFRI.

HFRI, Shimla observed IBD 2009 on 22nd May 2009. The event was organized with the view to make the students aware of the Invasive Alien Species and the Biodiversity of Himachal Pradesh.

IFP, Ranchi observed IBD on 22nd May 2009. A workshop was organized on the occasion.

World Environment Day

All ICFRE institutes observed World Environment Day on 5th June 2009 by organizing a number of different acticvities. The theme of the celebration was "Your Planet Needs You– Unite to Combat Climate Change".

FRI, Dehradun organized Forestry & Environmental Awareness programmmes on the World Environment Day & FRI Day. A move was organized to keep the institute free from polybags. All the officers, employees and students of FRI University took part to keep the FRI surrounding free from polybags/plastic. Chief Guest of the programme Dr. S.S. Negi, Director, FRI, Dehradun appealed to clean the surroundings and make it free from plastic and polythene. During this programme an exhibition was also organised in the information centre of FRI.

IFGTB, Coimbatore observed the World Environment Day through a commemorative tree planting programme. Dr. N. Krishnakumar, Director, welcomed the gathering and underlined the role of citizens in keeping the environment clean. Shri Anshul Mishra, IAS, Commissioner, Coimbatore Corporation was the Chief Guest.

AFRI, Jodhpur observed World Environment Day on 5th June 2009. Plantation activity of Neem (*Azadirachta indica*) was undertaken on the occasion. A leaflet containing research highlights of the institute in Hindi was also released.

IFP, Ranchi observed World Environment Day on 5th June 2009 by organizing a plantation programme. During the day, about 200 plants of different species viz. *Cycas* sp., *Elaecarpus sphaericus* (Rudraksh), *Mimosops elengi* and *Saraca indica*, etc. were planted in the surrounding of the Institute's campus.

World Forestry Day

FRI, Dehradun observed the World Forestry Day on 21st March 2010 with an exhibition organized in the information centre of the institute. The technologies displayed were explained to the visitors.

HFRI, Shimla observed World Forestry Day on 22nd March 2010. VVK, Sundernagar organized an Environmental Awareness programme for school children of Model Senior Secondary School, BBMB, Sundernagar (H.P.). TFRI, Jabalpur also observed World Forestry Day.

HFRI, Shimla Observed the World Forestry Day

Vigilance Awareness week

The Council and its institutes observed Vigilance Awareness week from 3rd to 7th November 2009.

National Technology Day

FRI, Dehradun observed the National Technology Day on 11th May 2009.

World Day to Combat Desertification

AFRI, Jodhpur observed World Day to Combat Desertification on 17th June 2009. Plantation of *Commiphora wightii* (Guggul) was undertaken in the institute. Hon'ble Shri Malkhan Singh, MLA, Luni constituency was the Chief Guest. Leaflets and pamphlets on "Desertification: Challenges and Strategies for Control" were released by the dignitaries on the occasion.

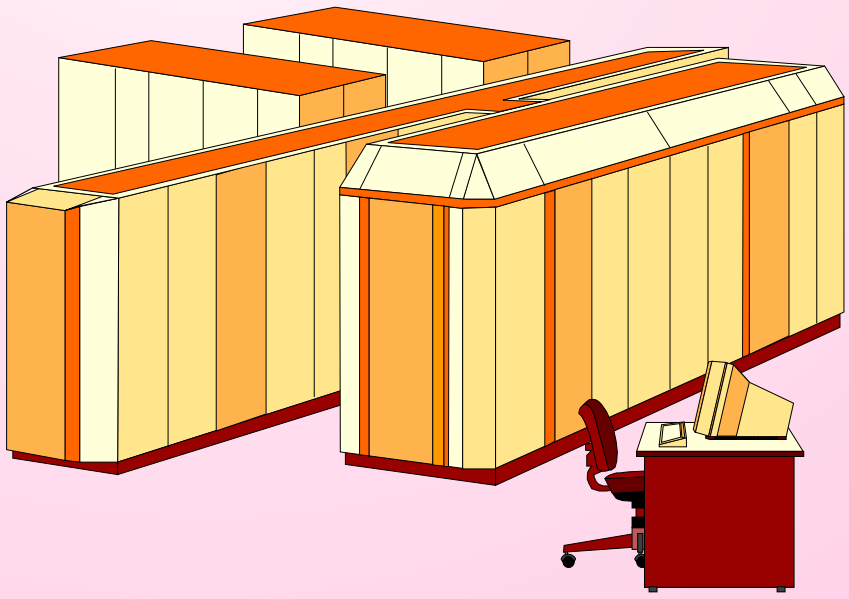
AFRI, Jodhpur observed 60th Van Mahotsava on 30th July 2009. On this occasion, Neem trees were planted in the campus.

AFRI, Jodhpur Observed World Day to Combat Desertification

Establishment of Advanced Wood Working Training Centre at IWST (Funding Agency: Italian Trade Commission/ACIMALL)

Advanced Woodworking Training Centre, an Indo-Italian joint project by IWST-ICE-ACIMALL entered into the eighth years of operation. The centre is equipped with 21 advanced wood working machines including one CNC machine, which was installed during the year 2008-09. During the year 2009-10, the centre has imparted training to 78 trainees for conventional course and 39 trainees for CNC course. So far, 1003 persons (batch wise) have been trained by the centre since 2003. More than 110 Industries (Solid Wood & Panel Materials Processing) in India offered jobs for the unemployed students joined in the Institute through Campus interview/Direct interview. About 98% of the unemployed trainees have been benefited for employment with this training. The AWTC also participated in "India Wood 2010" which was held at Bangalore.

ADMINISTRATION AND INFORMATION TECHNOLOGY



ADMINISTRATION AND INFORMATION TECHNOLOGY

Introduction

The Directorate looks after the establishment and controls the operations of Pension Cell, Procurement Cell, Recruitment Board, Budget Section and Drawing and Disbursement Office. The Directorate also caters to the Information Technology needs of ICFRE Hqrs. and FRI.

5.1 Information Technology

Information Technology (IT), today, is one of the great drivers of organizational efficiency and excellence and is, therefore, the necessary ingredient in every meaningful endeavour. This is the case with ICFRE too. The Information Technology Division under the Directorate of Administration in ICFRE caters to the IT needs of the ICFRE Hqrs. and the Institutes under it that are spread across the country. As the changes and advances in the area of IT take place at an extremely fast pace, ICFRE also keeps abreast with those changes. Meeting the organizational objectives and keeping abreast with the latest technology were the drivers for IT during 2009-10 in ICFRE.

ICFRE implements the eGovernance programme envisaged by the Ministry of Environment & Forests, New Delhi in terms of IT infrastructure and capacity building. The hardware requirements of ICFRE Hqrs. were analyzed and the demand met through receipt of desktop computers and printers from the MoEF and all the officers/ officials at ICFRE Hqrs. down to the level of LDC have been equipped with desktop computers and printers.

Besides building the above basic infrastructure, some important initiatives taken up are:

a. Development of Indian Forestry Research & Information System (IFRIS).

b. Establishment of ICFRE Server Farm (Data Centre).

Development of Indian Forestry Research & Information System (IFRIS)

IFRIS was conceptualized with the aim to implement a comprehensive IT solution with the following objectives:

a. To convert some of the present working manual systems into automated systems.

b. To enhance access, efficiency, transparency and accountability in the context of work in the organization.

c. To enhance responsiveness of ICFRE through workflow automation and knowledge management.

d. To enhance ease of access to information and services by users and stakeholders in ICFRE.

The project was planned as a three stages activity viz. Conceptualization, Project Development and Software Development & Implementation. The work was assigned to M/s Sobha Renaissance Information Technology, Bagalore through competitive bidding. The project took off during the month of January 2008 and the system is partially functional in 2009-10. It is expected to be fully deployed in 2010-11.

IFRIS broadly comprises of two main parts viz. Indian Forestry Research Management Information System (IFRMIS) and Indian Forestry Research Administration Information System (IFRAIS). Some key research–web enabled-services and records that would be provided by IFRIS are as follows:

a. Research Projects Database including externally funded projects.
b. Grants and Research proposals.
c. Role based access to information/reports.
d. Downloadable summary of research reports.
e. Personnel Information, Pay Roll and Financial Accounting System Procurement and Inventory.
f. Library Information Management System.
g. Real time availability of information on centralized data repository.

Project Institutional Framework has become an effective platform wherein Institute Apex Committees, Technical Committee and ICFRE Apex Committee regularly conduct meetings to gather expectations and concerns of stakeholders and to review implementation progress.

e-Champions, the change agents, have been identified from all the institutes for change management and adoption of application at levels of organization. e-Champions have been trained through Training–cum-Workshops at ICFRE.

ICFRE Server Farm (Data Centre)

The ICFRE Server Farm hosts the IFRIS application and other allied key services like:

a. Database and application service.
b. Email, Web services, Domain Name Services and Proxy services.
c. Antivirus and other security products like Firewalls, Intrusion detection and prevention systems etc.
d. Content filtering services like Anti-SPAM, Anti -Spyware etc.
e. Suitable Data Backup and Network Monitoring tools.

Based on its architecture, the type of services hosted and the monitoring protocols put in place, the ICFRE Data Centre has been granted an ISO 27001-2005 Certified Data Centre and Services status.

5.2 Sevottam

ICFRE interacts with citizens and its clients in a variety of ways. When it comes to IT, the interface is through the ICFRE websites and the email services- particularly its own email system that the organization has installed. The websites and email systems are managed on a 24 x 7 basis throughout the year and across various institutes of ICFRE all over the country.

5.2.1 Action Taken to Formulate the Charter for the Department and its Subordinate Formation

Public Grievance Mechanism and Service Delivery Capability are important elements of Sevottam framework. Administration and IT branches of ICFRE largely rely on providing information to the public and clients through the web-based tools, dissemination of information through a variety of means–including IT interface, responses to citizens by way of the tools that come under the purview of Right to Information Act and through workshops and seminars conducted by the organization.

The ICFRE website (www.icfre.org) provides information and details on IT initiatives taken and the progress of various works

underway. This information format, along with the whole layout of the website, was decided by a high level committee constituted a couple of years back. The information that we are providing currently follows the same approved format, the temporally variable information being the only element that changes with time.

5.2.2 Action Taken to Implement the Charter

The charter is being developed. However, the ideas that find place in a Charter of the nature envisaged in Sevottam, are mostly being implemented as the information given below shows.

5.2.3 Details of Training Programmes, Workshops, etc. Held for Proper Implementation of Charter

A large number of training programmes and workshops etc. were held by ICFRE and its institutes. Some of these are listed below:

a. Institute of Wood Science and Technology organizes 5 days and 3 days training courses on topics like Field Identification of Important Timbers, Timber Joinery, Classification and Grading of timbers, Wood Protection, Modern Seed and nursery Technology, Wood Seasoning and preservation, Extraction/Purification Techniques and Instrument Analysis, Plant Identification, Field Methods and Herbarium Techniques, Integrated Pest Management, Application of Statistics in Forestry and Agroforestry System: concept and case studies. These training are being organized since year 2005-2006.

b. The institute also conducts RAG meeting, stakeholders interactive meet/liaison meetings, Indo-Italian seminar and compulsory training for IFS officers every year.

c. Two one week trainings were organized for farmers and Field functionaries on Bamboo at Rajpipla, Gujarat and Kota, Rajasthan under National Bamboo Mission.

d. One week compulsory training of IFS Officers on "Integrated Approach for Sustainable Development of Fragile Desert Ecosystem" sponsored by Ministry of Environment & Forests, Govt. of India, New Delhi, was organized by this Institute from 14th to 18th December 2009 in which 31 IFS Officers attended the course.

e. Based on the request of stakeholders (Farmers, NGO's and Forest Department), one day brain storming seminar on Khejiri mortality in Rajasthan was organized on 16th November 2009 to formulate a coordinated project to address problem of Khejri mortality, its genetic improvement and conservation. As a followup of brainstorming session, coordinated project on Khejri on the above line were prepared and the same was approved by the RPC for the implement action.

f. A workshop on Development of criteria & indicators for sustainable NTFP management was organized on 29th August 2009 at Jodhpur in collaboration of Indian Institute of Forest Management (IIFM), Bhopal.

g. Based on the need and request from the M.Sc. students and facilities of the Biotechnology, summer training programmes on Plant Biotechnology for M.Sc., B.Sc. and B.Tech. Students at Jodhpur.

5.2.4 Details of Publicity Efforts Made and Awareness Campaigns Organized on Charter for the Citizen/Clients

ICFRE made substantial and varied efforts regarding publicity and awareness generation programmes and a large number of programmes were organized. An illustrative list, not exhaustive, is given below:

a. The Institute of Wood Science and Technology (IWST) at Bangalore, which is one of the institutes under the ICFRE, published the following handouts which are distributed free of cost in Krishi Melas, trainings and demonstration programme, VVK etc.

♦ **Pamphlets (Telugu)**

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Techniques for Treating small girth timber and bamboo
5. *Ficus bengalensis*
6. *Pongamia pinnata*
7. *Tectona grandis*
8. *Moringa olifera*
9. *Casuarina equisetifolia*
10. *Acacia nilotica*
11. *Dalbergia sissoo*

♦ **Pamphlets (Kannada)**

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Techniques for treating small girth timber and bamboo
5. Value addition of Timber–Plantation grown and lesser known species
6. Wood seasoning
7. Wood plasticization and bent wood products from coconut wood
8. AM fungi as biofertilizer in forestry

· **Pamphlets (English)**

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Techniques for treating small girth timber and bamboo
5. Value addition of Timber–Plantation grown and lesser known species
6. Wood seasoning
7. Wood plasticization and bent wood products from coconut wood
8. AM fungi as biofertilizer in forestry
9. Infrastructure requirement and vegetative propagation of *Dendrocalamus stocksii* by culm cutting

♦ **Pamphlets (Konkani)**

1. Portable Distillation Unit
2. Sap Displacement Techniques for treating small girth timber and bamboo
3. Ammonia Plasticization
4. Ammonia Fumigation

The institute has the following publications/technical bulletins some of which are in English, Kannada and Telugu. They are made available to the public on payment basis:

Sl. No.	Brochures	Language
1	Sandal	Kannada
2	Tamarind	Kannada
3	Bamboo	Kannada
4	Casuarina	Kannada
5	Neem	Kannada
6	Eucalyptus	Kannada
7	Jatropha	Kannada
8	Gmelina (Shivani)	Kannada
9	Moringa (Nugge)	Kannada
10	Agarbathis	English
11	Catamarans	English
12	Sandal	English
13	Biodeterioration of wood and its prevention in Indian Coastal Waters	English
14	Sandal	Telugu
15	Tamarind	Telugu
16	Bamboo	Telugu
17	Casuarina	Telugu
18	Neem	Telugu
19	Eucalyptus	Telugu
20	Red Sanders	Telugu
21	Catamarans	Telugu
22	Catamarans	Tamil
	Technical Bulletins/Information Series	
1	A Rapid and Non-destructive technique for estimating growth strain in trees and logs	English
2	Detection, Identity and Management of Insect Pests of Timber	English
3	Wood Seasoning & Preservation	English
4	A guide to some important timbers in south-Indian markets	English
5	Sandalwood Tree (pests and diseases and their management)	English
6	Portable Distillation Unit to extract essential oil	English
7	Ammonia Plasticization of coconut wood for value addition	English
8	Sap Displacement Techniques for treating small girth timber on bamboo	English/Kannada
9	Whitefly pests in forestry and their management	English
10	Arbuscular Mycorrhizal (AM) fungi as biofertilizer in forestry	English

Sl. No.	Books	Language
1	*Santalam album* (Sandal)	English
2	Biodeterioration of timber and its prevention in Indian Coastal Waters - 3rd Progress report 1982-2005	English
	Proceedings	
1	Forestry, Forest Products and Coastal Population	English
2	Wood Preservation in India: Challenges, Opportunuties & Strategies	English
3	Intellectual Property Rights in Forestry Issues	English
4	Conservation, Restoration and Sustainable Management of Mangrove Forests in India	English
5	Conservation, Improvement, Cultivation and Management of Sandal	English

b. Similarly, Arid Forest Research Institute (AFRI), Jodhpur also made the following publicity efforts:

- Forty two farmers and field functionaries trained under VVK from 27th to 29th November 2009 by a training organized at Gujarat Forest Research Institute, Gandhinagar.
- Three days training for farmers and field functionaries (SFD's) was conducted from 13th to 15th February 2010 under VVK (Rajasthan) at Kisan Bhawan Bikaner, Rajasthan.
- Participated in the western Rajasthan Hastshilp Utsav, held at Rawan Ka Chabootra, Jodhpur from 2nd to 11th January 2010 for dissemination of research results and developed technologies under various research projects of the Institute to the stakeholders (Farmers, NGO's, wood based industries, Environmentalists and SFD's).
- AFRI, Jodhpur participated in one day Kisan Mela organized by Agricultural Technology Management Authority (ATMA), Jodhpur in colloberation of Shri Marudhar Bagwani Krishi Utpadan Vikas Samiti on 22nd February 2010 at Beraie, Bhopalgarh Rajasthan to disseminate research findings of projects for the field application by the farmers.
- Quarterly publication of AFRI, Darpan for extension and publicity of the research interim findings and technologies for the dissemination and absorption by the stakeholders.
- Interpretation Centre has been established for public awareness and education in forestry for school and college students of forestry, agriculture and allied subject students, researchers, farmers, NGO's, and SFD's etc.
- Celebration of Days like Van Mahotasava, Environment, Biodiversity and combating deserts and desertification to generate awareness in public.

5.2.5 Details of Internal and External Evaluation of Implementation of Charter in the Organization and Assessment of the Level of Satisfaction among Citizen/Clients

As the charter is still being developed, formal evaluation has not yet started.

5.3 Welfare Measures for the SC / ST/ Backward/Minority Communities

Welfare of the SC/ST/Backward/ Minority communities is a major management concern in the ICFRE. Some of the details of actions taken in different institutes of the Council.

The Director General, ICFRE has constituted the SC/ST/OBC Cell (Grievances Redressal Cell) for SC/ST/OBC Officers/Employees of ICFRE (Hqr.) for consideration of their problems. As per Secretary, ICFRE's Order No. 63-37/2010-ICFRE dated 23/02/2010 Shri Omkar Singh, DDG (Edu.) took over the Charge of Chief Liaison Officer for SC/ ST/ OBC in the month of February 2010. During this period from February to March 2010 the following welfare measures for SC/ST/ OBC were taken.

1. Quarterly meeting with nodal officers was held in the month of March 2010.
2. One day training programme was organized on 23rd March 2010 for officers/officials dealing with matters of maintaining the Roster and followup of orders/instructions of Govt. of India relating to reservation and other related issues. Shri R.D.Chandras, Director, National Commission of Scheduled Castes, Lucknow was invited as Resource Person for the training. Total 27 officers/official under took the training.

FRI, Dehradun: The Director, Forest Research Institute reconstituted the SC/ST Cell (Grievance Reddressal Cell) form SC/ST Officers/ Employees of FRI, Dehradun for consideration of their problems under the Chairmanship of Shri Ganga Singh, C.F. Head, CC & FI Division, FRI, Dehradun.

The Cell functions under the Liaison Officer. The Liaison Officer examines and rectifies, wherever necessary, the roster maintained by the Institute for ensuring representation to SC/ST and OBCs. The Liaison Officer is expected to provide relevant guidelines to the officers of the Institute in accordance with the instructions issued by the Department of Personnel and Training (DoP&T) from time to time.

IFGTB, Coimbatore: A nodal officer has been appointed for taking up welfare measures for SC/ST/Backward/Minority Communities. Also welfare measures like improvement in fitness centre and children park have been carried out for the benefit of all employees of IFGTB. A community hall has been renovated and a canteen facility has been created for the use of employees and their families. Awards have been provided to the Children of Employees who have fared well in 10th and 12th standard board exams.

IWST, Bangalore: A meeting was convened by Dr. B.N. Mohanty, IFS, Liaison Officer SC/ST and OBC Cell of IWST in which all SC/ST and OBC Employees of Bangalore and WBD (Marine), Visakhapatnam were invited to attend. A separate meeting was also held for SC/ST and OBC employees of FRC, Hyderabad. One Committee for formulation of by-laws of the Association was constituted under the Chairmanship of Mr. Raja Muthukrishnan. The Committee is in the process of formation of bye-laws.

TFRI, Jabalpur: ICFRE Dehradun, has reconstituted the SC/ST/OBC Grievance Redressal Cell for the welfare of the community. Director, TFRI, has constituted a committee to initiate necessary steps to form a union under the guidance of Liaison Officer of the institute and preparation of bye-laws of the union is in progress. The union will conduct a

meeting every year in March. The committee has listed out the existing strength of SC/ST/OBC communities in the institute during 2009-10.

AFRI, Jodhpur: A SC/ST/Backward/ Minority communities' welfare committee has been constituted at the Institute. Dr. S.I. Ahmed, Scientist-F, is the chairman of the committee with four other members. The committee looks after the welfare aspects and the Grievances of the employees of the SC/ST/Backward/Minority communities, if any.

HFRI, Shimla: In accordance with the MHA, OM No. 16/17/67-Ests(C) dated 10.04.1968 (DoPT OM No. 36022/ 5/76 dated 27.5.1976) for ensuring proper compliance of instructions of Govt. of India in the matter of reservations for SC/ ST and OBC's. Dr. K.S. Kapoor has already been nominated as a Liaison Officer. Keeping in view the mandate of this constitution, the officer remains in touch with the welfare measures being/ to be taken up for these communities.

IFP, Ranchi: A meeting of all SC/ST/OBC Employees working at IFP, Ranchi was held on 18th March 2010 to discuss among themselves to decide the composition & finalize the bye-laws. SC/ST/OBC Cell (Grievance Redressal Cell) for SC/ST/OBC Officers/Employees IFP, Ranchi was constituted.

AUDITED ANNUAL ACCOUNTS

G.K. PATET & CO.
CHARTERED ACCOUNTANTS

Tel. : 0135-{ 2658411 / 2650215
Fax : 0135-2658411
(R) 0135-6537028

Office :
Abhishek Tower
Ist Floor,
14, Subhash Road,
DEHRA DUN - 248 001

AUDIT REPORT

We have audited the attached Balance sheet of **INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN as at 31st March, 2010** 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, read along with significant accounting policies as Schedule 24 and Notes on Accounts as Schedule 25 annexed herewith

i) In the case of the Balance sheet of the State of Affairs of the above named Council as at 31st March, 2010
ii) In the case of the Income & Expenditure Account, of the **SURPLUS** for the year ended on 31st March, 2010

For G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

DATED : 01.09.2010
PLACE : DEHRA DUN

(G.K.Patet)Partner
Chartered Accountant.
M.No.15736

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs.)

	SCHEDULE	CURRENT YEAR	PREVIOUS YEAR
CAPITAL FUND AND LIABILITIES			
CAPITAL FUND	1	1,368,254,507	1,367,326,733
RESERVE AND SURPLUS	2	295,528,949	264,286,976
PENSION FUND / GPF / GSLIS	3	1,121,289,084	1,125,033,295
SECURED LOANS AND BORROWINGS	4	NIL	NIL
UNSECURED LOANS AND BORROWINGS	5	NIL	NIL
DEFFERED CREDIT LIABILITIES	6	NIL	NIL
CURRENT LIABILITIES AND PROVISIONS	7	158,866,509	156,735,587
TOTAL		2,943,939,049	2,913,382,591
ASSETS			
FIXED ASSETS	8	1,368,254,507	1,367,326,733
INVESTMENTS -FROM EARMARKED/ENDOWMENT FUNDS	9	NIL	NIL
INVESTMENTS - OTHERS	10	NIL	NIL
CURRENT ASSETS ,LOANS , ADVANCES ETC	11	1,575,684,542	1,546,055,858
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		NIL	NIL
TOTAL		2,943,939,049	2,913,382,591
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR G.K.PATEL & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010
PLACE: DEHRADUN

Dr. G.S. RAWAT, (Director General, ICFRE)

M.S. GARBYAL (Deputy Director General, Administration,ICFRE)

PRAMOD PANT (Assistant Director General, Administration, ICFRE)

D. CHATTOPADHYAY (Financial Adviser & Chief Accounts Officer, ICFRE)

VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2010

(Amount in Rs.)

	Schedule	Current year	Previous year.
INCOME			
Income from sales / Subsidies	12	NIL	NIL
Grants / Subsidies	13	1,314,404,594	1,110,233,547
Fees / Subscriptions	14	55,276	780,390
Income from Investments	15	NIL	NIL
Income from Royalty,Publication etc.	16	367,078	536,774
Interest Earnad	17	7,288,011	10,797,814
Other Income	18	45,129,151	30,006,901
Increase/(decrease) in stock of Finished goods and works-in-progress	19	NIL	NIL
TOTAL (A)		1,367,244,110	1,152,355,426
EXPENDITURE			
Establishment Expenses	20	832,093,351	624,635,475
Other Administrative Expenses	21	297,725,814	270,143,690
Expenditure on Grants, Subsidies etc	22	82,185,000	116,542,834
Interest	23	NIL	NIL
Depreciation (Net Total at the year end corresponding to Schedule 8)		123,815,296	112,221,257
TOTAL (B)		1,335,819,461	1,123,543,256
Balance being excess Income over Expenditure (A - B)		31,424,649	28,812,170
Transfer to Special Reserve (Specify each)		NIL	NIL
Transfer to General Fund		31,424,649	28,812,170
BALANCE BEING SURPLUS/(DEFICIT) carried to corpus/capital fund		NIL	NIL
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

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"AS PER OUR SEPARATE REPORT
OF EVEN DATE ANNEXED"
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(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs.)

	Current Year		Previous Year	
SCHEDULE 1 - CAPITAL FUND:				
Balance as at the beginning of the year		1,367,326,733		1,387,629,115
Add; Transfere from General Fund		125,087,020		91,918,875
Less; Depreciation		-123,815,296		-112,221,257
Less: Delation of assets		-343,950		NIL
BALANCE AS AT THE YEAR END .		1,368,254,507		1,367,326,733

	Current Year		Previous Year	
SCHEDULE 2 - RESERVES AND SURPLUS				
1. Capital Reserve		NIL		NIL
As per last Account				
Addition during the year				
Less; Deduction during the year				
2. Revaluation Reserve		NIL		NIL
As per last Account				
Addition during the year				
Less; Deduction during the year				
3. Special Reserve		NIL		NIL
As per last Account				
Addition during the year				
Less; Deduction during the year				
4. General Fund				
As per last Account	264,286,976		217,323,532	
Addition during the year				
Excess Income over Expenditure	31,424,649		28,812,170	
Depreciation	123,815,296		112,221,257	
Received from other Units	52,133,257		40,410,371	
Less;				
Transfer to Revenue ICFRE	-51,044,209		-42,561,478	
Transfer to Capital Fund	-125,087,020	295,528,949	-91,918,875	264,286,976
TOTAL		295,528,949		264,286,976

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ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs)

SCHEDULE 3, PENSION FUND/GPF/GSLIS	GPF	GSLIS	PENSION/ New Pension Scheme	Total
Opening balance of the Fund	226,805,003	179,884	898,048,379	1,125,033,296
Add:				
Excess of Income over Expenditure	4,422,946	10,633	80,673,468	85,107,047
Saving Fund under GSLIS	0	756,688	0	756,688
Death Claim	0	278,396	0	278,396
Received from PAO	6,981,565	0	11,603,065	18,584,630
Subscription/Contribution	88,099,285	1,576,502	897,216	90,573,003
New Pension Scheme	0	0	2,873,846	2,873,846
Misc Receipts	5,088	1,630	1,448	8,166
TOTAL (A)	326,313,916	2,803,733	994,097,422	1,323,215,072
Less:				
Death Claim Paid	0	278,396	0	278,396
Saving Fund under GSLIS	0	740,523	0	740,523
Subscription to LIC	0	1,469,803	0	1,469,803
GPF Advance Reimbursement	20,820,132	0	0	20,820,132
GPF Part/Final Payment	21,745,750	0	0	21,745,750
GPF Final Payment	8,113,634	0	0	8,113,634
Pensionary benefit Paid	0	0	117,732,841	117,732,841
DCRG	0	0	31,024,064	31,024,064
ISO Charges	0	0	845	845
TOTAL (B)	50,679,516	2,488,722	148,757,750	201,925,988
BALANCE AS AT THE YEAR END (A - B)	275,634,400	315,011	845,339,672	1,121,289,084

SUB-SCHEDULE OF SCHEDULE 3.					
INCOME	GPF	GSLIS	Pension	New Pension	Total
Received from revenue-ICFRE	0	0	52,665,889	0	52,665,889
Bank Interest	4,422,946	10,633	27,931,340	76,239	32,441,158
TOTAL	4,422,946	10,633	80,597,229	76,239	85,107,047
EXPENDITURE		0	0	0	0
EXCESS OF INCOME OVER EXPENDITURE	4,422,946	10,633	80,597,229	76,239	85,107,047

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VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATEL & CO.
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs)

SCHEDULE 4, SECURED LOANS AND BORROWINGS	CURRENT YEAR	PREVIOUS YEAR
1.Central Government	NIL	NIL
2. State Government (Specify)	NIL	NIL
3. Financial Institutions	NIL	NIL
a) Term Loan		
b) Interest accrued and due		
4. Banks;	NIL	NIL
a) Term Loan		
Interest accrued and due		
b) Other Loans (Specify)		
Interest accrued and due		
5. Other Institutions and Agencies	NIL	NIL
6. Debentures and Bonds	NIL	NIL
7. Others (Specify)	NIL	NIL
TOTAL	NIL	NIL

SCHEDULE 5, UNSECURED LOANS AND BORROWINGS	CURRENT YEAR	PREVIOUS YEAR
1.Central Government	NIL	NIL
2. State Government (Specify)	NIL	NIL
3. Financial Institutions	NIL	NIL
4. Banks;	NIL	NIL
a) Term Loan		
Interest accrued and due		
b) Other Loans (Specify)		
Interest accrued and due		
5. Other Institutions and Agencies	NIL	NIL
6. Debentures and Bonds	NIL	NIL
7. Others (Specify)	NIL	NIL
TOTAL	NIL	NIL

Dr. G.S. RAWAT, (Director General, ICFRE)

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ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs)

SCHEDULE 6, DEFFERED CREDIT LIABILITIES:	CURRENT YEAR		PREVIOUS YEAR	
a) Acceptance secured by Hypothecation of capital equipment and other assets.		NIL		NIL
b) Others.		NIL		NIL
TOTAL		NIL		NIL

SCHEDULE 7, CURRENT LIABILITIES AND PROVISIONS:	CURRENT YEAR		PREVIOUS YEAR	
A- CURRENT LIABILITIES				
1. Acceptance		NIL		NIL
2. Sundry Creditors;		NIL		NIL
a) For goods				
b) Others				
3. Advances Received		NIL		NIL
4. Interest accrued but not due on		NIL		NIL
a) Secured Loans / Borrowings				
b) Unsecured loans/borrowings				
5. Statutory Liabilities;		NIL		NIL
a) Overdue				
b) Others				
6. Other Current Liabilities;				
a)Amount payable to Controller, ICFRE (As per annexure -A)	384,651		154,355	
b) Amount payable to PAO,New Delhi (As per annexure-B)	167,304		43,279	
c) Amount payable to Other Units (As per annexure-C)	108,635		223,006	
d) Amount payable to Others (As per annexure-D)	5,851,687		4,628,262	
e) Project Balances	143,463,899		143,452,945	
f) EMD/ Security deposit.	8,890,333	158,866,509	8,233,740	156,735,587
TOTAL (A)		158,866,509		156,735,587
B- PROVISIONS				
1. For Taxation		NIL		NIL
2. For Gratuity		NIL		NIL
3. Superannuation/Pension		NIL		NIL
4. Accumulated Leave Encashment		NIL		NIL
5. Trade Warrentics/Claims		NIL		NIL
6. Others (Specify)		NIL		NIL
TOAL (B)		NIL		NIL
TOTAL (A + B)		158,866,509		156,735,587

Dr. G.S. RAWAT, (Director General, ICFRE)

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ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATEL & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 03.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs)

ANNEXURE OF SCHEDULE-7.		
Annexure-A		
(Amount Payable to Controller)	**CURRENT YEAR**	**PREVIOUS YEAR**
GPF Subscription/Refund	303,089	87,379
GSLIS	2,220	345
Pension Contribution	66,190	57,590
New Pension Scheme	13,152	9,041
Total	384,651	154,355

Annexure -B		
(Amount Payable to PAO, New Delhi)	**CURRENT YEAR**	**PREVIOUS YEAR**
GPF Subscription/Refund	28,313	31,313
CGEIS	10,540	9,220
Any Other Recovery	128,451	2,746
Total	167,304	43,279

Annexure-C		
(Amount Payable To Other Units)	**CURRENT YEAR**	**PREVIOUS YEAR**
Saving Fund	64,071	61,071
Death Claim	44,013	44,013
Advance Recovery	0	114,371
CGEIS	551	551
Total	108,635	223,006

Annexure-D		
(Amount Payable to Others)	**CURRENT YEAR**	**PREVIOUS YEAR**
LIC	715,465	712,984
TDS/Service Tax/Proffissional Tax	0	48,582
Payable to Controller, ICFRE	3,987,908	3,186,789
Misc Recoveries	1,148,314	679,907
Total	5,851,687	4,628,262

Dr. G.S. RAWAT, (Director General, ICFRE)

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ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

SCHEDULE-8-FIXED ASSETS (Amount in Rs.)

DESCRIPTION	OPENING BALANCE AS ON 01/04/09	ADDITIONS	ADJUSTMENTS	GROSS BALANCE AS ON 31/03/10	DEPRICIATION	CLOSING BALANCE AS ON 31/03/10
PLAN ASSETS						
Land	5,201,020	0	0	6,201,020	0	6,201,020
Scientific Equipments	147,035,742	33,853,443	0	180,889,185	24,585,870	156,303,315
Furniture & Fixtures	10,778,430	3,898,659	0	14,677,089	1,272,776	13,404,313
Books & Journals	37,894,303	12,163,216	0	50,057,519	6,596,387	43,461,132
Vehicles	16,112,720	3,318,499	289,148	19,142,071	2,622,423	16,519,648
Building & Road	1,009,927,880	38756186	0	1,048,684,066	51,465,299	997,218,767
Office Equipments	115,725,129	862,643	54,802	116,533,964	17,415,321	99,118,643
Tools & Equipments	5,321,272	58,392	0	5,382,664	803,020	4,579,644
Electrical Fittings	3,552,534	0	0	3,552,534	532,880	3,019,654
IT Equipments	16,764,709	52,174,982	0	46,939,691	18,511,320	28,428,371
TOTAL	1,367,326,733	125,087,020	343,950	1,492,069,803	123,815,296	1,368,254,507

NOTE: Depriciation on additions has been charged for half year

ANNEXED TO AND FORMING PART OF THE
BALANCE SHEET OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
Dated: 01.09.2010

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INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

SCHEDULE-8A FIXED ASSETS

(Amount in Rs.)

Particulars of Assets	Gross Block of Assets at Cost				Depreciation				Net Block	
PLAN ASSETS	Cost/Valuation as at 01.04.2009	Addition during the year	Deduction during the year	As at 31.03.2010	Depreciation upto 31.03.2009	Depreciation during the year	Adjustment	Total	As at 31.03.2010	As at 31.03.2009
Land	6,201,020	0	0	6,201,020	0	0	0	0	6,201,020	6,201,020
Scientific Equipment	277,555,081	33,853,443	0	311,408,524	130,909,539	24,595,870	0	155,505,209	156,503,315	147,045,742
Furniture & Fixtures	21,834,488	3,898,659	0	25,733,147	11,056,058	1,272,776	0	12,328,834	13,404,313	10,778,430
Books & Journals	109,130,661	12,165,216	0	121,295,877	71,236,358	6,596,387	0	77,832,745	43,461,132	37,894,303
Vehicles	42,215,870	3,318,499	923,198	44,611,176	26,103,150	2,622,423	634,045	28,091,528	16,519,648	16,112,720
Building & Road	1,460,862,328	38,756,186	0	1,499,618,514	450,934,448	51,465,299	0	502,399,747	997,218,767	1,009,927,880
Office Equipments	344,076,168	863,645	186,636	344,713,175	228,311,045	17,415,321	131,834	245,594,532	99,118,643	115,735,123
Tools & Equipments	18,127,189	58,392	0	18,175,581	12,792,912	805,020	0	13,595,927	4,579,644	5,334,272
Electrical Fittings	12,098,736	0	0	12,098,736	8,546,202	532,880	0	9,079,082	3,019,654	3,552,534
IT Equipments	21,166,034	32,171,982	0	53,341,016	6,401,525	18,511,320	0	24,912,845	28,428,171	14,764,709
Total	2,313,627,575	125,087,020	1,109,829	2,437,594,766	946,290,842	123,815,296	765,879	1,069,340,259	1,368,254,507	1,367,326,733

NOTE: Depriciation on additions has been charged for half year

ANNEXED TO AND FORMING PART OF THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
Dated: 01.09.2010

Dr. G.S. RAWAT, (Director General, ICFRE)

M.S. GARBYAL (Deputy Director General, Administration,ICFRE)

PRAMOD PANT (Assistant Director General,Administration, ICFRE)

D. CHATTOPADHYAY (Financial Adviser & Chief Accounts Officer, ICFRE)

VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs)

SCHEDULE 9, INVESTMENT FROM EARMARKED/ENDOWMENT FUNDS:	CURRENT YEAR	PREVIOUS YEAR
1. In Government Securities	NIL	NIL
2. Other approved Securities	NIL	NIL
3. Shares	NIL	NIL
4.Debentures and bonds	NIL	NIL
5. Subsidiaries and joint Venture	NIL	NIL
6. Others (to be specifted)	NIL	NIL
TOTAL	NIL	NIL

SCHEDULE 10, INVESTMENTS- OTHERS:	CURRENT YEAR	PREVIOUS YEAR
1. In Government Securities	NIL	NIL
2. Other approved Securities	NIL	NIL
3. Shares	NIL	NIL
4.Debentures and bonds	NIL	NIL
5. Subsidiaries and joint Venture	NIL	NIL
6. Others (to be specified)	NIL	NIL
TOTAL	NIL	NIL

Dr. G.S. RAWAT, (Director General, ICFRE)

M.S. GARBYAL (Deputy Director General, Administration,ICFRE)

PRAMOD PANT (Assistant Director General,Administration, ICFRE)

D. CHATTOPADHYAY (Financial Adviser & Chief Accounts Officer, ICFRE)

VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF THE INCOME EXPENDITURE A/C OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2010.

(Amount in Rs.)

SCHEDULE 13,CURRENT ASSETS, LOANS, ADVANCES ETC:	CURRENT YEAR		PREVIOUS YEAR	
A) CURRENT ASSETS.				
1. Inventries:		NIL		NIL
a) Stores and Spares				
b) Loose Tools				
c) Stock-in-trade				
Finish goods				
Work-in-progress				
Raw Materials				
2. Sundry Debtors;		NIL		NIL
a) Debts outstanding for a period exiding six months				
b) Others				
3. Cash balance In hand.(including cheques/drafts and imprest)		885,333		927,517
4. Bank Balances				
a) With Schedule Bank				
Fixed Deposit	1,029,772,968		1,087,901,628	
Cash at Bank	404,374,531		319,029,793	
EMD	1,780,319	1,435,927,818	1,534,946	1,408,466,367
b) With non-Schedule Bank		NIL		NIL
Fixed Deposit				
Cash at Bank				
EMD				
5. Post office Savings Accounts		NIL		NIL
TOTAL (A)		1,436,813,151		1,409,393,884
B. LOANS, ADVANCES AND OTHER ASSETS				
1. Loans		NIL		NIL
a) Staff				
b) Other Entities engaged in activities/objectives similar to that of the entity.				
c) Others (Specify.				
2. Advances and other amounts recoverable in cash or in kind or for value to be received.				
a) On Capital Account (As per annexure-B)	100,086,998		89,834,334	
b) Prepayments	NIL		NIL	
c) Others				
i) Staff Advances (As per annexure F)	23,808,502		28,992,062	
ii) Amount Recoverable from Controller, ICFRE (As per annexure-C)	9,890,826		10,903,819	
iii) Amount Receivable from PAO, New Delhi (As per annexure-H)	4,827,605		5,160,533	
iv) Amount Recoverable from other Units, (As per annexure-I)	264,460	138,871,391	1,771,226	136,661,974
3. Interest Accrued:		NIL		NIL
a) On Investment from Earmarked/Endowment Funds				
b) On Investments Others				
c) On Loans and Advances				
d) Others				
TOTAL (B)		138,871,391		136,661,974
TOTAL (A + B)		1,575,684,542		1,546,055,858

ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.06.2010

Dr. G.S. RAWAT, (Director General, ICFRE)

M.S. GARBYAL (Deputy Director General, Administration,ICFRE)

PRAMOD PANT (Assistant Director General, Administration, ICFRE)

D. CHATTOPADHYAY (Financial Advisor & Chief Accounts Officer, ICFRE)

VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEETAS AT 31ST MARCH 2010.

(Amount in Rs.)

ANNEXURE OF SCHEDULE - 11.		
Annexure-b		
Advance for Capital Works/Equipments	CURRENT YEAR	PREVIOUS YEAR.
CPWD	180,281	NIL
CCU	99,853,394	89,834,334
Office Equipment	151,383	NIL
Total	100,086,998	89,834,334

Annexure-F		
(Staff Advance)	CURRENT YEAR	PREVIOUS YEAR.
Forest Advance	1,295,562	6,416,437
Festival Advance	971,580	654,480
Car Advance	579,999	630,515
Scooter Advance	3,108,942	4,001,822
Cycle Advance	289,976	84,000
House Building Advance	8,289,100	9,081,489
TTA Advance	1,036,703	948,269
LTC Advance	2,404,818	992,266
Pay Advance	166,525	177,170
Medical Advance	604,815	1,285,920
Computer Advance	716,100	765,800
TA Advance	1,650,365	1,162,869
Other Advances	2,692,017	2,693,061
Total	23,806,502	28,992,062

Annexure- G		
(Amount Recoverable fromController, ICFRE)	CURRENT YEAR	PREVIOUS YEAR
GPF Advance	2,068,273	2,105,525
DCRG	4,447,074	6,111,583
Provisional Pension	188,230	188,130
GPF Part/Final Payment	3,186,849	2,498,581
Total	9,890,826	10,903,819

Annexure- H		
(Amount Recoverable from PAO, New Delhi)	CURRENT YEAR	PREVIOUS YEAR
GPF Advance	1,647,414	1,969,120
CGEIS	963,856	963,856
DCRG	1,902,799	1,899,011
Provisional Pension	282,136	282,136
GPF Part/Final Payment	26,400	26,400
Total	4,822,605	5,160,533

Annexure- I		
(Amount Recoverable from other Units)	CURRENT YEAR	PREVIOUS YEAR
DDO		
(Primium for the Month of March	168,944	168,944
Deputation & Others	12,168	12,168
Service Taxes	81,138	87,894
International Workshop	0	1,500,000
GPF Subscription	2,220	2,220
Total	264,460	1,771,226

Dr. G.S. RAWAT, (Director General, ICFRE)

M.S. GARBYAL (Deputy Director General, Administration,ICFRE)

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D. CHATTOPADHYAY (Financial Adviser & Chief Accounts Officer, ICFRE)

VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
CHIRAG K PATEL & CO.,
CHARTERED ACCOUNTANTS

(CA. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2010.

(Amount in Rs)

SCHEDULE 12. INCOME FROM SALES/SERVICES	CURRENT YEAR	PREVIOUS YEAR
1) Income from sales	NIL	NIL
a) Sales of Finished Goods		
b) Sales of Raw Material		
c) Sale of Scraps		
2) Income from Services	NIL	NIL
a) Labour and Processing Charges		
b) Professional / Consultancy Charges		
c) Agency Commission and Brokerage		
d)Maintainance Services(Equipment/Property)		
e) Others (Specify)		
TOTAL	NIL	NIL

SCHEDULE 13. GRANTS/SUBSIDIES.	CURRENT YEAR		PREVIOUS YEAR	
(Irrevocable Grants & Subsidies Received)				
1) Central Government				
a) Plan (General Component)	1,049,300,000		879,300,000	
b) Non-Plan (General Component)	210,000,000		176,900,000	
c) Plan (North East)	50,000,000	1,309,300,000	50,000,000	1,106,200,000
2) State Government			NIL	
3) Government Agencies			NIL	
4) Institutions/Welfare Bodies			NIL	
5) Institutional Organisations			NIL	
6) Others (Specify)				
a) Sharing Cost (KVS)		5,104,594		4,033,547
TOTAL		1,314,404,594		1,110,233,547

Dr. G.S. RAWAT, (Director General, ICFRE)

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VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF THE
INCOME EXPENDITURE A/C OF EVEN DATE
FOR G.K.PATEL & CO.
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2010.

(Amount in Rs)

SCHEDULE 14 ,FEES/SUBSCRIPTION.	CURRENT YEAR	PREVIOUS YEAR
1) Entrance Fees	Nil	Nil
2) Annual Fees/Subscription	NIL	NIL
3) Seminer/Program Fees	NIL	NIL
4) Consultancy Fees	55,276	780,390
5))Other (Specify)	NIL	NIL
TOTAL	55,276	780,390

SCHEDULE 15, INCOME FROM INVESTMENTS. (Income on Invest from Earmarked/Endowment Funds transferred to Funds)	Investment from Earmarked Fund		Investment-Others	
	Current Year	Previous Year	Current Year	Previous Year
1) Interest	NIL	NIL	NIL	NIL
a) On Govt Securities				
b) Other Bonds/Debentures				
2) Dividends	NIL	NIL	NIL	NIL
a) On Shares				
b) On Mutual Fund Securities				
3) Rents	NIL	NIL	NIL	NIL
4) Others (Specify)	NIL	NIL	NIL	NIL
TOTAL	NIL	NIL	NIL	NIL

Dr. G.S. RAWAT, (Director General, ICFRE)

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VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF THE INCOME EXPENDITURE A/C OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS.

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2010.

(Amount in Rs)

SCHEDULE 16, INCOME FROM ROYALTY, PUBLICATION ETC.	CURRENT YEAR	PREVIOUS YEAR
1) Income from Royalty	NIL	NIL
2) Income from Publications	367,078	536,774
3) Others (Specify)	NIL	NIL
TOTAL	367,078	536,774

SCHEDULE 17INTEREST EARNED, .	CURRENT YEAR	PREVIOUS YEAR
1) Interest on deposit with Schedule Bank	6,003,785	10,062,553
2) Interest on depsit with Non-Schedule Bank	NIL.	Nil
3) On Loans/ Advance		
a) Employees/Staff	1,284,226	735,261
b) Others	NIL	NIL.
4) Interest on debtors and other Receivables	NIL.	NIL
TOTAL	7,288,011	10,797,814

Dr. G.S. RAWAT, (Director General, ICFRE)

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ANNEXED TO AND FORMING PART OF THE
INCOME EXPENDITURE A/C OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2010

(Amount in Rs)

SCHEDULE 18, OTHER INCOME,	CURRENT YEAR	PREVIOUS YEAR
1) Profit on sale / Disposal of Assets	NIL	NIL
a) Owned Assets		
b) Assets Acquired out of Grants or free of cost		
2) Export Incentives Realized	NIL	NIL
3) Miscellaneous Income	45,129,151	30,006,901
TOTAL	**45,129,151**	**30,006,901**

SCHEDULE 19,INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS &WORK IN PROGRESS.	CURRENT YEAR	PREVIOUS YEAR
a) Closing Stock	NIL	NIL
-Finished Goods		
- Work-in-Progress		
b) Less: Opening Stock	NIL	NIL
-Finished Goods		
- Work-in-Progress		
NET INCREASE/DECREASE (a-b)	**NIL**	**NIL**

SCHEDULE 20 ESTABLISHMENT EXPENSES,	CURRENT YEAR	PREVIOUS YEAR
a) Salaries & allowances		
i) Plan (General Component)	601,597,284	448,049,031
ii) Non-Plan(General component)	177,930,178	140,386,444
b) Contribution to Provident Fund	NIL	NIL
c) Contribution to Other Funds(Specify)		
i) Revenue Paid to Pension Fund out of own Revenue, ICFRE	52,565,889	36,200,000
d) Staff Welfare Expenses	NIL	NIL
e) Expenses on Employees Retirement and Terminal Benefit.	NIL	NIL
f, Other (Specify)	NIL	NIL
TOTAL	**832,093,351**	**624,635,475**

Dr. G.S. RAWAT, (Director General, ICFRE)

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FOR G.K.PATEL & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
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INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2010.

(Amount in Rs)

SCHEDULE 21, OTHER ADMINISTRATIVE EXPENSES ETC.	CURRENT YEAR	PREVIOUS YEAR
1) Traveling Expenses	16,817,433	17,427,361
2) Fuel Charges (Vehicle)	6,302,092	7,363,195
3) Repairs and Maintanence(Vehicle)	4,256,483	4,739,644
4) Road Taxes and Insurance	1,089,380	1,109,006
5) Electricity Charges	27,641,138	27,091,507
6) Telephone Charges	4,947,337	4,797,352
7) Repair and Maintanence of Equipments	21,032,251	15,693,555
8)Water Charges	2,393,598	2,070,811
9) Stationeries	2,612,278	2,717,201
10) Contingency Expenditure	36,840,336	27,609,891
11) Legal and Consultancy Charges	2,916,311	3,772,753
12) Municipal Tax	2,147,265	1,450,231
13) Medical / X-Rays	6,089,944	5,542,551
14) Liveries	211,097	351,706
15) Postage/Stamp Charges	788,758	740,353
16) Advertisement	2,394,568	1,294,440
17) Seminar/Conference/ IIRD Expenses	7,599,461	6,472,685
18) News Paper Bill	414,792	405,925
19) Extension - Normal	1,648,242	1,609,730
20) Extension- VVK & Dema Villagies	12,563,864	10,987,034
21) Rent of Building and Equipment	401,808	519,378
22) Fellowship/Scholorship/Cash award	14,228,487	4,462,463
23) Printings and Publication	1,428,348	1,598,130
24) Field Research Expenses	30,372,579	23,364,608
25) M & S (Lab Contingency)	8,691,734	8,219,057
26) Minor Works and Maintainance	71,246,776	64,323,872
27) Expenses on North East.	10,624,951	24,299,258
TOTAL	297,725,814	270,143,690

SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC	CURRENT YEAR	PREVIOUS YEAR
a) Grants given to Institutions/Organisation		
i) Grant to KVS	37,185,000	36,614,327
ii) Grant to Universities	45,000,000	49,928,507
iii) Grant to Pension Fund,ICFRE	NIL	30,000,000
b) Subsidies given to Institutions/Organisation	NIL	NIL
TOTAL	82,185,000	116,542,834

SCHEDULE 23, INTEREST,	CURRENT YEAR	PREVIOUS YEAR
a) On Fixed Loans	NIL	NIL
b) On Other Loans (including Bank Charges)	NIL	NIL
c) Others (Specify)	NIL	NIL
TOTAL	NIL	NIL

Dr. G.S. RAWAT, (Director General, ICFRE)

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VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF
THE BALANCE SHEET OF EVEN DATE
FOR G.K.PATEL & CO.
CHARTERED ACCOUNTANTS

(G.K. PATEL) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2010.

SCHEDULE 24, SIGNIFICANT ACCOUNTING POLICIES:

1 **ACCOUNTING CONVENTION.**
The Institute follows cash basis system of accounting, as management policy.

2 **FIXED ASSETS.**
The fixed assets on written down value as per Schedule 8 are annexed with balance sheet., the management have also compiled schedule 8-A,of assets showing the gross value of the fixed assets and these have not been verified by us.

3 **DEPRECIATION.**
Depreciation during the year was charged on Written Down Value Basis (WDV) method as per the rates prescribed in Income Tax Act 1961 and routed through Income and Expenditure Account. The amount of depreciation has been added to General Fund and deducted from Capital Fund to match the Fixed Assets and Capital Fund balance.

4 **GOVERNMENT GRANTS & SUBSIDIES.**
As per consistent accounting practice Government Grants are recognized in the financial Statements as and when received i.e. on realization basis.

5 **RETIREMENT BENEFITS.**
Since the books of accounts are being maintained on cash basis no provision for liabilities like retirement benefits if any is being made.

Dr. G.S. RAWAT, (Director General, ICFRE)

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VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF THE BALANCE SHEET& INCOME EXPENDIDTURE ACCOUNT OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF ACCOUNTS FOR THE YEAR ENDED 31st MARCH 2010.

SCHEDULE 25, CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1 **CONTINGENT LIABILITIES.**
No provision for contingent liabilities, if any has been done in the books of accounts.

2 **TAXATION.**
As informed to us , the organisation is registered u/s 12AA of Income Tax Act 1961 and exempt from Income tax as per the provisions of the act.

3 **PROJECT BALANCE.**
The opening balance of units, balance outstanding under various projects and inter unit balances are subject to confirmation & reconciliation.

4 **PENSION FUND.**
The amount recoverable from controller has been arrived on the basis of data produced by the units and after reconcile the same with the books of the controller pension cell.

5 Grants in aid Non-Plan (General Component) received during the year includes Rs 1.00 Crore pertaining to the Financial year 2008-2009.

6 During the year, Advance to CCU to the extent of Rs 354.60 lacs (North East) has been capitalised by the organisation on the basis of Statement of work wise expeinditure provided by CCU.

7 Corresponding figures for the previous year have been regrouped / rearrange suitably as far as practicable in the new format of Financial Statements for the Central Autonomous Bodies provided by the Comptroller and Auditor General of India.

8 Schedules 1 to 25 are annexed to and form an integral part of the Balance Sheet as at 31st March 2010 and the Income and Expenditure Account for the year ended on that date.

Dr. G.S. RAWAT, (Director General, ICFRE)

M.S. GARBYAL (Deputy Director General, Administration,ICFRE)

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VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

ANNEXED TO AND FORMING PART OF THE
BALANCE SHEET& INCOME EXPENDITURE
ACCOUNT OF EVEN DATE
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

(G.K. PATET) Partner
Chartered Accountant
Membership No.15736
DATED: 01.09.2010

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2010

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
OPENING BALANCE AS ON 1-4-2008			NON PLAN		
To Cash In Hand			By Salaries (Technical Staff)	106,833,883	
Name of Component			By Salaries (Non Technical Staff)	72,293,315	
Plant (GC)	927,519		By Salaries (Research KVS)	28,785,000	206,816,179
Plan (Research)	-				
Non-Plan (GC)	-	927,519	Plan (General Components)		
			By Salaries to KVS(50% Arrier)		8,400,000
			By Salaries (Technical Staff)	410,418,446	
			By Salaries (Non Technical Staff)	191,177,838	
To Cash at Bank			By T.E. (Technical Staff)	10,045,060	
A/c No. & Name of Component			By T.E. (Non Technical Staff)	6,787,343	
Plant (GC)	308,233,693		By O.E. (Technical)	-	613,409,717
Plan (Research)	-		Maintenance of Vehicle		
Non Plan (GC)	6,757,270		- Fuel	6,302,092	
To Earnest Money	1,534,646	316,525,609	- Repair	4,255,463	
North East		4,038,930	- Road Taxes / Insurance	1,086,360	
To FDRs			Electricity Charges	27,641,158	
A/c No. & Name of Component			Telephone charges	4,947,337	
Plant (GC)	1,084,101,628		Maintenance of Equipments		
Plan (Research)	3,830,000		- Scientific	3,367,951	
		1,067,931,628	- Office	5,015,092	
			- I.T. Equipments / Services	12,649,208	
Grants-In-Aid			Others		
To Plan (General Component)	1,049,330,000		- Water Charges	2,393,568	
Less Paid to Centre			- Stationery	2,042,276	
To Plan DDG(Ecu)	-		- Contingency Expenditure	36,842,336	
Less Paid to Centre	-		- Legal / Consultancy charges	2,915,314	
To Non Plan (General Component)	181,270,000		- Municipal Tax	2,147,265	
To Non Plan (KVS)	28,786,000		- Medicines / X-ray	6,085,944	
To North East	50,000,000	1,309,330,000	- Liveries	211,097	
To Staining Cost		5,134,894	- Postal / Stamp Charges	788,758	
To Revenue Receipt From D.D.Os		52,133,257	- Advertisement	2,394,568	
To Revenue Receipt Payable to DG/ICFRE		52,839,516	- Seminar / Conference / HRD	7,595,461	
To Amount Received from DG /ICFRE Revenue		52,835,689	- Newspeper Bill	414,792	
			- Extension - Normal	1,649,247	
			- V.V.K. & Demo Villages	12,563,864	
			- Rent building / Equipment	401,809	144,391,386
			Plan (Research)		
			By Fellowship/Scholarship/cash Awards	14,228,487	
			Printings & Publication	1,428,348	
			Field Research Expenses	30,372,579	
			By M & M (Lab Contingencies)	8,891,734	
			By Minor Works/Maintenance	71,245,278	
			Conveyance Advances	-	
			HBA	-	
			By Building & Roads	3,286,188	129,263,810
			By Equipments		
			Scientific Equipments	30,953,812	
			Office Equipments	375,982	
			I.T. Equipments/Services	31,575,791	
			Tools & Equipment	56,392	
			Furniture & Fixture	2,490,141	
			Books & Journals	12,165,218	
			Vehicles	3,316,499	
			By Grants to Universities	45,000,000	125,943,035

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2010

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
			North East Plan		
			Equipments / Vehicle	5,387,001	
			Expenses Incurred	10,624,951	16,011,952
			By Advance Payments		
			CCU -North East	45,061,000	
			RFRI Jorhat	-	45,061,300
			CPWD NE(Through Institue/Centre)		450,281
			By Advance Payments		
			Scientific Equipments	151,383	
			Office Equipments	-	
			IT Equipments	-	
			Furniture & Fixture	-	
			Books & Journals	-	151,383
To Revenue Receipt Payable to own Revenue Account No.		16,431,529	To Revenue Receipt paid to own Revenue Account No.		16,630,410
			By Revenue Receipt paid to D.G. ICFRE		51,044,209
			By Revenue Receipt paid to Controller ICFRE		52,635,889
To Securities / EMD			By EMD/Security Refunded		2,414,445
Plan (CC)	3,071,028				
Plan (Res)	-	3,071,028			
GRANT TO UNIVERSITY:		-			
To Reimbursement from PAO (F) New Delhi			By Payments made on Behalf of PAO (F) New Delhi		
GPF Advance	5,120,500		GPF Advance	4,778,784	
CGEGIS	-		CGEGIS	-	
DCRG	248,475		DCRG	252,263	
Provisional Pension	-		Provisional Pension	-	
GPF Part/Final Payments (Group'D')	-	5,368,975	GPF Part/Final Payments (Group'D')	-	5,031,047
To Reimbursement from Controller, ICFRE			By Payments made on Behalf of the Controller, ICFRE		
GPF Advance	20,537,868		GPF Advance	20,631,116	
DCRG	35,192,437		DCRG	33,527,928	
Provisional Pension	-		Provisional Pension	-	
GPF Part/Final Payments (Group'D')	250,800	56,081,105	GPF Part/Final Payments (Group'D')	939,068	55,366,112
To Recoveries from Staff on behalf of PAO (F), New Delhi			By Payment made to PAO (F) on behalf of Staff		
GPF Subscription	8,170,454		GPF Subscription	8,173,454	
Refund of GPF Advance	1,952,655		Refund of GPF Advance	1,932,655	
CGEGIS	80,335		CGEGIS	79,015	
House Building Advance	7,234		House Building Advance	7,234	
Interest on House Building Advance	14,200		Interest on House Building Advance	14,200	
Car Advance	-		Car Advance	-	
Interest of Car Advance	-		Interest of Car Advance	-	
Scooter Advance	-		Scooter Advance	-	
Interest of Scooter Advance	-		Interest of Scooter Advance	-	10,125,538
Etc. (Please specify)	125,705	10,250,583	Etc. (Please specify)		

- 1 SEP 2010

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2010

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Receipt from Staff on behalf of other Offices			By Payments made to other offices on Behalf of Staff		
GPF Subscription / Refund	5,571,530		GPF Subscription / Refund	6,926,141	
CGEGIS	88,260		CGEGIS	88,260	
H B A	208,380		H B A	213,060	
Interest on House Building Advance	230,425		Interest on House Building Advance	232,425	
Car Advance	13,990		Car Advance	13,990	
Interest of Car Advance	153,205		Interest of Car Advance	153,205	
Scooter Advance	12,750		Scooter Advance	5,250	
Interest of Scooter Advance	-		Interest of Scooter Advance	-	
Etc. (Please specify)	734,718	7,015,658	Etc. (Please specify)	352,138	7,182,469
To Recoveries from Staff on Behalf of Controller, ICFRE			By Payments to Controller, ICFRE on Behalf of the Staff		
GPF Subscription	72,813,547		GPF Subscription	72,413,797	
Refund of GPF Advance	11,813,857		Refund of GPF Advance	11,792,197	
GSLIS	1,544,793		GSLIS	1,542,924	
Pension Contribution	757,502		Pension Contribution	743,932	
New Pension Scheme	1,226,207		New Pension Scheme	1,222,096	
Employer's Share	831,643	88,587,355	Employer's Share	831,643	
			DCRG	-	88,357,059
To Recoveries of Advances from Staff on Behalf of, ICFRE			By Advances paid to Staff		
Forest Advance	78,752,076		Forest Advance	73,631,201	
Festival Advance	2,037,450		Festival Advance	2,364,550	
Car advance	50,518		Car advance	-	
Interest Car Advance	-		Interest Car Advance	-	
Scooter Advance	1,480,646		Scooter Advance	596,824	
Interest Scooter Advance	-		Interest Scooter Advance	942	
Cycle Advance	53,025		Cycle Advance	9,000	
Interest Cycle Advance	-		Interest Cycle Advance	250,000	
House Building Advance (HBA)	1,292,975		House Building Advance (HBA)	530,566	
Interest House Building Advance	-		Interest House Building Advance	-	
TA Advance	21,033,198		TA Advance	21,517,669	
LTC Advance	5,361,073		LTC Advance	6,772,525	
TTA Advance	1,439,511		TTA Advance	1,524,945	
Medical Advance	2,635,505		Medical Advance	1,859,400	
Pay Advance	200,382		Pay Advance	189,757	
Computer Advance	258,200		Computer Advance	208,500	
Etc. (Please specify)	2,199,697	116,301,229	Etc. (Please specify)	2,198,860	111,616,669
To Recoveries from Staff on behalf of Others			By Payments made to other Offices on Behalf of Staff		
			By Payments		
By Recoveries Income Tax (Salary)	53,471,583		By Recoveries Income Tax (Salary)	53,459,314	
TDS (Contractor/Firms, Service Tax	8,100,399		TDS (Contractor/Firms, Service Tax	8,194,269	
Professional Tax)	467,494		Professional Tax)	467,320	
PPF	206,822		PPF	206,922	
LIC	2,860,551		LIC	2,858,180	
EMD / Securities	3,305,514		EMD / Securities	1,817,203	
Court Attachment	-		Court Attachment	-	
Hindi Translation	-		Hindi Translation	-	
Quarter Rent	690		Quarter Rent	80,565	
Staff Association	-		Staff Association	-	
Etc. (Please specify)	53,610,826	126,021,799	Etc. (Please specify)	31,517,369	98,350,752
Service Tax Other Unit		14,200	Any other Payment (Please specify)		24,716,54
			Service Tax Other Unit		7,434

1 SEP 2010

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2010

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Project Receipts / Revenue Receipt		229,348,253	By Project Payments/Revenue		229,337,258
Amount Received by Controller ICFRE			Amount paid by Controller ICFRE		
Amount received from PAO (F) on account of GPF Transfer	6,981,585		By GPF reimbursement to DDO's	29,820,132	
			By GPF Part Final payment	21,745,780	
Amount received from Various DDO'S on account of GPF Subscription	88,789,285		By GPF Final payment	8,113,634	
			Death Claims paid	275,399	
			Saving Fund paid	740,523	
			Amount of premium to LIC for GSLIS Subscription	1,466,803	
Amount received from Others on account of refund of excess GPF Payments	-		Pensionary benefit paid	117,732,841	
			Reimbursement of DCRG, Pension to	31,024,094	
			Various DDO's	-	
			ISC Charges	845	201,925,998
Closer of New Pension Accounts	2,673,845				
Bank & FDR Interest	32,441,155				
Amount received on account of Saving			By Closing Balance		
Funds under GSLIS	750,699		Cash-in-hand	885,333	
Amount received on account of Death			Name of Component		
Claim under GSLIS	275,399		Cash at Bank with different nationalised		
Subscription from various DDOs	1,379,592		Plan (GC) / Revenue / Project	991,733,614	
Pro-rata Pensionary benefit received from PAO (F)	11,603,085		Plan (North East)	90,275	
			Non Plan including share cos.	3,827,026	
Amount received from Various DDO's on account of Pension Contribution	697,215		Non Plan Ave	8,717,616	
Amount recovere on account of excess payment of pension by bank	-		Name of Component	-	
			FDR's	1,028,772,990	
Amount received from other Departments on account of Pensionary benefits	-		FMD	1,780,319	1,436,815,157
Govt. Securities					
FDR Interest / SB interest					
Misc.	3,188	145,515,807			
GRAND TOTAL:		3,684,945,012	GRAND TOTAL:		3,684,945,012

Dr. G.S. RAWAT, (Director General, ICFRE)

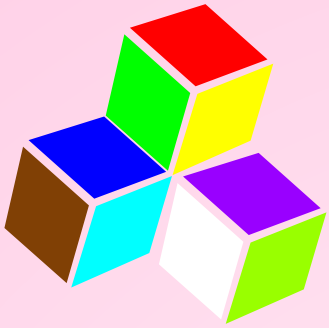
M.S. GARBYAL (Deputy Director General, Administration, ICFRE)

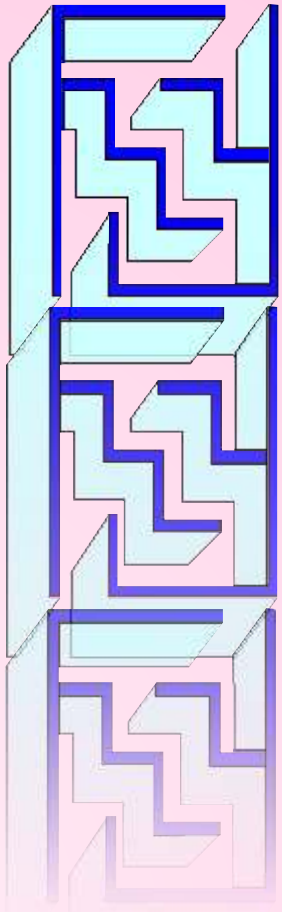
PRAMOD PANT (Assistant Director General, Administration, ICFRE)

D. CHATTOPADHYAY (Financial Adviser & Chief Accounts Officer, ICFRE)

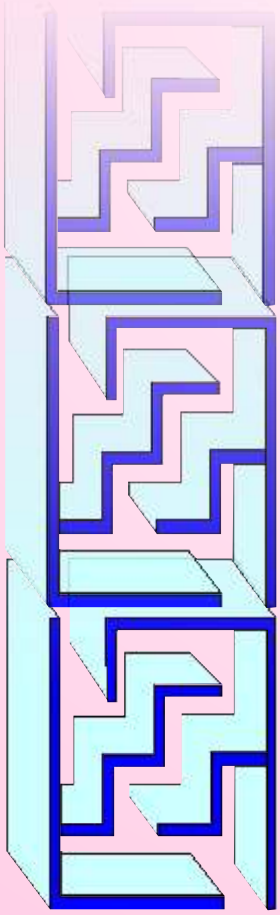
VIJAY DHASMANA (Establishment & Accounts Officer, ICFRE)

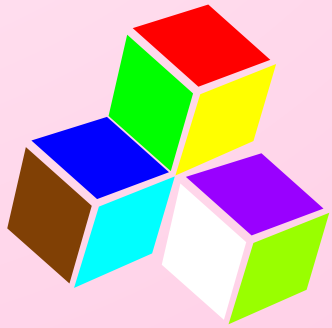
- 1 SEP 2010





ANNEXURES





Annexure-I

NAMES AND ADDRESSES OF PUBLIC INFORMATION OFFICERS AND APPELLATE AUTHORITIES UNDER THE RIGHT TO INFORMATION ACT 2005 IN ICFRE AND ITS INSTITUTES

Headquarters / Institutes	Appellate Authorities	Public Information Officers	Subject matter(s) allocated
Indian Council of Forestry Research and Education (ICFRE Hq.), P.O. New Forest Dehradun-248 006	Dr. Govind Singh Rawat, Director General Phone: 0135-2759382; 2224855 Fax: 0135-2755353 E-mail:dg@icfre.org	Dr. Sudhanshu Gupta, Secretary, ICFRE Phone: 0135 2758614, 2752933(R) Fax: 0135-2750298 E-mail: sudhanshu@icfre.org sec@icfre.org	All matters related to ICFRE Hqrs., Dehradun
Forest Research Institute, P.O. New Forest, Dehradun-248 006	Dr. S.S. Negi, Director Phone: 0135-2224444, E-mail: negiss@icfre.org dir_fri@icfre.org	Shri A.S.Rawat, IFS Group Coordinator (Research) Phone:0135-2224316 , 2752670 (O) E-mail: groupco_fri@icfre.org	All matters related to Research and Accounts
		Mr. Piar Chand,IFS Registrar, FRI Dehradun Phone: 0135-2224222, 2752678 E-mail: registrar_fri@icfre.org Fax:0135-2756865	Establishment, Administrative & all other matters
		Dr. A.K. Tripathi Registrar, FRI Deemed University Phone:0135-2751826, 2224439 (O) E-mail: tripathiak@icfre.org	All matters related to FRI Deemed University
Centre for Social Forestry & Eco-Rehabilitation (CSFER), 3/1, Lajpath Rai Road, New Katra, Allahabad - 211 002	Dr. S.S. Negi, Director Phone: 0135-2224444, E-mail: negiss@icfre.org dir_fri@icfre.org	Shri A.S.Rawat, IFS Group Coordinator (Research) Phone:0135-2224316 2752670 E-mail: groupco_fri@icfre.org	All matters related to CSFER, Allahabad
Institute of Forest Genetics & Tree Breeding, Forest Campus, P.B.No 1061 R.S.Puram, Coimbatore - 641 002	Dr.N. Krishnakumar, Director Phone: 0422-2484100, 2431540 Fax : 0422 – 2430549 E-mail: dir_ifgtb.icfre.org Direct No.- 2431942	Shri T. P. Raghunath, IFS Group Coordinator (Research) Phone: 0422-2484102	All subjects related to IFGTB, Coimbatore

Headquarters / Institutes	Appellate Authorities	Public Information Officers	Subject matter(s) allocated
Institute of Wood Science & Technology, P.O. Malleswarum, Forest Research Lab. Bangalore– 560003, Karnataka	Shri. S.C. Joshi, Director, Phone : 080-23341731, 23345965 E-mail: scjoshi@icfre.org dir_iwst@icfre.org	Dr. B.N. Mohanty Group Coordinator (Research), Phone: 080-23340115, 22190104	All matters related to IWST, Bangalore and FRC, Hyderabad
Forest Research Centre Dulapally, P.O. - Hakimpet Hyderabad-500 014			
Tropical Forest Research Institute, Jabalpur P.O. – R.F.R.C, Mandla Road, Jabalpur – 482 021 (M.P)	Dr. A.K. Mandal, Director Phone: 0761-4044002 4044011 2840483 Fax: 0761-4044002, 2840484 E-mail: dir_tfri@icfre.org	Dr. K.C. Joshi, Scientist-G Group Coordinator (Research) Phone: 0761-4044003	All matters related to TFRI, Jabalpur
Centre for Forestry Research and Human Resources Development (CFRHRD), P.O. - Kundalikala, Poama, Chhindwara - 480 001 (M.P.)			All matters related to CFRHRD, Chhindwara
Rain Forest Research Institute Post Box No. 136, Deovan, Sotai, A.T. Road, Jorhat- 785 001 (Assam)	Dr. N.K. Vasu, Director Phone: 0376-2350273 (O) 2350271 (R) Fax: 0376-2350273 E-mail: dir_rfri@icfre.org	Shri Gautam Banerjee, DCF Public Information Officer (PIO) Phone: 0376-2350272 (O) Fax: 0376-2350274 (R)	All matters related to RFRI, Jorhat
Advanced Research Centre for Bamboo and Rattans (ARCBR), P.O. Box 171, Kulikawn Aizwal- 796 001 (Mizoram)	Dr. N.K. Vasu, Director Phone: 0376-2350273 (O) 2350271 (R) Fax: 0376-2350273 e-mail: dir_rfri@icfre.org	Shri Gautam Banerjee, DCF Public Information Officer (PIO) Phone: 0376-2350272 (O) Fax: 0376-2350274 (R)	All matters related to ARCBR, Aizwal

Headquarters / Institutes	Appellate Authorities	Public Information Officers	Subject matter(s) allocated
Arid Forest Research Institute, P.O. Krishi Upaz Mandi, New Pali Road, Jodhpur- 342005	Dr. T.S. Rathore Director, Phone : 0291-2722764 2742549 Fax : 0291-2722764 Email: dir_afri@icfre.org	Dr. Pradeep Chaudhary, IFS, Head Silviculture Division Phone : 0291-2729196 FAX : 0291-2722764 Email: pradeep@icfre.org	All matters related to AFRI, Jodhpur
Himalayan Forest Research Institute, Conifer Campus, Panthaghati, Shimla – 171 009 (Himachal Pradesh)	Sh. Mohinder Pal, IFS Director Phone – 0177-2626778(O) Fax - 0177- 2626779 (O) 0177- 2624392 (R) E-mail: hfri@icfre.org : m palifs@yahoo.com : dir_hfri@icfre.org	Dr. K.S. Kapoor Coordinator (Research) & Head, Division of Ecology & Biodiversity Conservation HFRI, Shimla – 171 009 Phone : 0177-2626801 (O) Fax : 0177-2626779 (O) E-mail: hfri@icfre.org kapoorks@icfre.org	All matters pertaining to HFRI, Shimla
Institute of Forest Productivity, Aranvodaya, Gumla, N.H.-23, P.O. Lalgutwa Ranchi-835 303 (Jharkhand)	Shri R. Krishnamurthy, Director Phone: 0651-2948505(O) 0651-2546044(R) Fax: 0651-2241457 E-mail: krishnamurthyr@icfre.org dir_ifp@icfre.org	Shri Rameshwar Das, C.F. Phone: 0651-3296974 E-mail: dasr@icfre.org	All matters related to IFP, Ranchi

Annexure-II

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Director
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Annexure III

LIST OF ABBREVIATIONS

AAS	-	Atomic Absorption Spectrophotometer
ACA	-	Ammonical Copper Arsenic
AM	-	Arbuscular Mycorrhizal
AWWTC	-	Advanced Wood Working Training Centre
BA	-	6-Benzyl Adenil
BAU	-	Birsa Agricultural University
BGT Div.	-	Biotechnology, Genetics & Tree Improvement Division
BHU	-	Banaras Hindu University
BR	-	Biosphere Reserve
BRIS	-	Biosphere Reserve Information Series
BSI	-	Botanical Survey of India
CBNRM	-	Community Based Natural Resource Management
CCA	-	Copper Chrome Arsenic
CCB	-	Copper Chrome Boron
CCF-II	-	Country Cooperation Framework –II
CEC	-	Cation Exchange Capacity
CF	-	Conservator of Forests
CFRHRD	-	Centre for Forestry Research Human Resource and Development
CG	-	Chhattisgarh
CIMAP	-	Central Institute of Medicinal and Aromatic Plants
CNSL	-	Cashewnut Shell Liquid
CPT	-	Candidate Plus Tree
CSIR	-	Council for Scientific and Industrial Research
CSO	-	Clonal Seed Orchard
CTPS	-	Chanderpura Thermal Power Station
DBT	-	Department of Biotechnology
DDG	-	Deputy Director General
DID	-	Department for International Development
DG	-	Director General
DNA	-	Deoxyribo Nucleic Acid
DNTP	-	Deoxyribonucleotide triphosphate
DSAEPL	-	DS Agri Estate Private Limited
DST	-	Department of Science & Technology
DUS	-	Distinctiveness Uniformity Stability
DVC	-	Damodar Valley Corporation
EBC Div.	-	Ecology & Biodiversity Conservation Division
EC	-	Exchangeable Capacity

EIA	-	Environmental Impact Assessment
E-mail	-	Electronic mail
EMP	-	Environmental Management Plan
EPN	-	Entomopathogenic Nematode
ERS	-	Environmental Research Station
ETP	-	Entire Trans Planting
EWI	-	Earthwatch Institute
FDA	-	Forest Development Agencies
FMS Div.	-	Forest Management & Silviculture Division
FPO	-	Food Products Order
FRC	-	Forest Research Centre
FRI	-	Forest Research Institute
FRO	-	Forest Range Officer
FS	-	Fibre Strength
FSI	-	Forest Survey of India
FTA	-	Forestry Training Academy
FT-IR	-	Fourier Transform Infrared
FYM	-	Farm Yard Manure
GA	-	Gibbrelic Acid
GBH	-	Girth at Breast Height
GC/MS	-	Gas Chromatography/Mass Spectrometry
GLC	-	Gas Liquid Chromatograph
GoI	-	Government of India
GPS	-	Global Positioning System
GUI	-	Graphical User Interface
HARP	-	Horticultural & Agroforestry Research Programme
HNBGU	-	Hemwati Nandan Bahuguna Garhwal University
HP	-	Himachal Pradesh
HPLC	-	High Pressure Liquid Chromatography
HRD	-	Human Resource Development
IAA	-	Indole Acetic Acid
IBA	-	Indole Butyric Acid
ICFRE	-	Indian Council of Forestry Research & Education
IDRC	-	International Development Research Centre
IGAU	-	Indira Gandhi Agricultural University
IFGTB	-	Institute of Forest Genetics & Tree Breeding
IFP	-	Institute of Forest Productivity
IFRIS	-	Indian Forestry Research Information System
IINRG	-	Indian Institute of Natural Resins and Gums
ILRI	-	Indian Lac Research Institute
ISSR	-	Inter Simple Sequence Repeat

ISM	-	Indian School of Mines
IT	-	Information Technology
ITTO	-	International Tropical Timber Organization
IWST	-	Institute of Wood Science & Technology
JFMC	-	Joint Forest Management Committee
JFM	-	Joint Forest Management
JNKVV	-	Jawaharlal Nehru Krishi Vishwavidyalaya
JSFDCL	-	Jharkhand State Forest Development Corporation Ltd.
KVK	-	Krishi Vigyan Kendra
LAN	-	Local Area Network
LC	-	Lethal Concentration
L-DOPA	-	L-3,4-dihydroxyphenylalanine
MADP	-	Medicinal Aromatic and Dye Plants
MAP	-	Medicinal & Aromatic Plants
MoEF	-	Ministry of Environment & Forests
MoE	-	Modulus of Elasticity
MoR	-	Modulus of Resistance
MoU	-	Memorandum of Understanding
MoWR	-	Ministry of Water Resources
MP	-	Madhya Pradesh
MPCA	-	Medicinal Plant Conservation Area
MPFD	-	Madhya Pradesh Forest Department
MPMFP	-	Madhya Pradesh Minor Forest Produce
MPSBDB	-	Madhya Pradesh State Biodiversity Board
MS	-	Maharashtra
MTE	-	Mid Term Evaluation
MW	-	Microwave
NAA	-	Naptha Acetic Acid
NABARD	-	National Bank Agriculture & Rural Development
NAP	-	National Afforestation Programme
NBM	-	National Bamboo Mission
NBRI	-	National Botanical Research institute
NERIWALM	-	North Eastern Reginal Institute of Water and Land Management
NFT	-	Nitrogen Fixing Tree
NGO	-	Non-Government Organization
NMBA	-	National Mission of Bamboo Application
NMPB	-	National Medicinal Plant Board
NTFP	-	Non-Timber Forest Produce
NWFP	-	Non-Wood Forest Products
NRC	-	National Research Centre
NRCAF	-	National Research Centre for Agroforestry

OKDISCD	-	Omeno Kumar Das Institute of Social Change and Development
OSR	-	On Station Research
PCR	-	Polymerase Chain Reaction
PDBC	-	Project Directorate of Biological Control
PFA	-	Prevention of Food Adulteration Act
PF	-	Project Formulation
PRA	-	Participatory Rural Appraisal
PSB	-	Phosphate Solubulizing Bacteria
QPM	-	Quality Planting Material
RAPD	-	Random Amplified Polymorphic DNA
RBD	-	Randomized Block Design
RH	-	Relative Humidity
RPC	-	Research Policy Committee
RS	-	Remote Sensing
SASVPESY	-	Samudai Adharit Samanvit Van Pravardhan Evam Sanrakshan Yojna
SEPC	-	Shellac Export Promotion Committee
SFD	-	State Forest Department
SHG	-	Self Help Group
SLR Div.	-	Soil & Land Reclamation Division
SPA	-	Seed Production Areas
SPM	-	Suspended Particulate Matter
TBO	-	Tree Borne Oilseeds
TC	-	Tissue Culture
TDZ	-	Thidiazuoron
TEM	-	Transmission Electron Microscopy
TERI	-	The Energy and Resources Institute
TFRI	-	Tropical Forest Research Institute
TFT	-	Thin Film Transistor
TLC	-	Thin-Layer Chromatograph
UNDP	-	United Nation Development Programme
UV IR	-	Ultra Violet Infrared
VAM	-	Vesicular Arbuscular Micorrhizae
VPC	-	Vegetative Propagation Centre
VPN	-	Virtual Private Network
WB	-	West Bengal
WPM	-	Woody Plant Media
WWF	-	World Wide Fund