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Indian Council of Forestry Research and Education
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Annual Report

2013-14

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

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DEHRADUN (UTTARAKHAND)

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Back Cover:
1. Lysimeter experiment for phytoremediation -AFRI Jodhpur
2. Bhoot Jolakia nursery and its extension in farmer's fields at Demo Village under Areca-Bhoot Jolokia Agroforestory model-RFRI, Jorhat
3. Grafted plants of *M. indica*-TFRI, Jabalpur
4. Preparations of bundles of broodlac-TFRI, Jabalpur

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महानिदेशक, भा.वा.अ.शि.प.
तथा कुलाधिपति, वन अनुसन्धान संस्थान-सम-विश्वविद्यालय
Dr. Ashwani Kumar, IFS
Director General, ICFRE
and Chancellor, FRI University

पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
भारतीय वानिकी अनुसन्धान एवं शिक्षा परिषद्
(आई एस ओ 9001:2000 प्रमाणित संस्था)
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Government of India
Indian Council of Forestry Research and Education
(An ISO 9001 : 2000 Certified Organization)
P.O. New Forest, Dehra Dun - 248006

FOREWORD

The Indian Council of Forestry Research and Education (ICFRE), Dehradun is a premier institution in the country coordinating and undertaking forestry research, education and extension activities for achieving sustainable development of natural resources. The year 2013-14 has been particularly important for the Council as several important events were organised by it, such as the 'Asia Pacific Workshop on Forest Hydrology' in collaboration with Asia Pacific Association of Forestry Research Institutions (APAFRI), Malaysia and Korea Forest Research Institute (KFRI) Korea at FRI Dehradun; International seminar on 'Sandalwood: Current trends and future prospects' at IWST, Bangalore and, the Fifth International Casuarina Workshop under the aegis of IUFRO Working Party S2.08.02, *Improvement and Culture of Nitrogen-Fixing Trees* at Mamallapuram, Chennai by IFGTB, Coimbatore.

Acknowledging the significance of extension activities, the Council implements several schemes like 'Direct to Consumer', 'Van Vigyan Kendras' (VVKs), 'Demo Villages' (DVs), 'Networking of VVKs with Krishi Vigyan Kendras (KVKs)' of ICAR to take the research outputs to the end users. Under one such programme, introduction of the new lac host *Flemingia* spp. by IFP, Ranchi is proving to be very promising to the farmers in enhancing their livelihood. Similarly, ICFRE through the Bamboo Training Support Group (BTSG), is training different end users to enhance their income.

The Council also extended its expertise in the field of environment management under which, the Reclamation and Rehabilitation (R&R) Plans for individual mines in the mining districts of Karnataka i.e., Bellary, Tumkur and Chitradurga are being prepared. In this regard, I am happy to inform that so far 93 R&R Plans have been prepared and submitted to the Central Empowered Committee (CEC) of the Hon'ble Supreme Court, out of which, 90 have been approved.

Further, the ICFRE regularly holds workshops, trainings etc. under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In another major development, the National Working Plan Code 2014 has been prepared by incorporating provisions that address the emerging issues at the national and global level.

The ICFRE, acting as Technical Facilitation Organization for the SLEM Project (SLEM TFO), has come up with various important publications on best practices and other key aspects, besides making an informative documentary on SLEM. Also, two regional and one national consultative workshops were organised for finalization of indicators for Desertification, Land Degradation and Drought (DLDD), at Hyderabad, at Kolkata and at New Delhi.

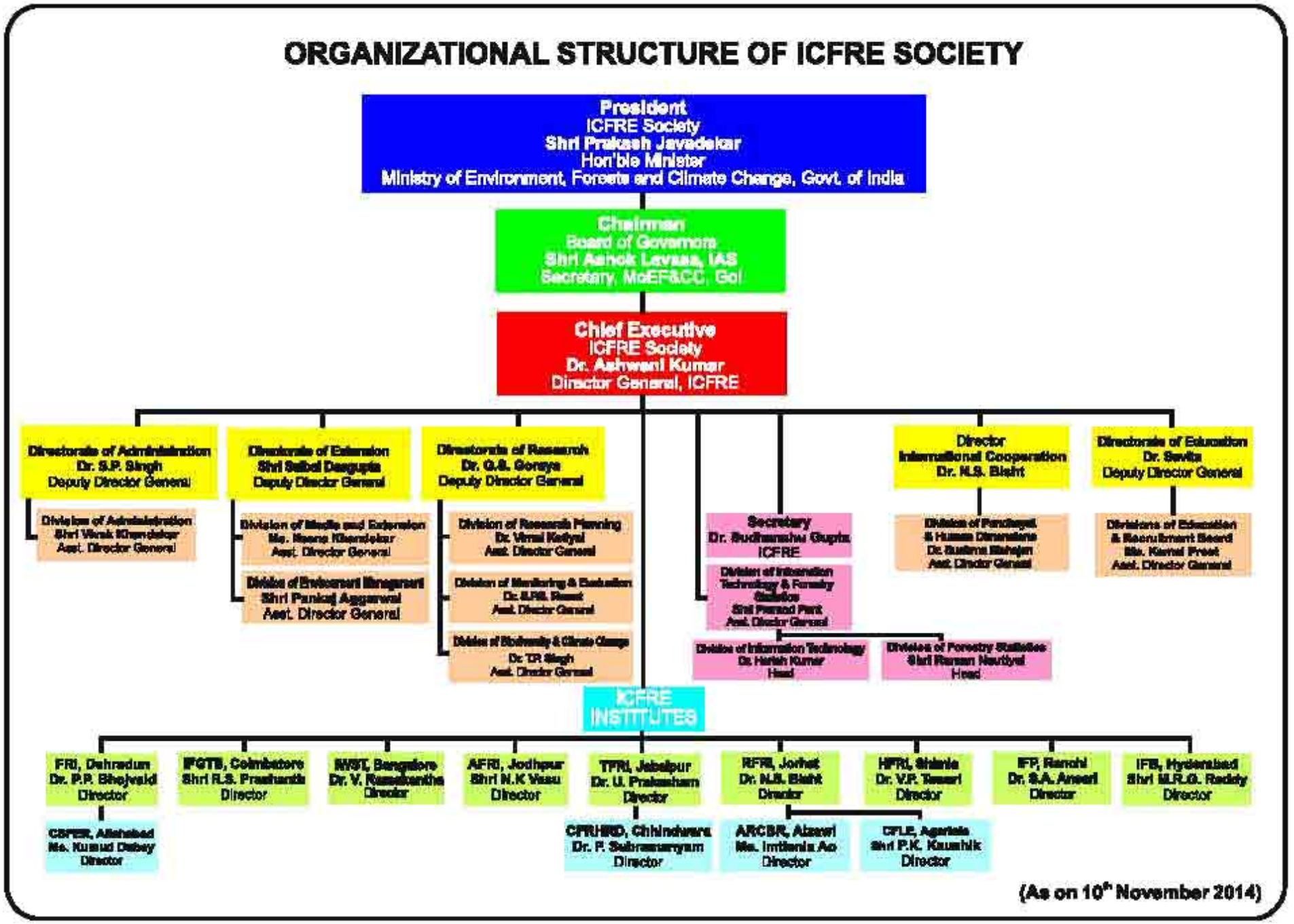
The Council is striving to put up modern infrastructural facilities across the ICFRE Institutes. New research facilities created include Teak Vegetative Multiplication Garden (VMG) at Walayar, Kerala, research centre at Neyveli, Tamil Nadu by IFGTB, Coimbatore, 'Open Top Chamber Facility' at FRI, Dehradun and establishment of an Interpretation Centre for Jharkhand by IFP, Ranchi to name a few.

Another significant step has been the evolution of a comprehensive Intellectual Property Management (IPM) policy governing generation and management of intellectual property emanating from ICFRE Institutes along with Material Transfer Agreement (MTA) and License Agreement (LA).

It gives me immense pleasure in presenting this Annual Report giving an overview of the activities of the Council along with Audited Annual Accounts for the year 2013-14.

(Dr. Ashwani Kumar)

ORGANIZATIONAL STRUCTURE OF ICFRE SOCIETY



(As on 10th November 2014)

Executive Summary

Based on the revision of ICFRE research system that took place during 2012-13 in line with the Government's priority for various sectors and people centric thrust areas, following thrust areas were identified for the year 2013-14:

1. Managing Forests and Forest Products for Livelihood Support and Economic Growth
2. Biodiversity Conservation and Ecological Security
3. Forests and Climate Change
4. Forest Genetic Resource Management and Tree Improvement
5. Forestry Education and Policy Research to meet Emerging Challenges
6. Forestry Extension for taking Research to People

The overall allotted budget for current financial year 2013-14 for Research, Extension and Education was Rs. 825.14 lakhs and the expenditure incurred was Rs 777.1 lakhs.

The Annual Report of 2013-14 describes the thrust areas in six different chapters and the projects undertaken have been grouped in the relevant sections of these six chapters. The information related to the Directorate of Administration and Information Technology has been presented in a separate chapter.

The research under **Managing Forests and Forest Products for Livelihood Support and Economic Growth** identifies contribution of forests for improving livelihood and economic growth. Forest Research Institute (FRI) developed cultivation protocol for enhancing productivity of fodder in degraded lands of Uttarakhand. A total of 275 forest fringe districts were identified in rain fed districts using GIS, and their forest types, area of each forest type and density classes were estimated. The socio-economic status and dependence of forest fringe villagers on forests and the ecological status were assessed in depth. Alternative raw materials from *Sesbania grandiflora* were tested in FRI for making strong craft paper Grade-I. A raw material from *Lannea coromandelica* was tested and suggested to Indian Pulp and Paper mills for making good quality of bleached grade writing and printing paper. A new initiative was made by FRI for utilizing recycled waste gunny bags and pine needles in different proportions for manufacturing of handmade paper, having adequate strength properties of unbleached craft Paper Grade-I as recommended in IS:1397:1990. Further, processes were developed for preparation of nano cellulose, using Scanning Electron Microscope (SEM). FRI has also revised and prepared the National Working Plan Code 2014 which was approved by MoEF &CC and circulated to all the States and UTs for implementation from 1st April 2014.

Institute of Wood Science and Technology (IWST) assessed the mechanical properties of *Acacia auriculaeformis* and *Melia dubia*, treated with copper for wood density and termite resistance, respectively. IWST has also developed a useful tool of stand density diagram for designing, displaying and evaluating alternative density regimes for even-aged *teak* forests of Karnataka. Rheological studies on natural fibre-PVC composites for light structural applications, indicated increase in fibre content. IWST assessed nano particles based wood coating for outdoor applications indicated protection from harmful UV radiation. The whole pest spectrum of sandalwood in different agri-horti-silvi models in Karnataka was documented for farmers and foresters. A weed, *Lobelia nicotianaefolia* based liquid formulation was tested as insect pesticide along with neem products. *Toddalia asiatica*, *Ruta graveloens* and *Zanthoxylum rhetsa* extracts of root, stem and leaves showed potential larvicidal and mosquito repellent properties. IWST has developed key identification with microstructure of 200 species of Indian shrubs and Lianas Species for the purpose of their efficient utilization for timber and pharmaco-logical industry along with photomicrographs for understanding the anatomical features. Testing and evaluation of wood quality of Teak grown in Andaman and Nicobar Island was made for

anatomical, physical and mechanical properties for Forest Department.

Tropical Forest Research Institute (TFRI) has documented 63 invasive plant species growing in the forest areas of Jabalpur, Katni, Mandla and Seoni district for their spread and density. Foliar spray for nitrogen deficient soil treatment to increase leaf surface area of *Diospyros melanoxylon* were standardized in Chhattisgarh. A combined dose of nitrogen and phosphorus to enhance the tendu leaf size in Kotadol and Morga and an individual dose of nitrogen in Litipara were standardized. A combined dose of ranker neem granules and VAM in Morga and an individual dose of neem granules in Kotadol and Litipara were observed to enhance tendu leaf size. A total of 39554 and 9,699 sal trees were marked under different categories of borer attack in Madhya Pradesh and Chhattisgarh respectively. Non-conventional alternative lac host species, such as, *Flemingia semialata* and *F. macrophylla* were established as an alternative to *Butea monosperma* and *Zizyphus mauritiana* as agroforesty model in the farmers field for income generation in Madhya Pradesh.

Rain Forest Research Institute (RFRI) has collected 750 numbers of tested clones of *Morinda citrifolia* L. (Noni) from CARI, Port Blair for improving the livelihood option for the people of North East India. Carbendazim (Trade name-Zoom) was found to be the most effective fungicide in checking further spread of the disease in Ukhrul District of Manipur. AFRI studied the antifungal properties of *Datura stramonium* leaf extract and evaluated eight lesser known wild edible plant species for food and nutrient from Rajasthan. It established *Hardwickia binata* and *Colophospermum mopane* tree based agro forestry trials using *Cymopsis tetragonoloba* as a crop species. It developed model for estimation of total and, merchantable volume for *Prosopis cineraria* and *Ailanthus excelsa* plantations in Indira Gandhi Nahar Project (IGNP) area in Rajsathan. HFRI recorded the extent of distribution, abundance and associations of medicinal plants of Ashtavarga group with other species in five districts viz. Sirmour, Solan, Kinnaur, Shimla and Kullu of Himachal Pradesh. Nursery trials for assessing the optimum harvest limits of *Picrorhiza kurrooa* and *Valeriana jatamansi* were laid out at three different locations. IFP introduced genotypes of karanj, kusum and bamboo as Agroforestry nodels in lateritic belt of Eastern India. Five year old plantation of karanj and mahua plots were converted into Tree Borne Oilseeds (TBO) demonstration plots.

Institute of Forest Genetics and Tree Breeding (IFGTB) established Mangrove nurseries of *Rhizophora* sp, *Ceriops* sp, *Bruguiera* sp, *Xylocarpus* sp in South Andaman and middle Andaman for undertaking restoration ecology and species recovery studies in *tsunami* impacted mangrove areas. It has also established 15 ha agroforestry systems in three zones of Tamil Nadu with fast growing tree species of *Melia dubia, Gmelina arborea, Neolamarkia cadamba* and *Sweitenia macrophylla*. Seven agroforestry systems demo units in all talukas of Ramanathapuram district in Tamil Nadu were established. It completed two collaborative projects with State Agricultural Universities on NTFP Network Project on selected NTFPs of Kerala.

In the area of **Biodiversity Conservation and Ecological Security**, FRI assessed the impact of human induced disturbances on regeneration and population structure of *Rhododendron arboreum* and *Myrica esculanta* in mid hills of Garhwal Himalaya. FRI has also supplied quality seeds of 15 species to Punjab State Forest Department. IWST assessed the floral morphology, flowering season and pollination biology of five major mangrove species namely *Avicennia officinalis, A. alba and A. marina* (Avicenniaceae) and *Sonneratia caseolaris and S. alba* (Sonneratiaceae). TFRI prepared vegetation change matrix for the preservation plots of Bhimashankar Sub Tropical Hill Forest of Maharashtra for future trend analysis. Density and distribution of medicinal plant species viz; *Uraria picta* and *Andrographis paniculata* in the buffer region of Tadoba Andhari Tiger Reserve (TATR) were also studied. Grafted strain of *M. indica* were procured

from the State Forest Research Institute, Jabalpur for producing seed originated seedlings and planted in the experimental area of TFRI, Jabalpur. RFRI prepared a data base of 365 species of butterflies along the altitudinal gradients of forest ecosystem of Eastern Himalaya of Arunachal Pradesh, in 13 districts. Distribution of different species of *Garcinia* (Cluciaceae) and its ecology and utilization in the upper Brahmaputra valley of Assam were studied by RFRI. IFP has developed agro- techniques for organic cultivation of *Tribulus terrestris* L. and *Cissus quadrangularis* L.- medicinal plants.

Under **Forests and Climate Change,** ICFRE has published *Forest Types of India: Revisited"* with the data generated from extensive survey made at national level. NATCOM had entrusted ICFRE for conducting India's first biennial update report – "Forestry Sector – Mitigation and Gaps & Constraints". ICFRE delegation participated in eleventh session of the Committee for the Review of the implementation of the United Nations Convention to Combat Desertification (UNCCD) in Bonn, Germany; thirty-eighth session of the SBSTA/SBI meetings of the United Nations Framework Convention on Climate Change (UNFCCC) in Bonn, Germany and in the nineteenth session of the Conference of Parties and the thirty ninth session of SBSTA/SBI meetings of the UNFCCC in Warsaw (Poland). ICFRE delegation also participated in the International Expert Group Meeting on *Geospatial Information Systems for Multi-scale Forest Biomass Assessment and Monitoring in the Hindu Kush-Himalayan Region* at the International Centre for Integrated Mountain Development, Kathmandu, Nepal. FRI studied the soil organic carbon store under different land uses in Haryana. Soil Quality Index and data base for different land uses for Tehri Garhwal district of Uttarakhand and a Soil Health Card was also prepared.

In the area of **Forest Genetic Resource Management and Tree Improvement,** FRI established field trials of promising clones of *Populus deltoides*. Germplasm banks were established for *Grewia optiva* at Dudhli, Lachhiwala Range, Dehradun Forest Division and for Quercus leucotrichophora at Magra, Jaunpur Range, Mussoorie Forest Division. IFGTB has been identified as the "Distinctness, Uniformity and Stability (DUS) Centre for *Casuarina* and *Eucalyptus"*. It was also entrusted with the responsibility of developing descriptors and DUS guidelines for teak and *Melia dubia* by the Protection of Plant Varieties and Farmers Rights (PPV&FR) authority. The Ministry of Environment, Forests and Climate Change has recognized IFGTB for establishment of ENVIS for Forest Genetic Resources and Tree Improvement (FGR-TIP) thematic area. Seventeen different clones of *Eucalyptus camaldulensis, Casuarina equisetifolia* and *C. junghuhniana* were released for public having superior growth, resistance to gall infestation, and windbreak properties. An FGR centre has been established at Neyveli, covering an area of 25 ha with a state of art infrastructure facility for large scale vegetative multiplication of tropical hardwood species. A Vegetative Multiplication Garden (VMG) and shade house with mist chambers, hardening chamber and office building were established at Walayar, Kerala for mass production and supply of teak planting stock. A Geomatics Lab covering Geographical Information System and Remote Sensing facilities has been setup at IFGTB and a website on *Silico Gene Bank for Adaptation to Abiotic stress* has also been launched.

Institute of Wood Science and Technology established *Melia dubia* progeny trials consisting of 21 progenies and standardized protocol for extraction of DNA for assessment of genetic diversity. FRI has established demonstration plot for four species of bamboo, such as, *Dendrocalamus asper, Dendrocalamus hamiltonii, Bambusa balcooa, Bambusa nutans* in Desuya, Mohali, Ludhiana and Ropar Forest Division, Punjab. A total of 102 genotypes of *Dendrocalamus stocksii* were evaluated, offsets/ culm cuttings were collected for establishing Multilocational trials. Micropropagation of *Embelia ribes* was achieved through proliferation of auxiliary shoots obtained from mature plants. DNA purity index and wood fibre length for

Boswellia serrata were analysed for 12 populations collected from Madhya Pradesh. A multilocational trial comprising of 100 superior accessions of *Jatropha curcas* received from the Department of Biotechnology (DBT) network partners were established in GRC Farm House Sita Pahad, Jabalpur.

Rain Forest Research Institute studied the phenology and population dynamics of selected Rattans in Assam. It has also standardised methodology for extraction of DNA from *Melia compostia* fruits collected from Assam, Nagaland, Manipur, and Tripura. AFRI conducted population density and selection of candidate plus plant (CPP) of Guggal (*Commiphora weightii*), in Rajasthan for conservation and improvement. Multilocational progeny trials of *Melia composita* (*M. dubia*) in Rajasthan (one) and Gujarat (two) were also established and four progeny trials of *Tectona grandis* in Rajasthan and Guajrat were evaluated. HFRI established a Field Gene Bank (FGB) for *Podophyllum hexandrum*, an important medicinal plant. A Field Research Station at Brundhar, Himachal Pradesh was also established. HFRI has initiated DUS trait trails for *Pinus roxburghii* and *Cedrus deodara* in Himachal Pradesh.

Institute of Forest Productivity assessed the variability and genetic fingerprinting for *Pongamia pinnata* (L.) Pierre using microsatellite markers. *Dalbergia sissoo* Roxb., clones were evaluated for large-scale clonal forestry in Gangetic plains and Chotanagpur platcau. Propagation method and germplasm conservation for *Machilus villosa* (Roxb.) & *Quercus lineata*, promising timber & fuel wood in North West Bengal were standardised. Twenty five phenotypically superior trees of both the species were selected for future improvement and conservation programme. Collection, conservation and evaluation of *Melia dubia* germplasm was made in North-Bengal, Orissa hills and other parts of India for identification and release of superior clones. *Jatropha curcas* was taken up for multilocational trial in different agroclimatic zones for agronomic practices.

Under **Forestry Education and Policy Research to meet Emerging Challenges**, FRI Deemed University conducted all India Competitive Entrance Test for admission in Post Graduation. Course plan was prepared and internal and external faculties were invited for conducting classes. During the current year, 57 research scholars were registered for Ph.D and a total 64 Ph.D degrees were awarded. Placement Brochures & students' profiles were prepared for all M.Sc. courses. Various Industries/ organizations visited the campus for campus interview and 46 students were selected. Five students from SAARC joined for various M.Sc. and PhD programmes. Two students of Forest Research Institute (Deemed) University were awarded International Tropical Timber Organization (ITTO) Fellowship in the autumn cycle under 'Human Resources to enhance Professional Expertise in Sustainable Management of Tropical Forests'.

Under **Forestry Extension for taking Research to People**, IFGTB launched interactive meetings at Thrissur, Kerala and in Coimbatore as a part of networking initiatives of VVK and KVK. It has also undertaken training / refresher course for IFS officers, and officials from Revenue, Agriculture, Horticulture, Animal husbandry, NGOs and farmers on various forestry and environment related topics. Web application for 160 important plant species of arid and semi arid region were hosted on the URL http://www.seracharidplants.in. HFRI imparted training programmes to different stakeholders. A training manual for sustainable harvest for selected medicinal plants was developed in Hindi and was distributed to end users. ICFRE imparted trainings and conducted workshops for various stakeholders in close coordination with FRI, IFGTB, RFRI, HFRI and TFRI under Bamboo Technical Support Group (BTSG). ICFRE conducted series of training workshops and trained around 400 persons including officers, scientists, and staff. *Hindi Saptah* was also orgnaised at ICFRE and its institutes.

Under scientific services in the form of consultancies, FRI conducted midterm

Monitoring and Evaluation of PUNCAMPA plantations and FDA plantations in all the districts and Forest Divisions of Punjab. ICFRE extended consultancy service for hydropower sector to Tehri Hydropower Development Corporation (THDC), Himachal Pradesh Power Corporation Limited (HPPCL) and Directorate Energy, Himachal Pradesh; in the mine sector for Ankua Iron ore mine, West Singhabhum district of Jharkhand state for M/s JSW Steel Ltd. It has also prepared 32 individual Reclamation and Rehabilitation (R&R) Plans of category A and B for the mines in Bellary, Chitradurga and Hospet Districts as per the directions of the Honourable Supreme Court during 2013-14 in line with Central Empowered Committee (CEC) guidelines to Department of Mines and Geology, Government of Karnataka. Under Sustainable Land and Ecosystem Management (SLEM), ICFRE, as technical facilitation organization (TFO), imparted training-cum- workshop for scientists and frontline forest officials at Himachal Forest Research Institute, Shimla; Tropical Forest Research Institute, Jabalpur and Institute of Forest Genetics and Tree Breeding, Coimbatore. It also conducted two National Steering Committee meetings to monitor and evaluate the Sustainable Land and Ecosystem Management (SLEM) programme at Bhopal; and two regional (state) level and a national level consultative workshops to finalise the impact indicator for issues related to desertification, land degradation and drought. A series of publications under SLEM-TFO in the form SLEM e-Newsletter, proceedings of the seminar on *Drought and Water Scarcity,* eight flyers on best practices of SLEM and semi-annual report SLEM - TFO Project were also published.

1. Introduction

The Indian Council of Forestry Research and Education is an autonomous organization under the Ministry of Environment Forests and Climate Change (MoEFCC), Government of India. The Minister of Environment, Forests and Climate Change is the President of ICFRE and the Director General is its Chief Executive. The General Body is the supreme authority of the ICFRE, headed by the Union Minister, Environment, Forests and Climate Change, Government of India. Its members consist of serving and retried Officers from various state governments, educational institutes, and scientific organizations.

Mission

To generate, preserve, disseminate and advance knowledge, technologies and solutions for addressing the issues related to forests and to 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.

A. Structure

The organizational chart is presented at page IV. The Governing Body is headed by the Chief Executive i.e. the Director General who is the decision-making authority of the ICFRE. The DG is supported by four Deputy Director Generals (heading Administration, Research, Education and Extension Directorates); Director (International Cooperation); Assistant Director General Information and Technology and Forestry Statistics and Secretary ICFRE. Further, the Deputy Director Generals are assisted by Assistant Director Generals and scientists at the headquarters. Each Institute is headed by a Director and is supported by a Research Coordinator, scientists, officers and other staff.

Directorate of Research

The Directorate is headed by Deputy Director General and supported with three Assistant Director Generals. Research Planning Division is responsible for conducting Research Advisory Group (RAG) meetings at the Institute level, as per approved calendar at each Institute and Research Policy Committee (RPC) meeting at ICFRE level. It coordinates with all the institutes of ICFRE to formulate national level coordinated projects. Also, as a part of Bamboo Technical Support Group (BTSG), it conducts training programmes for various target groups. The Monitoring and Evaluation Division regularly monitored and peer reviewed completion of various projects.

Biodiversity and Climate Change (BCC) Division is working on biodiversity, climate change related research and policy issues leading to international negotiations for United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). The Division is also engaged in capacity building programmes of forest officers, scientists, technologists and other stakeholders in biodiversity and climate change through organizing various training programmes. ICFRE with the status of an observer organization participates in all the United Nations Framework Convention on Climate Change (UNFCCC) meetings.

Directorate of Education

This Directorate is headed by the Deputy Director General who is supported by one Assistant Director General. It is responsible for capacity building of the Council's scientific and managerial cadre, through various training programmes. Also, it enhances forestry education

at national level through financial support to the state universities imparting forestry education. This Directorate has also initiated accreditation process, in line with All India Council for Technical Education (AICTE) to improve the quality of forestry education and conducts national policy research reviews along with analysis of the existing forest policies, statutes and framework.

Directorate of Extension

The Directorate is headed by the Deputy Director General and supported by two Assistant Director Generals. The Media & Extension Division facilitates various publications, such as, bulletins, brochures, pamphlets, newsletters and annual reports and undertakes activities to promote Rajbhasha Hindi. It also extends the technologies developed by the Council to various target groups, especially the farmers, through Van Vigyan Kendras (VVKs) and Demo Villages (DVs) through comprehensive extension strategies. The Environment Management Division extends scientific expertise in the field of environment and forestry to various agencies through consultancies. The SLEM Project Unit acts as the Technical Facilitation Organization (TFO) to implement Global Environment Facility (GEF) and World Bank (WB) supported medium size projects on policy and institutional reforms for mainstreaming and up scaling sustainable land and ecosystem management in India.

Directorate of Administration

The Directorate is headed by the Deputy Director General and supported by two Assistant Director Generals. For general administration this Directorate is supported by Assistant Director General, Administration. Assistant Director General Recruitment Division looks into the employees service matters and conducts regular Flexible Complementing Scheme and Department Promotion Committee activities. It also recruits human resources as and when required.

The Information and Technology (IT) Division, under the direct control of Director General, is headed by Assistant Director General, caters to the needs on Information Communication of all Institutes and ICFRE Head Quarter. The ICFRE Server Farm hosts the IFRIS Application and other allied key services. The Statistics Division collects data from all the states, pertaining to forestry to disseminate through publication of yearly Forestry Statistics Reports and Bulletins.

Director (International Cooperation)

The Director (International Cooperation) is supported by one Assistant Director General for Panchayat and Human Dimensions Division to develop linkages with international and national organizations in respect of developing projects and processing of memorandum of understanding (MOU).

Institutes and Centres of ICFRE

ICFRE has nine Regional Research Institutes and four Research Centres located in different bio-geographical regions of the country catering to the forestry research needs of the nation.

Forest Research Institute (FRI), Dehra Dun, established in 1906 is a premier scientific research and ISO 9001:2000 certified Institute. It carries forward the rich tradition of forestry research, carried out by erstwhile Imperial Forest Research Institute to cater to the forestry research needs of the states of Uttarakhand, Uttar Pradesh, Haryana, Punjab and National Capital Territory of Delhi. The advanced Centre for Social Forestry and Eco-Rehabilitation (CSFER), Allahabad, under FRI focuses on social forestry and eco-rehabilitation catering to the needs for Eastern Uttar Pradesh, North Bihar and Vindhya, Region of Uttar Pradesh.

FRI has been conferred with the status of "Deemed University" by the Ministry of Human Resource Development, Government of India, New Delhi to conduct M.Sc. Forestry, M.Sc. Wood Science & Technology and M.Sc. Environment Management programmes besides conducting Post Masters diploma in Natural Resource Management and Non-Wood Forest

Products, and Post Graduate Diploma in Pulp & Paper Technology. It also runs Doctoral Programme leading to the award of Ph.D. degree.

The National Forest Library and Information Centre (NFLIC) of the Institute is the richest centre of forestry and allied sciences document collection in South and South-East Asia.

Tropical Forest Research Institute (TFRI), Jabalpur focuses on research activities in the states of central India, viz., Madhya Pradesh, Chhattisgarh, Maharashtra and Odisha. It has a satellite Centre for Forestry Research and Human Resource Development (CFRHRD) at Chhindwara which conducts research in the specialized areas of human resource development in forestry sector by imparting vocational training, leading to poverty alleviation through self employment.

Arid Forest Research Institute (AFRI), Jodhpur focuses on research activities in Rajasthan, Gujarat and Dadra & Nagar Havelli. The Institute carries out research in forestry and allied fields to enhance arid and semi arid land productivity and vegetative cover to conserve biodiversity and to develop technologies for the end-users.

Himalayan Forest Research Institute (HFRI), Shimla was established in 1987 from Conifer Regeneration Research Centre. The Institute caters to the research needs of the states of Jammu & Kashmir and Himachal Pradesh with focused research on Himalayan and cold desert areas. It has nine Field Research Stations for carrying out site specific research, including the one located at Tabo and Lahaul-Spiti (HP) to address specific research needs of cold deserts. The Institute has also been declared as the "Advanced Centre for Cold Desert Afforestation and Pasture Management" for taking up advanced research.

Rain Forest Research Institute (RFRI), Jorhat was established in 1988 to support forestry research in North-Eastern states. The Institute focuses on conservation methods for restoration of degraded lands under shifting cultivation, management of community forests and multi-facet use of bamboo and cane. Advanced Research Centre for Bamboo and Rattan (ARCBR) has also been established in Aizawl (Mizoram) as its unit in 2004, which conducts research for socio-economic upliftment of North-Eastern people, which revolve around bamboos and rattans.

Institute of Forest Productivity (IFP), Ranchi established in 1993 to look into the forestry research and education needs in eastern region i.e. the states of Bihar, Jharkhand and West Bengal. The Institute also has Forest Research Centre at Mandar (Ranchi), Environmental Research Station at Sukna (West Bengal) and Forest Research & Extension Centre at Patna (Bihar) to carry out research and extension activities.

Institute of Forest Biodiversity (IFB), Hyderabad was established during December 2012 by up gradation of the erstwhile Forest Research Centre with the mandate to carry out research on forest biodiversity of Andhra Pradesh with special emphasis on the forest biodiversity of Eastern Ghats.

Institute of Wood Science and Technology (IWST), Bangalore was established in 1988. The Institute caters to the forestry research needs of the states of Karnataka and Goa. The Institute has widened its research activities in the fields of tree improvement and wood energy in addition to conventional wood sciences. This Institute has also been widely recognized as the centre for advanced studies in areas of improved utilization of wood, mangrove coastal ecology and sandal research of Western Ghats.

Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore was formed during 1988 by up gradation of Forest Research Centre (FRC), working under the Forest Research Institute and Colleges since 1959. The Institute caters to the forestry research needs of the states of Tamil Nadu, Kerala, Andaman and Nicobar and Lakshadweep Islands. It maintains seed

production areas and clonal orchards for important tree species, such as, teak, casuarinas, eucalypts, *Pongamia, Jatropha* and *Acacia*. The Institute has field units in Kerala, Tamil Nadu and Andaman and Nicobar islands.

B. Research Management

Directorate of Research

The Directorate ensures that all the research projects taken up by ICFRE Institutes are need based and address the regional and national forestry research problems. The research prioritization by the Directorate is through participatory mechanism involving all the stakeholders and end users.

Research Planning Division under the Directorate of Research deals with the planning, formulation and finalization of plan funded forestry projects of nine research institutes and four research centers of ICFRE. The process involves stakeholders meets, Research Advisory Group (RAG) meetings at each Institute and national level Research Policy Committee (RPC) meeting at ICFRE HQ under the chair of Director General, ICFRE keeping in view the balance among international, national, regional and state research requirements and decides on investment in high quality forestry research/emerging issues to meet the aspiration of the society with transparent and participatory approach.

Research Advisory Group (RAG) meetings of each of the nine ICFRE institute for 2013-14 were convened as per approved calendar at Institutes/ by circulation of the proposals to the RAG members.

XIV Research Policy Committee Meeting (RPC) for the year 2013-14 was convened under the Chairmanship of Director General, ICFRE from 30th to 31st May, 2013 at Dehra Dun. A total of 76 new projects with a budget of Rs 631.23 lakhs were approved.

The Council is implementing 125 projects funded by agencies, such as, Ministry of Environment Forests & Climate Change (MoEFCC), Protection of Plant Varieties and Farmers' Right Act (PPV&FRA) Authority, Compensatory Afforestation Fund Management and Planning Authority (CAMPA), state forest departments (SFD), Uttarakhand State Council for Science and Technology (UCOST), Bamboo Technical Support Group (BTSG), National Medicinal Plants Board (NMPB), State Medicinal Plants Boards (SMPB), Department of Biotechnology (DBT), Department of Science & Technology (DST), National Seeds Corporation (NSC), IITs, ITC Bhadrachalam , Hill Area Development Programme (HADP), National Rain fed Area Authority (NRAA) and so on, with total budget outlay of Rs. 48.52 crore. Under the Bamboo Technical Support Group, eight trainings were conducted at various ICFRE institutes.

Monitoring and Evaluation Division under the Directorate of Research deals with the annual review and evaluation of all the ongoing research projects of ICFRE institutes. It suggests corrective measures for timely completion of the projects and achievements of the objectives with perfection. Total 293 projects are being implemented that include 228 ICFRE plan projects and 65 externally aided projects during the current year. During the annual review, ongoing and completed ICFRE plans and externally aided projects were reviewed. A peer review of Project Completion Reports (PCRs) process at ICFRE level has been initiated to maintain the quality of the project completion report.

Forests Biodiversity and Climate Change Division provides advisory and consultancy services for conceptualizing, implementing, monitoring and evaluating the Clean Development Mechanism (CDM) and Reduced Emissions from Deforestation and Degradation (REDD-Plus) projects in the country. The Division Participated in the Conference of the Parties (COP) ; Subsidiary Body for Scientific and Technological Advice which focuses on setting policy as an observer organization of United Nations Framework Convention on

Climate Change (UNFCCC). It also conducted national level training programme for Indian Forest Services, researchers and academicians. The *Reassignment of Forest Types of India* conducted by ICFRE has been published in the form of a book titled "Forest Types of India: Revisited" and released on 17 May 2013.

Director (International Cooperation)

The Director (International Cooperation) facilitates in implementation of externally aided research projects for processing approvals and clearances from the Director General, ICFRE or MoEF & CC. The Division organizes seminars, meetings and conferences, especially pertaining to forestry research and livelihoods. A coffee –table book has been published highlighting the success stories of Bihar project on prosperity of farmers through poplar based agroforesty models. The Hindi version of this book is also prepared.

2. Managing Forests and Forest Products for Livelihood Support and Economics Growth

Forestry research that will truly benefit the people in terms of their economic upliftent has been stressed upon in the ICFRE and its institutes. This thrust area has been carved out for sustainable management of the forests and natural resources as well as to protect and conserve the natural resources on the one hand and, to provide opportunity for economic well being of the people on the other. It aims for integration of environmental issues with the suitable developmental strategies; those will pave the way for sustainability of the resources and provide livelihood support to the people. It is beyond any doubt that the diversity of products, goods and services that are available from the forests are tremendous. In view of this, the ICFRE is implementing the research projects that are highlighted below.

2.1 Silviculture and Forest Management

Identification of extent of forest land in forest fringe villages

In 275 forest fringe villages identified in rainfed districts using GIS, the forest types, area of each forest type and density classes estimated. The socio-economic status and dependence of forest fringe villagers on forests and the ecological status of such forests were assessed in depth in 194 districts. A web portal was also developed for storage and analysis of data generated for 275 rainfed districts.

Assessment of soil quality indicators for different forest stands in Uttarkashi district

Soil health assessment cards of *A pindrow / P smithiana, Cedrus deodara, Pinus roxburghii, Quercus leucotrichophora, and* miscellaneous forests were prepared. Maximum SQI values were found in soils under miscellaneous forests followed by *A.pindrow / P.smithiana* forest stand, *Cedrus deodara* forests, *Quercus leucotrichophora* forests and *Pinus roxburghii* forests.

Soil organic carbon store under different land uses in Haryana

Information generated from the project on SOC store will provide authentic information on this important aspect of climate change. Maximum SOC stock was found under chir (*Pinus roxburghii*), followed by dhak (*B. monosperma*) miscellaneous forests and the least was under sal (*Shorea robusta*). Maximum organic carbon stock was found in the soil of Panchkula district. In total, forest land of Haryana holds 7.88 million tons of soil organic carbon while soil under horticulture land use has 1.37 million tones of SOC stock. Under horticulture land use, maximum organic carbon stock was estimated under mango, followed by nimbu, ber, guava, kinnu, aonla, etc. Similarly, under plantations, maximum carbon was under neem followed by khair, teak, eucalyptus, poplar, *Ailanthus* and shisham and the least SOC stock was under *Pongamia*.

Assessment of soil microbial community and soil quality under poplar and eucalyptus plantations in Haryana

Soil sampling was done three times in a year at a depth of 0-30 cm, 30-60 cm and samples collected and analyzed for soil pH, organic carbon, available Nitrogen, Phosphorus and Potassium. Along with this, some growth promoting bacteria and fungi were also isolated, characterized and their plant growth promoting ability tested on Poplar and Eucalyptus by pot experiments.

Soil Quality Index (SQI) for different land uses of Tehri Garhwal district of Uttarakhand (Externally aided project UCOST):

About 200 soil samples have been collected from miscellaneous forest, pine forest, oak forest and agriculture field and grasslands in the project area. The samples were processed and analyzed for physico-chemical and biological properties. Soil Quality Index of all these villages were calculated seasonally and accordingly, a database and a soil Health card was prepared for the different villages.

Clonal screening of *Dalbergia sissoo* in relation to nitrogen fixation and biomass production

24 clones of *D. sissoo* were assessed for nodulation, nitrogen fixation, nitrogen assimilation and biomass production under pot culture condition. Taking into consideration all the parameters studied, it was concluded that clone no. 9058(1) & 9058(2), Dhani Kakarhawo, (Sidharthnagar); 9064(2), Tilkhana Village, (Maharajganj) and 9093(1), Galla Mandi, (Behrampur), 002 (Bijnor, Uttar Pradesh); 009 & 013 (Haridwar, Uttarakhand) and 057 (Ambala, Haryana) performed better. All clones are available in the VMG of G&T P Division of FRI, Dehradun.

Creation of field germplasm bank of *Grewia optiva* and *Quercus leucotrichophora*, the important indigenous fodder tree species of Uttarakhand

Germplasm banks for *Grewia optiva* at Dudhli, Lachhiwala Range, Dehradun Forest Division and for *Quercus leucotrichophora* at Magra, Jaunpur Range, Mussoorie Forest Division were established and strengthened through more plantings.

Multiplication, conservation and promotion of Ringal cultivation for socio-economic upliftment of hilly rurals in Uttarakhand

The Ringal cuttings were planted at FRI and Magra Nursery (Mussorrie) for outplanting. Nearly 300 plants were produced through macroproliferation technique for dissemination.

Multiplication of Bamboo through macroproliferation

Bamboos transplanted in polypots

Influences in regeneration of silver fir (*Abies pindrow*) and spruce (*Picea smithiana*) forests - Effect of natural leachates on seedling growth in nursery

Litter, humus and soil samples were collected from fir and spruce forests in Deovan, Chakarata and soil samples analyzed for nitrogen, phosphorus and organic carbon. Leachates of litter, humus, soil and under-storey plants were prepared, analyzed for allelochemicals and also applied on fir and spruce to observe their effect on growth and establishment of the seedlings in nursery. The readings are completed and its analysis is in progress.

Allelopathic potential in regeneration of Sal (*Shorea robusta*) forests

Litter, humus and soil samples were collected from sal forests, Dehradun and analyzed for total

Nitrogen, available N and organic carbon. Seeds of sal collected and germination experiments were conducted in laboratory to observe the effect of leachates on germination and early growth of sal seedlings.

Impact of Sal-ANR in Shiwalik region of Dehradun and Kalsi forests (Externally aided by Uttarakhand Forest Deptt)

Under the project, field survey was carried out in March 2014 and geo-references of sal ANR were recorded for GIS map for further data collection in the field.

Revision of National Working Plan Code

With the objective of incorporating criteria & indicators for SFM, usage of modern technologies like GIS, GPS, etc., addressing new concepts like climate change, carbon sequestration, inclusion of focused management of NWFPs and people forest interface, the working plan code was revised by FRI, Dehradun and the new National Working Plan Code 2014 prepared after incorporating suggestions in several consultative and regional workshops was finalized by MOEF &CC, New Delhi for its implementation in the country from 01-04-2014.

Study on constraints in the export of carved out wood products and its economical and social impact on the livelihood of dependent people in North India

To address the issues of wood carving industry and its impact on the people engaged, this project was undertaken by FRI for which ten wood carving centers were selected spread in J&K, H.P., Punjab, western U.P. and Rajasthan. Questionnaires were developed to assess the economic condition, literacy level, specialization, working tools or machines (technology) used, alternate sources of income, type of working and constraints. Draft report has been completed.

Survey of bamboo resources and quantitative assessment of their production and consumption in North India

The data on production, supply, consumption and market mechanism was collected from the study area in Chandigarh, Delhi, Haryana, Punjab, Uttarakhand and Uttar Pradesh. The analysis of the data showed that the contribution of state own production in the consumption of bamboo of state under study area was between 4 and 31 % except Chandigarh and Delhi, that have no production of their own. Project completed and final report submitted to MoEF &CC in May 2014.

Screening of some forest tree species for their antioxidant properties

The bark of *Prunus cerasoides*, the leaves and the bark of *Toona serrata*, *Bauhinia retusa*, *Populus ciliata*, *Robinia pseudoacacia* and the saw dust of *Ailanthus excelsa*, *Melia azedarach*, *Toona serrata*, *Toona ciliata* were collected and extracted with different solvents, under vacuum. Screening of these extracts for their antioxidant capacity (AOXC) and total phenolics contents (TPCs) was also carried out.

Phytochemical screening of selected wild edible plants for exploration of new sources of luteolin

Total polyphenolic and flavonoid contents of edible parts (fruits) of *Prunus armeniaca* and *Hippophae rhamnoides* were estimated at FRI. DPPH Free radical scavenging potency of different fruit extracts of target plant species was determined to establish a credible correlation between total phenolic content and antioxidant activity of fruit extracts.

Value addition of Acacia resources of the Nilgiris for employment generation and livelihood support

Nutritive and anti-nutritive chemical analysis of seeds of *Acacia mearnsii* was carried out wherein, extracts from the pods were developed and tested for insecticidal / microbial activity and crude samples of essential oils were extracted from plant material.

Restoration ecology and species recovery studies in tsunami impacted mangrove areas in Andamans

15 Sample plots in each island group were selected, based on stratification and the damaged areas were stratified and vegetation surveys done. Studies on tidal fluctuations and vertical zonation of mangroves species in the affected areas are going on. Mangrove nurseries of *Rhizophora* sp, *Ceriops* sp, *Bruguiera* sp, *Xylocarpus* sp have been established in South Andaman and Middle Andaman. Supplementation of natural regeneration by introduction of seeds directly into the selected sites and collection of seeds and establishment of nursery for rare mangroves species will also be carried out.

Developing yield tables for short rotation tree crops in Kerala

The project aims to develop regional prediction models for constructing yield tables for fast growing five tree crops viz. *Acacia auriculiformis, A. mangium, Albizia falcataria, Eucalyptus pellita,* and *E. grandis* in Kerala. Sample trees were felled and field measurements completed for all the five species. Regression analysis will be used to develop models for volume estimation and preparation of volume tables.

Growth and yield studies on forest plantations of teak in Karnataka for their sustainable management.

Annual measurements carried out in 27 sample plots laid out in five Forest Divisions in Karnataka and growth data of teak recorded in all the plots. Compiled data were analyzed. Stand density diagram has been constructed and relationship between stand density, dominant height, quadratic mean diameter, relative spacing and stand volume was developed. An equation was developed to enable prediction of reduction in tree number due to density-dependent mortality.

Biomass, net primary productivity and shoot productivity of seven industrially important bamboo species in semi-aird and humid tropics of Peninsular India

Growth observations including various culm and clump parameters were recorded for all the seven species in two agroclimatic zones (Humid tropics - Koppa, Chickmagalur and Semi-arid - Hoskote, Bangalore). Basic nutritional analysis of the juvenile edible shoots of the various bamboo species was also done.

Standardization of plantation techniques for major forest plant species in Madhya Pradesh

Eight species *viz., Tectona grandis; Gmelina arborea; Dalbergia sissoo; Dalbergia latifolia; Terminalia tomentosa; Albizia procera; Terminalia beleirica; Dendrocalamus strictus* were chosen for the experiments for which pits of three different sizes were dug post site preparation and plantation at different spacement under irrigated and non- irrigated conditions done for all. Growth data (quaterly) and rate of

Pit digging at site

Fixing of earthen pot (Surahi)

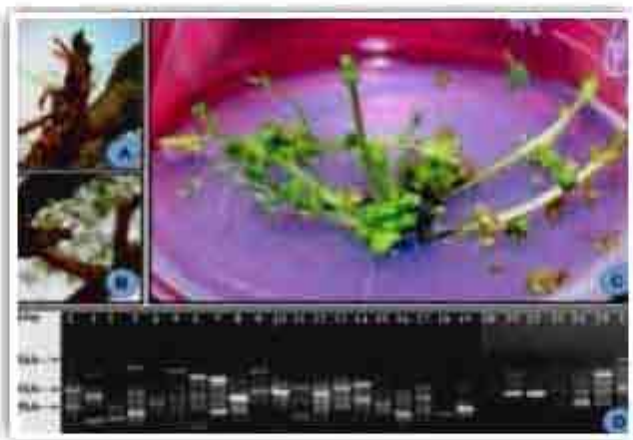
photosynthesis (half yearly) are being recorded in these plantations.

Integrated nutrient management for improved growth of trees on overburden dumps

Overburden samples were analyzed for its physico-chemical properties at Shivpuri open cast mine-1. Plantation was done with 10 tree species. Physicochemical analysis of overburden dump showed nutrient status of the spoil increased gradually with the increase in age of the plants with respect to EC, organic carbon and available N, P, K. Combined treatment with farm yard manure (FYM), vesicular arbuscular mycorrhiza (VAM) and NPK showed good result in survival in *Gmelina arborea, Mangifera indica, Moringa oleifera, Cassia siamea* and *Emblica officinalis*.

A coordinated project on integrated management of 'khejri' mortality for socio-economic upliftment in Rajasthan

Component 1 of project focuses on forest protection studies where the result of field trials at six sites in five districts of Rajasthan revealed that the best treatment was AFRI, followed by CAZRI and ARS in managing the 'khejri' mortality. The major biotic factor responsible for 'khejri' mortality is root rot disease (*Ganoderma lucidum*), followed by *Acanthophorous serraticornis* (root borer). The II component on genetics aspect involved survey and selection of 5 CPTs in various districts. The biotechnological component achieved 5 to 6 fold multiplications of shoots from fresh shoot. Standardization of DNA extraction, purification and quantification was done. The ecological component assessed the effects of abiotic stresses with relation to 'khejri' mortality for which meteorological data of Churu, Jhunjhunu and Jodhpur districts were collected along with ground water table data, and soil samples analysed. Data were correlated with metrological figures from previous years. Biochemical studies on causal organism, *Ganoderma lucidum* indicated that for screening of healthy trees from diseased trees, proline and ash content could be used as biochemical markers. The socio-economic aspects of 'khejri' mortality were assessed in 190 villages. Lastly, under the extension component, awareness generation programme on 'khejri' mortality and its management was done during visits to AFRI, in mela, workshop, meeting, trainings.



In- vitro cloning and DNA fingerprinting of *Prosopis cineraria*: A & B. Shoot initiation from nodal shoot segment of lopped trees, C. Six fold shoot multiplication on MS+5mg/l BAP+ additives in 8 week; D. DNA fingerprint using 25 RAPD primers.

Participatory forest management- Identification of extent of forest lands in forest fringe villages funded by NRAA, Govt. of India

The project aims undertake socio-economic survey and ecological studies in North-eastern region except Sikkim, covering different aspects of livelihood including dependence on forests etc. During this year, seven states of Northeast India were covered.

Identification of extent of forest land in forest fringe villages

Socio-economic survey in Barumal village

Socio-economic survey through questionnaires and vegetation studies were carried out in Jamnagar, Junagarh, Panchmahal, Surat, Vadodra, Valsad, Dahod and the Dangs districts in Gujarat dominated by tribal communities. Due to continuous hacking or clearing of trees for cultivation and uncontrolled grazing and repeated fires, the natural regeneration of teak was low, whereas, regenerations of *Diospyros melanoxylon, Anogeissus latifolia, Butea monosperma* and *Lagerstroemia parviflora* were relatively better. People have small and marginal land holdings and due to poor irrigation facilities, have to depend on kharif crops.

Innovative approaches for augmentation of composting and biofertilizer production in hot arid regions

Vermi- compost samples were analysed for mycoflora associated with various pedding material adopting dilution plate technique. The mycoflora, *Acremonium sp., Cladosporium sp.,Penicillium sp. Aspergillus niger, Aspergillus flavus, Alternaria sp., Trichoderma viride, Fusarium* spp, *Actinomycetes* and *Streptomyces* were isolated and identified. Three litter decomposing fungi, *Trichoderma viride, Aspergillus niger* and *Streptomyces* and PSBs were selected for amendment for rapid composting process and to enhance nutritive value of compost. Training on production of composting, vermicomposting and biofertilizer multiplication and their application in forestry was imparted to stakeholders/VVK.

Preparation of vermicompost using neem leaf + cow dung

Vermi- compost ready for use

Multiplication of in AM fungi (Glomus fasiculatum) in pot with maize host

Vermi- composting and AM fungi (*Glomus fasiculatum*) multiplication

Enhancing fodder productivity through silvipastoral system on degraded land of India

Annual growth data (height and collar diameter) were recorded in *Colophospermum mopane* plants. Structure repairing was undertaken and grass sowing was carried out. Green grass yield for *Cenchrus ciliaris* was, then, measured. Soil analysis indicated that pH was high (9.08 -10.0) of soil structures, where, grass establishment was poor. Yield of other grass

(a) Establishment of S. *nudiflora* on soil bunds

(b) Establishment of *C. ciliaris* on soil slope with *C. mopane*

(c) Various salt tolerant grasses with *C. mopane*

(a to c): Silvipastural trials at Gangani, Jodhpur

species was measured. *S. nudiflora* seedlings were planted post preplanting operations on soil bunds.

Tapping potential of some selected indigenous lesser known wild edible plants for food and nutrition in arid and semi arid region

Selected lesser known wild edible plants viz. *Cordia gharaf (Goondi), Cassia tora (Puad), Ceropegia bulbosa (Khedula), Haloxylon salicornicum (Sajji) and Grewia tenax (Gangeran), Calligonum polygonoides (Phog), Leptadenia pyrotechnica (Khimp) and L. reticulata (Rai dodi)* with edible leaves/fruits /tubers consumed in arid and semi arid forest regions of Rajasthan were evaluated for their nutritive value in order to identify alternative bio-nutritional sources.

Productivity enhancement of Kair (*Capparis decidua*) fruit to generate livelihood in rural areas of Thar desert

Gogelao in Nagaur was selected for field trial and plants of *Capparis* decidua were divided into three blocks. Fertilizer treatments with leaf compost, goat FYM and VAM in combination with different fertilizers; were applied with irrigation. Data analysis indicated that maximum flowering (73.5%) was in compost treated plants, followed by AM fungi treated plants (24.3%). Flowering was minimum (14.4%) in goat FYM treated plants.

Productivity and biometrics studies on some important species in semi-arid regions of Rajasthan for their sustainable management

Felling of trees to develop regression equation to estimate biomass of *Prosopis cineraria & Ailanthus excelsa* plantations was done in 14 permanent sample plots laid in the IGNP area. Annual observations were recorded. Models for deriving the total volume, merchantable volume over bark and under bark for both species were developed. Growth and yield models are under process. Simiarly, fodder and fire wood yield models in *Prosopis cineraria* were developed using multiple regression techniques.

Productivity study and growth and yield in teak plantation in Gujarat state

The main objective of this project is to construct and validate tree volume function and to develop growth and yield models. For this purpose, annual observation on growth parameters of *Tectona grandis* were recorded from 14 sample plots spread across various locations in Gujarat. Linear regression equations developed between height and diameter were fitted. The Quadratic Equation between H and D is $H = 2.55 + 0.877\ D - 0.086\ D^2$ was found most suitable with $R^2 = 0.737$. Also, the frequency curve of *Tectona grandis* was found asymmetrical and positively skewed in comparison to normal frequency distribution.

Studies on seed germination and longevity of *Abies spectabilis* (D.Don) Spach

Extensive surveys were conducted during the year for identifying the additional natural populations of *Abies spectabilis* in the state. Eight new natural populations in Kinnaur, Parvati, Kullu Forest Divisions and Sarahan Wildlife Division in Himachal Pradesh were identified, georeferenced thereby, raising the total locations to 25. Site characteristics were analysed. The seeds were extracted from cones of *A.spectabilis* from two sites i.e., Chhitkul and Churdhar forests for carrying out trials on seed germination both in the laboratory and in nursery conditions and the germination data are being recorded.

Determination of nursery requirements and initial planting performance of *Diploknema butyracea (Roxb.) H. J. Lam* and *Myrica esculenta* Buch. Ham. under mid-hill conditions of Himachal Himalayas

Germination studies in 'kaphal' were initiated from the seeds collected during May 2013 from Shimla and Mandi districts. Seed germination trials in 'kaphal' at Baragaon and Shilly nurseries had little success. Trials with root cutting were also initiated. Similarly, seeds of 'cheura' collected from Uttarakhand and sown in

Root cutting plants of Kaphal

nurseries at Shilly (Solan) and Bir Plassi (Nalagarh) recorded about 80% germination. Planting of 'cheura' in Solan district showed good initial establishment.

The succession trends and productivity studies of Sriharikota (SHAR) and Pulicat lake ecosystems for conservation of biodiversity

In this ongoing all India coordinated project, phyto-sociological data of terrestrial and aquatic ecosystems from 30 quadrats, data on people's perception about natural regeneration on communities, priorities and local vegetation was collected along with the phenological observations. Biotic interference and productivity aspects of terrestrial ecosystem were assessed and recorded in permanent quadrats with portable photosynthetic system.

2.2 Agroforestry and people-forestry interface:

Development of agroforestry model of some important medicinal plants with *Melia composita* and *Emblica officinalis* in degraded land of Punjab and Uttarakhand

Selected sites at Naukra grant (Buggawala) and Handesara (Punjab) were developed and experimental areas at Naukragrant (Buggawala), Haridwar and Handesra, Mohali were maintained along with data recording on growth performance of tree species, medicinal plants and yield of agri crop from both the sites.

Study on status of agroforestry systems existing in Punjab, Haryana, Uttarakhand and North-West Region of Uttar Pradesh.

17 villages were surveyed and data collected on socio-economic status and agroforestry practices from Rangadwala, Imalikheda, Mewarkhurd, Shahpur and Ranimajara districts of Haridwar (UK) and Sherpur, Nahartarpur, Baloli, Khurdi, Damla, Dhoraung, Gulabgarh, Machhrouli, Parboli, Taharpurkhurd, Khijari and Mandewala districts of Yamunanagar (Haryana). Compilation work of 31 villages of Punjab (3), Haryana (12) and Uttarakhand (16) has been completed.

Enhancing fodder productivity through Silvi-Pasture system on degraded land of India

Grewia optiva and grasses procured and established silvi-pasture agroforestry models established on degraded land at Kharakhet, Dehradun and observations on survival noted along with maintenance of experimental site at Kharakhet, Dehradun

Introduction and evaluation of fast growing tree species under agroforestry systems in different agro-climatic zones of Tamil Nadu

Established agroforestry systems under 15 ha farm land in three zones (Northeastern, Cauvery delta and Southern zones) with fast growing tree species of *Melia dubia, Gmelina arborea, Neolamarkia cadamba* and *Sweitenia macrophylla*. Intercropping activities carried out and the biomass and yield of annuals of various species (as intercrops) assessed. From the intercropping activities carried out in the first year, *M. dubia* with turmeric registered highest net annual return followed by *G. arborea* with Banana, *M. dubia* with Tapioca on per ha basis. Allelopathy study was conducted with exudates prepared from fast growing tree species and study completed in maize, sorghum and black-gram. Training on capacity building of farmers of Pudukottai district was also conducted.

Development of Integrated Dry Land Agroforestry Systems in Tamil Nadu for enhancing livelihood opportunities

Seven Agroforestry systems demo units in all talukas of Ramanathapuram district in Tamil Nadu done with creation of farm ponds on six farm fields in six taluks. Superior planting stocks of Casuarina, pungam, neem, teak, amla, sapota and mango multiplied and seven agroforestry plots established and recorded soil parameters, survival and growth of tree components. Also, completed two collaborative projects with State Agricultural Universities on NTFP Network Project on seelected NTFPs of Kerala.

Capacity building, skill up-gradation of artisans and promotion of traditional bamboo handicraft and art with improved technology, suitable design and value addition under 'Direct to Consumer' scheme of ICFRE.

Establishment of agroforestry system with *Melia dubia* and sorghum in farmers' field

Training on bamboo handicraft and agarbatti stick making at Bamboo Composite Centre, RFRI, Jorhat

A training programme on Agarbatti stick making was organized on 5th September '13 at Nemuguri, Dist. Sivsagar, Assam for 135 women members of 16 SHGs and at Meleng, Jorhat on 7th October,'13, where 37 ladies from 17 SHGs participated. For, skill upgradation of artisans, a 10 days training- cum- workshop from 26th September to 5th October,'13 was organized and was attended by 21 artisans from 4 districts of Assam. Similarly, a training was organised on bamboo products for a group of Don Bosco, drop out students of the Mishing tribal community of Assam from 21st to 25th October,'13 with 21 participants.

Development of lac based agroforestry (silvi-agri-lac) system

Broodlac of 'kusumi' strain from the Kanker Forest Division was inoculated on *F.semialata* and *F. macrophylla* after organic manure was added and irrigation, avoiding water logging. The growth data revealed gradual increase in height - maximum 2.5m in *F.semialata* and 2.4m in *F. macrophylla* and intercropped with oleri crop viz. *Lycopersicon esculentum* as summer crop. The system is maintained with regular irrigation and other cultural operations and monitored.

Evaluation of *Madhuca indica* based silvi-agri system in arid and semi arid region of India (AICP project)

Grafted plants and seedlings of *M.indica* were transplanted in the experimental area of TFRI in 2012 and growth data on survival % revealed 50% survival of grafted plants as compared to seedlings. Data of growth and nutrient status at the initial stage of the study and one year after its plantation were recorded indicating that all the parameters of soil decreased from the initial stage i.e pH value from 8.36-7.96, EC value 0.25-0.21 but OM value increased from 0.86 to 1.376, N and 169.34-287.89.

Development of silvi-agri-medicinal/agri-medicinal systems in Vidharbh Region of Maharashtra

A farmer's field in Chandrapur district was selected as OFR and an experimental area of agroforestry division was selected as an OSR for the establishment of silvi -agri-medicinal and agri – medicinal system. Root-shoots of *Gmelina* (silvi crop) were tansplanted and seedlings of *R.serpentina* and *Withania somnifera* and rhizome of *A.calamus* at 30 cm x 30 cm and 45 cm x 45cm transplanted as an intercrop along with *Oryza sativa*. Data on survival and growth parameters showed 80% survival of *Gmelina* and only 20% of *R.serpentina* and *W.somnifera*. *A.calamus* crop is performing well.

Farmer at his farm with *Gmelina* seedlings, Chandrapur district

Empowering tribal community through lac cultivation in Madhya Pradesh

Experiment was conducted to cultivate lac as baisakhi crop after the pruning of lac host trees i.e.

Butea monosperma and Zizyphus mauritiana existing in farmer's field. The data were recorded and phunki removed and the lac was scrapped. Data show 30% survival of the crop despite adverse conditions. Simultaneously, broodlac of kusumi strain was also cut and inoculated on the remaining branches of *S.oleosa* as aghani crop in study site. The crop is being maintained and monitored.

Raising planting material of selected cane species and establish plantation in fringe villages of Karbi-anglong, Assam to sustain rural livelihood.

Three villages namely Jongpha village, Akhaiphutia, Lakhan Terang village, Chowkiholla and Kingdir Terang village, Dolamara were selected to have collection of planting material of cane and other important NTFPs.

Managing resources to enhance productivity of agroforestry system in dry areas of Rajasthan

Established *Hardwickia binata* and *Colophospermum mopane* trees based agroforestry trials in AFRI, Jodhpur. The four treatments for each species viz; intact tree (T_1), Tree branch removal only (70% of total tree height) (T_2), root barrier treatment (T_3) and both tree branched removal and root barrier treatment (T_4) were adopted and *Cymopsis tetragonoloba* crop grown with *H. binata*. The grain production of *C.tetragonoloba* was higher in T_4 than T_3 treatment. The crop production of *C. tetragonoloba* increased significantly in T_4 treatment as compared to other treatments. Clump number and diameter and production of *C. ciliaris* grass were significantly higher in control plot. Physico-chemical properties of soil were analyzed.

Designing and development of urban forestry model for Indian Institute of Technology (IITJ), Jodhpur, Rajasthan

This project was developed for shelterbelt –cum- urban forestry model for 5000 m long stretch along the boundary of IIT Rajasthan campus. Six thousand plants of different species have been planted in strip plots in three tier system. Due to shallow soil depth and gravel, amendment was made by replacing with good soil, application of FYM, neem cake, bio-fertilizer and micro-water harvesting structure (saucer pits). Growth parameters have been recorded and technical report submitted to the funding agency

Development of agro-forestry models in *Wrightia tinctoria* and *Gmelina arborea* as tree species in semi-arid tropics of Andhra Pradesh.

This ongoing project aims to develop *Wrightia tinctoria* R.Br and *Gmelina arborea* based agroforestry models in semi-arid tropics of Andhra Pradesh and to study the interactions of tree and crop combination of agroforestry system based on the combination with pigeon pea and sorghum. Data of agricrop and tree crop had been collected.

Introduction of selected genotypes of 'karanj', 'kusum' and bamboo as tree components in Agroforestry models in lateritic belt of eastern India

Grafting was done for clone production of 'karanj' & 'kusum' trees and seedlings raised. Two year old seedlings of 'karanj' and 'kusum' were used for tree plantation. 60 grafts of both species were planted at Mandar. Five agricultural crops viz, ginger, turmeric, colocasis, black gram and ragi were sown, harvested and yield data recorded. Soil samples were analyzed. Shade reduction was done in bamboo plots through clump management.

2.3 Wood Science and Technology

- A project on the performance of ZiBOC treated imported wood species is under progress. Results on termite mound test revealed complete protection of treated meranti and Douglas Fir against termites.

- Evaluation of performance of treated timber in cooling tower is under progress with observation that CCA and ZiBOC performance are comparable. Also, in another project, to study the durability of *Melia composita* after treatment with CCA and ZiBOC in different agro climatic conditions through stake test for exterior/structural uses has shown that boiling treatment followed by vaccum and pressure for a specified time and capacity resulted in optimum retention of CCA and ZiBOC preservatives.

- A project funded by BTSG-NMBA is under progress to set up bamboo processing facility centre at FRI for product development. 20 trainings were organized where participants learnt the technique of bamboo sliver mats and products processing techniques for glue preparation and board making or press. Another DST funded project post harvest management for value addition of wood/bamboo for livelihood support of rural population is under progress.

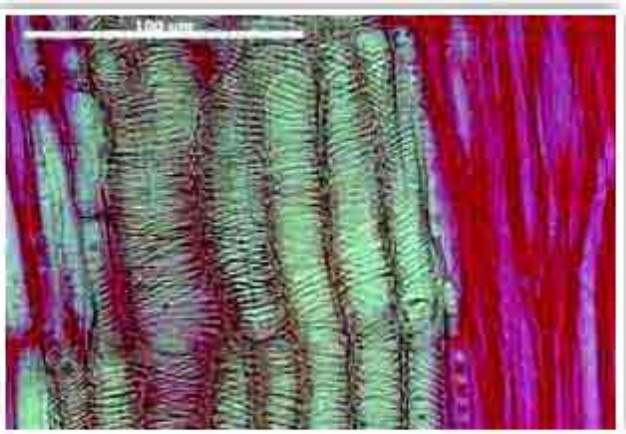
- A project on chemical modification of wood with citric acid (CA) and sodium hypophosphite monohydrate (SHP) for durability improvements is under progress.

- Six projects on composite wood/ reconstituted wood are in progress in F.R.I that includes projects on 'Studies on the suitability of paper mulberry for plywood','Study of the effect of nano-clay on physical and mechanical properties of plywood', 'Study the suitability of combi-ply from *Melia composita* and poplar' through which different plantation species can be utilised for developing plywood and for effective utilization of timber. In project 'Studies on the suitability of different combinations of plantation grown species for laminated veneer lumber (LVL)' wood for load bearing components is being studied. In project on medium density fibre boards, lops and tops of Poplar are being used for preparing boards. Under the ongoing project 'Refinement in vacuum timber dryer designed by FRI and its performance', vacuum drying experiments were carried out on *Cedrus deodara* wood to study its drying behavior under vacuum.

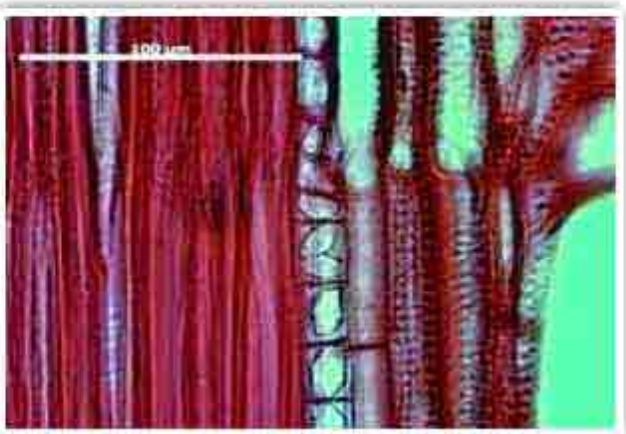
- An ultrasonic technique was developed and modified (based on eight point testing) for defect detection for trees.

Utilization potential of timber from *Melia composita* syn *Melia dubia*

Lops and tops of *Melia composita* are also being utilized to prepare particle board and medium density fibre board. Under the ongoing project 'Vacuum press drying studies on *Melia composita*', wood was dried in a vacuum press dryer. The drying was done at two temperatures, above and below boiling point of water and drying rates were found higher for the temperature above boiling point of water.



Caragana brevispina: RLS showing storied structure and spiral thickening: DDw 4461 at 40x (Papilionoideae)



Desmodium tiliaefolium RLS showing chambered crystals in parenchyme: DDw 2934 at 40x (Papilionoideae)

Wood anatomical studies of Indian shrubs

The study of microstructure of 200 species of Indian shrubs and Lianas species with species identification key developed can be utilized to distinguish the studied species for the purpose of their efficient utilization by timber and pharmacological industry. Photomicrographs of all the studied species have been added as follows for understanding the anatomical features.

Effect of treatment with micronized copper preservative on the strength, treatability and durability of selected wood species

Wood samples *of Acacia auriculaeformis* and *Melia dubia* were treated with 1-2% MCA using vacuum-pressure cycles. Copper retention, weight gain, physical and mechanical properties were evaluated. Amount of copper retention and penetration was found to increase with increasing concentration and pressure duration. Density was also found slightly increased while some mechanical properties were either comparable or reduced. Water treated and untreated rubberwood installed in test site were most affected by termite attacks while MCA treated stakes were not attacked even after three years.

Furfurylation of wood to improve properties for various applications

Maleic anhydride and citric acid were found to be optimum for higher resin yield. Uptake of furfuryl alcohol solution was less in *Melia dubia* followed by *Grevellea robusta*. However, the uptake in *Bombax ceiba* and *Maesopsis eminii* was good. Weight percent gain (WPG) in *Bombax ceiba* and *Maesopsis eminii* are significantly higher. WPG increased with increase in furfuryl alcohol concentration in the treating solution. Moisture absorption was reduced and dimensional stability significantly improved due to furfurylation of wood. Modified samples showed improved decay and termite resistance.

Natural Fibre-PVC composites for light structural applications

Fusion property of PVC was studied and its processing temperature and time optimized. Concentration of plasticizer required to process PVC-biofibres has also been optimized. Rheological studies of PVC- biofibers has been completed. The results showed an increase in fibre content increases torque. This study helped in processing thermoplastic-biofiber composites in the extruder. Also, injection moulding of PVC-biofibre composites has been completed.

Nanoparticles based wood coatings for outdoor applications

UV resistance of rubberwood coated with zinc oxide nanoparticles dispersed polyurethane (PU) exterior clear coating, was evaluated. Weathering performance of rubberwood specimens coated with nano object embedded PU was evaluated under accelerated and outdoor conditions. Results indicated potential of nano-particle based wood coatings for providing protection from harmful UV radiation in outdoor environment.

Wood quality variability in sawn timber from three plantation grown species

Wood quality parameters and drying defects were found to be highly variable in seemingly identical sawn timber of silver oak, *Acacia auriculiformis* and eucalyptus. Eucalyptus exhibited highest dynamic modulus of elasticity. Pilodyn penetration was strongly negatively correlated with wood basic density in all. Acoustic velocity in clearwood samples exhibited strong negative association with longitudinal shrinkage. Potential utility of acoustic technique in determining the magnitude of moisture loss in sawn timber and round logs during storage and drying was suggested.

Studies on macro wood deteriogens at Kakinada port and Narsapur Greenfield port, Andhra Pradesh

Marine exposure trials at Kakinada port and Narsapur test site were continued and

observations made along with digital photographs for analysis using the software *Photogrid*. Water samples were analysed and internal destruction of wooden test panels was recorded and species of marine wood borers identified. The project concluded on 31-3-2014.

Effect of flowering on culm quality of *Dendrocalamus brandisii* and to explore its potential for making bamboo composite products

Histoanatomical studies completed. Biochemical studies and assessment of physical and mechanical properties under progress. Static bending test on samples from during and after flowering stages of bamboo being carried out.

Screening of oil of *Pongamia pinnata*, *Jatropha curcus* and *Simarouba glauca* for developing eco-friendly wood preservatives

Observations were made on the treated rubber wood specimens with pure and copper incorporated oils of *Pongamia pinnata*, *Jatropha curcas and Simarauba glauca* untreated control rubber wood specimens at Nallal. Jatropha oil treated rubber wood specimens were also exposed to fungus and borers in the laboratory and the percentage of decay was evaluated. Chemical analysis of decayed specimens was analyzed for the wood content using FTIR.

Screening of certain plant extractives for developing eco-friendly wood preservatives

The extracts from two plant species were incorporated with copper ions. Rubber wood of two different sizes, Test-yard specimens (40x5x150mm) and Fungus specimens ($20mm^3$) were converted and treated with 5% concentration of these formulated preservatives by different methods. The treated fungus specimens along with untreated controls were exposed to two types of fungus in the laboratory and the percentage of decay was evaluated.

Evaluation of the performance of Steam Volatile Creosote (SVC) as a wood preservative

Eight species of wood specimen were treated with Steam Volatile Creosote (SVC) along with natural and synthetic dyes and evaluated the preservative activity. Pressure treatment of wooden specimen with SVC has withstood attack of insects and pathogens for almost 2 years for less perishable woods, 18 months for medium perishable woods and 12 months for highly perishable woods. In pressure treated specimens with natural dye and synthetic dye there was no infestation up to 2¼ years. Treated wood samples exhibited resistance to brown and white-rot fungi. FTIR spectroscopy showed effectiveness of SVC treated wood in restricting chemical degradation.

Determination of the treatability and durability of imported timbers as per Bureau of Indian Standards

Observation at 72 months after implantation has been taken in all the testing sites, on the durability of moderately resistant timber *Quercus robur*, and highly resistant timbers viz., *Dryobalanops aromatica, Tectona grandis, Shorea laevis, S. marcoptera, S. robosta, Pterocarpus soyauxii* and *Xylia dolabriformis*. Natural durability experiment with imported timber species viz., *Instia palembanica* (Merbau) from Malaysia and *Dipterocarpus grandiflorus* (Gurjan) from Myanmar were initiated.

Development of Sandal (*Santalum album* Linn.) Information System

System analysis about sandal web database and feasibility study completed and model web database and its detail design completed. System coding, and testing, data validation and feeding and its implementation in server are under process.

Evaluation of wood properties of *Melia dubia* of different ages from southern India for finding suitability for various end products and development of value added products

The logs of the trees of different age groups (5-6 and 9-10 years) converted into planks and

test specimens tested for different anatomical, physical and mechanical properties as per BIS:1708. Wood working qualities were evaluated with the help of artisans.

Wood modification of *Melia composita* for improving its dimensional stability and durability

Specimens of *M. dubia* wood were thermally modified in the temperature range of 180 – 235 °C in a vacuum oven and evaluated. Heat treated wood was characterized using FTIR spectroscopy. Work on chemical modification of *Melia dubia* wood with acetic anhydride was initiated.

Variability of growth stresses in *Melia composita*

Growth strain measured in standing trees and logs of *Melia composita*. Measurements were carried out in plantations of 3 age groups growing in Punjab.

Durability and treatability of *Melia composita*

Melia composita specimens were air seasoned, moisture content and specific gravity were determined. The specimens were treated with oils of *Pongamia*, Neem, CNSL regular, CNSL distilled and CCB (8.5%) by non-pressure method and pressure methods. Retention of the preservatives was calculated on weight basis.

Bio-thermoplastic composites: Evaluation of physical, mechanical, morphological and thermal properties.

Experiments on blending of coir+HDPE and Rubberwood + HDPE completed.

Microwave assisted chemical modification of wood

In this DST funded project, solvent free acetylation of rubberwood carried out and effect of temperature, reaction time, and NBS concentration studied. The extent of acetylation was measured by weight percent gain and the modified wood was characterized by FTIR-ATR method. Further work on optimization of reaction conditions and hydrophobic properties of modified wood is in progress. Microwave-assisted solvent free acetylation and butyrylation of rubberwood was carried out and investigated. Extent of modification of wood for microwave and conventional heating reactions was compared.

New methods of chemical modification of wood for improving dimensional stability and durability

Experiments on chemical modification of wood and its constituents using isopropenyl acetate (IPA) using iodine as catalyst has been carried out. The average weight percent gain increased with increasing reaction time. Samples upto weight gains of 17 % were obtained. Further work was in progress.

Development of natural fibre filled thermoplastic composites from natural resources available in the State of Punjab

Tensile and flexural strengths of *Lantana* wood fibre PP composite was far superior than pure PP and also is comparable with the strength properties of wood and bamboo filled PP composites at the same fibre loading. Impact strength of *Lantana* filled PP composites was better than wood and bamboo filled composites at the same fibre loadings. Composites could be prepared with bark intact. Moulded products from the lantana filled composite material have been successfully developed.

Thermal modification of wood for value addition to plantation timbers in Punjab

The colour change and surface roughness was observed in wood blocks with increasing heat treatment temperature. EMC was found to be reduced by 50-70% compared to untreated wood. Specific gravity and few mechanical properties were found to decrease slightly at 220°C. The mass loss was found to be up to 15%. Higher

treatment temperature made the wood more water resistant and dimensionally stable. MOR was found to decrease slightly with increasing temperature.

Assessment of wood quality variability in tree species prevalently grown in Punjab

In-situ assessment of morphological and wood quality traits were done in the plantations of *Melia composita*, Poplar and Eucalyptus hybrid growing in different locations and of different age groups. Variability was also assessed in morphologically superior trees selected in a 11 year old plantation of *Melia composita*. Based on the wood quality parameters, 20 trees were screened as the superior trees for wood quality and seeds from these trees were collected. The trees were identified as the potential superior trees for further propagation.

Testing and evaluation of wood quality of plantation Teak grown in Andaman and Nicobar Island

The teak wood quality at five locations in Andaman & Nicobar Islands was evaluated with the objectives of studying various anatomical, physical and mechanical properties. Based on properties studied and suitability indices, the wood quality was compared with the standard teak. Report including the recommendation on the quality of the timber based on physical and mechanical properties was submitted to the Andaman & Nicobar Forest Department.

2.4 NWFP and medicinal plants

Assessment of economic contribution of NTFPs of Chir Pine in the economy of forest dwellers in North India

The project work in the states of J&K, Himachal Pradesh, and Uttarakhand studied the economic contribution of NTFPs of chir pine, mainly resin, on economy of forest dwellers. The observation shows that resin extraction work contributes 73% -83% share in the total income of dependent forest dwellers, besides, other benefits bonafide uses. The final report of the project was submitted to MoEF in May 2014.

Process refinement for extraction of quality fibre and optimal isolation of bioactive constituents from *Agave sisalana*

Leaves juice of *Agave sisalana* was fractionated with organic solvents & solvent combinations of varying polarity at FRI. Saponin from the leaf juice was subjected to hydrolysis followed by partitioning to aglycone (sapogenin) and glycone (sugar) components.

Enzyme aided alternative process for the extraction of oil from *Cymbopogon citratus*

An innovative approach for isolation of essential oil from *Cymbopogon citratus* (lemon grass) was evolved by using enzymes and mechanical process that enhanced yield and superior quality of oil and reduced the artifacts formation.

Development of category shades of natural dyes of *Pinus roxburghii* and *Mallotus philippensis*

Various category shades from the dyes isolated from *P.roxburghii* (needles) and *Mallotus philippensis* (fruits) on silk, wool and cotton were developed. It was observed that *M. philippensis* dye could be 50% replaced with much cheaper substitute *Pinus roxburghii* needles dye.

National study on commercial production of NTFPs for ensuring fair economic returns to primary collectors

The study sponsored by MoEF, GoI aims to document various non-nationalized commercial NTFPs in selected states of India. Primary data collected in 10 states of more than 100 NTFP species doing household survey. The collectors are earning sizeable income from the sale of these NTFPs apart from self-consumption of some NTFPs. The final report has already been submitted.

Development of sustainable model for enrichment of selected Medicinal Plant Conservation Areas (MPCAs) of Uttarakhand Himalayas

Collection of seeds and enrichment field trials of Atish, Kutki and Jatamansi laid out at identified sites at Khuliya and Kandara MPCAs. Data was recorded on habitat types, frequency and density.

Picrorhiza kurrooa (Kutki)

Nardostachys grandiflora (Jatamansi)

Baseline survey/inventory of guggal and salai guggal distribution in Haryana

This study aims at preparing district- wise availability of guggal and salai guggal in forest and non forest areas of Haryana for serving as baseline documentation for future conservation and potential utilization of *Commiphora wightii* and *Boswellia serrata*. The surveys have been completed and mapping of their distribution is in progress.

Structural studies and utilisation of *Acacia tortilis* gum exudates

Polysaccharide was isolated and purified followed by complete hydrolysis. Alditol acetates of the hydrolysed polysaccharide were prepared. The GLC analysis of alditol acetates of the hydrolysate of the native polysaccharide confirmed the presence of L-arabinose, D-galactose D-glucose, L-rhamnose, D-xylose and D-mannose in the molar ratio of 78.1%, 18.65%, 0.60%, 1.17%, 0.16% and 0.74% respectively.

Augmentation of medicinal plants resources for primary health care practices by the tribal communities in the Nilgiris and enabling their livelihood enhancement

Ezhumuram tribal village herbal garden near Gudalur, Nigiri district

Information on knowledge of 15 different medicinal plants on 14 diseases among tribals in seven villages was recorded along with the traditional practices adopted by the communities with regard to their primary health care. Data of NTFPs were also documented and marketing linkages established for marketing at the village level. Nursery and two herbal gardens with 30 medicinal plant species were established in two selected villages.

Distribution, assessment and growth of *Santalum album* L., an important medicinal plant of Karnataka

This funded project involves surveying the sandalwood growing areas in Bangalore, Kolar, Mysore and Mandya forest divisions laying 12 sample plots. Data have been collected, processed and compiled.

Standardization of pruning practices and optimum doses of organic and inorganic fertilizers to increase leaf surface area of tendu (a sub project of "Standardization of technique to enhance the quality and sustainable production of *Diospyros melanoxylon* leaves in Chhattisgarh")

Pruning experiment conducted at Kotadol

Experiments at three sites in three Forest Divisions of Chhattisgarh were conducted using different doses of foliar spray. A combination of 2% nitrogen and 1% phosphorus was found to be the best treatment in Kotadol and Morga and 2% nitrogen (no phosphorus) in Litipara. Different doses of urea, single super phosphate (chemical fertilizers), vermicompost and neem based biofertilizer showed that combined dose of 100 kg/ha nitrogen and 25 kg/ha phosphorus had the maximum enhancement in tendu leaf size in Kotadol and Morga with an individual dose of 100 kg/ha nitrogen in Litipara. Experiments on pruning practices of tendu show that maximum size of tendu leaves was found when seedlings having 2 – 4 cm diameter pruned at ground level. Surface and sub-surface soil samples were analyzed for their physico-chemical characteristics.

Standardization of sustainable harvesting practices of Mahul Patta (*Bauhinia vahlii*)

To standardize sustainable harvesting limits, leaves were harvested as per different treatments T0 (No harvest/control), T1 (40% harvest), T2 (60% harvest) and T3 (80% harvest) with 4 replications and 4 treatments and observations made. On the basis of average % increase of *B.vahlii* leaves, it was observed that T3 i.e., 80% harvesting treatment was found to be the best followed by T2, T1 and T0. 'Dona' with different type of layering materials were made to avoid plastics use.

Studies on harvesting time of some medicinal plants for their natural antioxidants constituents

To standardize method for the estimation of antioxidant activity, total phenol, flavonoids and antioxidant activity were assessed in fresh and dried samples of *Asparagus racemosus, A. officinalis, A. speciosa,* and *C. orchioides* in selected sites in Nasik, Akola, Wardha, Buldana and Amravati districts of Maharashtra.

Evaluation of *Schleichera oleosa* (Kusum) fruits for their nutritional value and development of value added products for economic development of local people

Prepared three value added products -'kusum' concentrate, 'kusum leather' and 'kusum katmith'. Nutritional values in Kusum concentrate was analysed and total carbohydrates, ascorbic acid, CFC and protein was noted. Sensory test analysis was carried out by following Hedonic scale. Further work as per action plan is under progress.

Kusum katmith

Chemo-profiling of some Dashmoola species in Madhya Pradesh

A study was initiated to quantify the active ingredients of three Dashmoola species (*Solanum*

Indicum, Solanum xanthcarpum and *Uraria picta*) collected from different agroclimatic regions of Madhya Pradesh to locate the best areas/populations. Under the above said study, forest area was surveyed and the different plant parts of *Solanum xanthocarpum* and *Solanum indicum* were collected from eight agroclimatic regions and of *Uraria picta*, from six agroclimatic regions. It was dried, processed and preliminary phytochemical screening and quantitative analysis of total phenols carried out. Quantification through HPTLC is under progress.

Wild *Abroma augusta* plant

Standardization of processing and storage techniques of Malkangni *(Celastrus paniculatis)*, Baheda (*Terminalia belerica*) & Baividang (*Embelia tsjeriam –cottam*) fruits/seeds

Under the study, the fruits/ seeds of Malkangni, Baividang and Baheda collected from Chhindwara district of Madhya Pradesh were dried, processed and analyzed. Malkangni seeds were found to have 58% oil content. Baividang seeds will be analyzed for embelin content and baheda fruits for gallic acid content. Some samples were also stored at 4-5°C to examine the effect. Quantification of major active ingredients is under progress.

Collection of root for analysis

Studies on the traditional knowledge of the medicinal plants used by Nepali community in Assam and identification of important species for chemical analysis.

Survey was conducted in 12 Nepali villages in Kamrup, Morigaon, Jorhat, Golaghat, Sivasagar, Dibrugarh and Tinsukia districts of Assam for the collection of information recording commonly used medicinal plants by the villagers. It was found that women have fair knowledge on use of traditional medicine particularly those plants available in homestead gardens and in the villages. Present status and comparison with other communities on its use were also studied.

Preliminary phytochemical analysis of *Abroma augusta* L.

Samples of root, shoot and leaves collected during the survey in Guwahati, Garbanga R.F. Nakachari, Namti, Amguri were analyzed for various phytochemical constituents and compared with same constituents in inoculated *Abroma augusta* plant parts planted in RFRI campus.

Quantification, value addition of NTFPs and improved agricultural productivity to enhance livelihood opportunities in tribal belt of Sirohi District of Rajasthan

Village profile of 24 tribal dominated villages of Sirohi districts on NTFP collection and selling was done and key NTFPs identified in them. Identified *Butea monosperma* as a dominated species for value addition. Organized meeting of tribal farmers to acquaint them with the various uses of *Acacia senegal* and other species to be planted in agriculture land. Planted seedlings of *Acacia*

senegal, *Dalbergia sissoo*, *Bambusa bambos*, *Azadirachta indica* and grafted ber on farm bund.

Standardization of non-destructive harvesting practices of *Commiphora wightii oleogum* resin

The project aims to survey the guggul population in Rajasthan and Gujarat states and to relate the gum yield based on plants girth size. Project was initialed in February 2014 and the initial data collected from the plant population in Kailana, Jodhpur and Jawai dam area in Pali district.

Status, survey and mapping of 'ashtavarga' group of medicinal and aromatic plants (MAPs) in Himachal Pradesh

Survey was continued for the 'ashtavarga' group of medicinal plants in Sirmour, Solan, Kinnaur, Shimla and Kullu districts collecting samples of 'ashtavarga' group of plants and their associated species that were processed and herbarium sheets prepared and preserved. Household data were also collected from different villages of Sirmour and Shimla districts.

Assessment of optimum harvest limits of *Picrorhiza kurroa* and *Valeriana jatamansi* in Himachal Pradesh

The trials were conducted at three sites where five harvesting treatments viz. control, 25, 50, 75 and 100 per cent harvest of selected medicinal plants/plant parts were tried with ten replications. Population status, number of fruit/seed productions, growth, regeneration and the ability of the population to withstand the extraction was monitored and a training manual for sustainable harvest for selected medicinal plants in Hindi was distributed during trainings organised.

Identification of superior chemotypes and *ex-situ* conservation of *Podophyllum hexandrum* Royle from Himachal Pradesh and Jammu & Kashmir (Ladakh Valley)

Podophyllum hexandrum species were collected from 30 georeferenced locations of the two states, processed and sent to the Institute of Himalayan Bio-resource and Technology (IHBT), Palampur for carrying out their analysis for further identification of superior chemo-types on this basis. Subsequently, data were statistically analyzed to identify the superior chemo-types from most probable geographical locations. Also established Field Gene Bank (FGB) at Field Research Station, Bruhandhar, Manali (HP). Trials were undertaken for devising user friendly propagation techniques and training programmes were organized for different stakeholders.

Production of quality planting material of *Aconitum heterophyllum* Wall. *ex* Royle, *Podophyllum hexendrum* Royle & *Angelica glauca* Edgew and extension of their cultivation technology to local communities

Under this ongoing project, quality planting stock of 'atish', 'ban kakri' & 'chora' was raised for distribution amongst local communities. Seeds sowing of these species was accomplished in the Field Research Stations at Shillaru and Bruhandhar, Manali during November-December 2013. Training programmes were also conducted for the farmers and forest officials of both states. A poly-tunnel under this project was established at Shillaru for raising QPM.

Network project on "Population assessment and identification of superior genetic stock of *Picrorhiza kurrooa* Royle ex Benth and *Valeriana jatamansi* Jones by screening different populations from North-Western Himalayas (H.P. and Uttrakhand)"

Post initial groundwork, extensive survey of probable sites in Rampur, Shimla, Chamba, Dharamsala, Nahan, Kullu and Mandi forest circles of Himachal Pradesh was done. Habitat and population status was recorded and plant samples collected from the identified sites. They were dried, processed and sent to IHBT, Palampur and J.P. University Waknaghat for carrying out a.i. analysis to screen out the superior genetic

stock. One portion of the samples was used to establish the Field Gene Bank. DNA fingerprint profiling of superior genetic stock of *P. kurroa* was also carried out.

Studies on nutrient management practices in *Flemingia* species for lac cultivation and promotion of rural livelihood

The project aimed to develop a nutrient management protocol in *Flemingia* sp. to increase lac yield. The application of nutrients showed the significant effect on Flemingia plant growth, lac development and pest attack. Superior plant growth of *Flemingia semialata* was found to be 130.0 cm in T5 over control (78.30cm) while in *F. macrophylla:* maximum plant height was found to be 203.0 cm in T2 over control (107.0cm). The lac production on *Flemingia semialata* was found to be 284 gm in T2 over control (57gm), While on *F. macrophylla:* the production was 280 gm in T7 over control (82gm). Lac parasitization in *Flemingia semialata* was found to be 6.0 parasite /cm in T2 over control (19.0/cm), While in *F. macrophylla* parasitization was found 5.2/cm in T2 over control (15.6/cm).

Raising of model nursery under the project of A.P. Medicinal and Aromatic Plants Board

Seedlings of *Santalum album*-25000, *Pterocarpus santalinus, Terminalia bellerica, - 40000 each, Terminalia arjuna*-50000, *Aloe vera* – 25000, *Coleus forskohlii*- 100000 and Asparagus plants -16000 were raised along with other medicinal species like *Ocimum sanctum, Andrographis paniculata, Asparagus racemosus,* etc. An SSO of myrobalans (*Terminalia arjuna*) was raised in one hectare area in Mulugu.

Quality standardization of some important medicinal plants of Madhya Pradesh

Samples of *Gymnema sylvestre, Ocimum sanctum, Phyllanthus amarus* and *Tinospora cordifolia* were collected from 16 districts, processed for chemical analysis and phenol, flavonoid and antioxidant property was estimated in all the collected samples. Fingerprints were generated using HPTLC. Harvesting and processing experiments were laid in NWFP nursery. Harvesting techniques were standardized for *O. sanctum* and *T. cordifolia.*

Development of descriptors and evaluation of artificial inoculation in *Aquilaria malaccensis* Lamk

Surveys were carried out in different agar growing areas of Assam and Manipur under NMPB funded project to evaluate the variants of *A. malaccensis* and at least three variants could be located based on foliar morphology. A trial on artificial inoculation for agarwood formation was laid out at Bongaigaon District.

Study on Indigenous Knowledge and documentation of extent of utilization of herbs in folk medicines prevalent in tribal pockets of Madhya Pradesh.

The study has been initiated in 7 agro -climatic zones in MP inhabited by Kol, Mawasi, Raj Gond, Gond, Bhilala and Pardhi ethnic communities collecting information on existing flora with names, species overexploited, plant parts used in herbal medicines, formulations prepared along with dosage, utilisation of plants in JFM and harvesting methods. 95 uses from 68 plants of local flora existing were recorded in cure of various ailments. There was high demand in trade of species. Threat status in forest of over exploited species in Chhatatrpur, Satna districts was recorded in this ongoing study.

2.5 Fungus and microbes

Interaction between *Pseudomonas fluorescens* and AM fungi on *Dendrocalamus strictus:*

Efficient P solubilizers (6 in no.) were tested for their *in-vivo* behavior by quantifying their effect on the growth of *D. strictus* using unsterilised and sterilised soils under glass house condition. Destructive sampling revealed that except in culm number, in other plant parameters, the inoculated seedlings behaved marginally better in sterilized soil. The findings indicated that

D. strictus rhizosphere supported plant growth and biocontrol populations of fluorescent pseudomonas.

Prospecting fungal resources for development of natural dye

Dyes were extracted from cultured fungi, *Fusarium sp. and Penicillium sp.*, and applied on various fabrics such as silk, wool and cotton. The results indicated that the dye produced from fungi have some unique shades as compared to the plant based dyes.

Bioassay of plant extractives for antibacterial activity of marine biofilm isolates

Processed leaf biomass of *Parthenium hysterophorus* was subjected to separation process in water medium. The crude extractive collected and preserved for further experimental work.

Development of certification criteria and production of microbial inoculants for application in forest nurseries and plantations

Effect of growth promoting microbes on tinsa (*Ougenia oojeinensis*) seedlings.
(From left to right: Control, *Aspergillus niger, Trichoderma harzianum*, AM fungi, *Azospirillum* sp.)

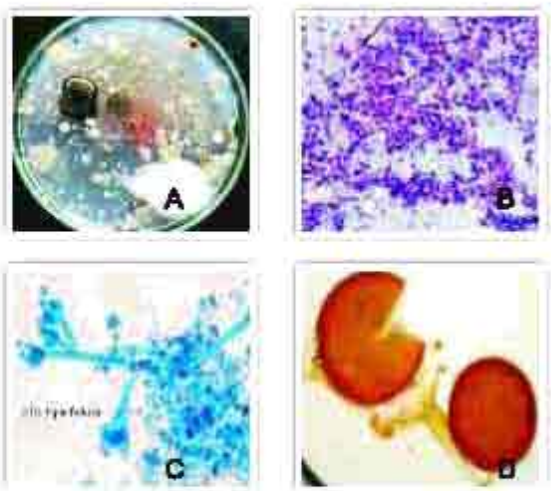
Inocula of AM fungi, Rhizobium and PSB were developed and used for development of certification criteria of plant growth promoting microbes (*Azospirillum*, AM fungi, PSB and *Rhizobium*). The total number of infective propagules of these microbes, required for proper infection/colonization of target host plant were standardized. Pot experiments were conducted on bel, beeja sal, mahua and tinsa to test the effect of biofertilizers on these species. It was concluded that application of AM fungi along with *Azospirillum* sp., enhanced dry biomass and shoot P content of bael seedlings.

Studies on ecological and ethno mycological aspects of wild mushroom of Nagaland.

Ethnomycological survey and collection of wild edible mushrooms has been carried out from the selected areas of Mokokchung and Kohima districts of Nagaland. Twenty four nos. of mushroom species were collected, out of which, only five spp. were edible, 19 were non edible and eight species were recorded as new from Nagaland. All details of site including vegetation documented and traditional knowledge on wild mushrooms recorded.

Effect of the endomycorrhiza along with other bio-agents on biomass production, conservation and accumulation of some phytochemicals in *Abroma augusta* L.

Assessment of the endomycorrhizal biodiversity and presence of other beneficial microbes in *Abroma augusta* L. along with physico-chemical variability analyses in all the rhizospheric soil samples collected from eight natural provenances of Brahmaputra valley



Legend: A- Rhizospheric bacterial and fungal colonies in media, B- Rod shaped (Gram +ve) rhizobacteria, C- *Trichoderma harzianum*, D- *Acaulospora denticulate* X 400, E- Trap culture (mass multiplication) of AM strains with maize as host, F- Conservation of *A. augusta* seedlings inoculated with bio-agent/s.

completed. A total of 26 species of fungi belonging to 14 families were isolated. First-stage and second-stage inoculation of the target plant species with three bio-agents (viz., a bacterium, a non- mycorrhizal fungus and an AM fungus), alone or in consortia (i.e. 8 treatments; along with a non-inoculated/ control set) for biomass production has been done. The inoculation experiments showed good significant results on growth and development of this target plant species.

Studies on the diversity of soil borne entomopathogenic fungi in different land use system of North East India and their utility for the management of major defoliators of *Gmelina arborea* roxb. and *Aquilaria malaccensis* lamk.

Field tours were carried out in 11 villages in Nagaland, 4 villages in Assam and 6 villages in Meghalaya. Total 46 soil samples were collected from different locations. Five fungi were isolated from the infected insects and identified. The soil borne fungi *Fusarium oxysporum*, *Aspergillus flavus*, *Beauveria bassiana*, *Rhizopus sp.* and *Metarhizium anisopliae* were isolated from the cadavers of *G.mellonella*. Pure cultured *Fusarium oxysporum*, *Beauveria bassiana* and *Rhizopus* sp. and mass multiplied in artificial media.

Evaluation and selection of efficient strains of AM fungi and Rhizobium for *Acacia nilotica* and *Ailanthus excelsa* in western Rajasthan

In order to evaluate most efficient mycorrhizae to enhance survival and growth of seedlings, rhizosphere soil and root samples of *Acacia nilotica* and *Ailanthus excelsa* were collected from various forest nurseries and plantations in Rajasthan. The important five genera were identified as *Acaulospora*, *Gigaspora*, *Glomus*, *Sclerosystis* & *Scutellospora*. Among these five genera, 12 species of *Glomus* occurred most frequently. Field trials have been established to demonstrate the impact of biofertilizers (AMF + *Rhizobium* strain) on survival and growth of *A. nilotica* and *Ailanthus excelsa*. One day training was organized on application of VAM in *Acacia nilotica* and *Ailanthus excelsa*.

Evaluation of antifungal potential and identification of broad spectrum antifungal compound from selected tree/shrubs/weeds of Indian arid region

Antifungal properties of selected plant species viz; *Balanites aegyptiacan*, *Tephrosia perpureas*, *Citrulus colocynthis*, *Tribulus terristis*, *Argemone mexicana*, *Solanum xanthocarpum* and *Datura stramonium* were evaluated. Two types of extract prepared viz; aqueous and ethanolic from every plant species were evaluated against five fungi; *Rhizoctonia solani*, *R.bataticola*, *Fusarium monliliforme*, *Fusarium solani* & *Alternaria alternata*. Antifungal activity of extract was determined by poison food technique. Ethanolic extract of *Datura stramonium* leaves has been identified with most potent broad spectrum antifungal activity among all the tested extracts.

Induction of systemic acquired resistance in Rohida (*Tecomella undulata* (Sm.) Seem.) against stem canker

In order to find out casual organism and development of aquired resistance on Rohida (*Tecomella* undulata) six fungi were isolated from infected cankered stem. The pathogenecity studies were conducted on one and half year old rohida seedlings. Once the pathogen was established and disease symptoms were developed, 10mM Salicylic acid, 10mM

Jasmonic acid and *Trichoderma viride* were sprayed on these seedlings to study the induction of defense enzymes. The level of total protein and sugar was high in control (healthy plants), whereas, phenolics and Phenylalanine lyase were high in diseased plants at 30, 60, 90, 150, 220, 330 days.

Occurrence and diversity of the entomopathogenic fungus, *Metarhizium* in the soils of varied ecoclimatic forest habitats of South India

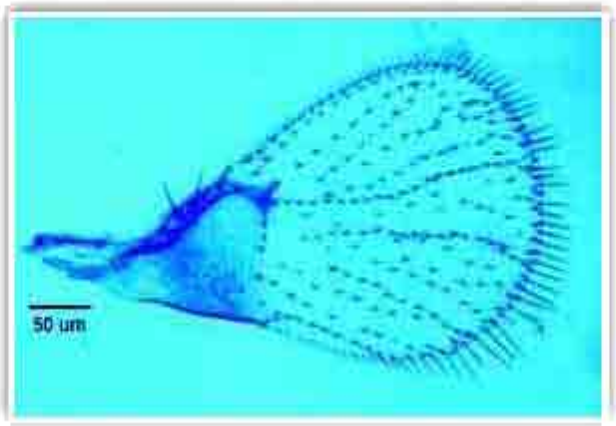
In this DBT funded project collection of soil sample from selected area, its culturing, isolation of desired fungus, *Metarhizium* and analysis of physical parameters of soil with the assistance of NBSS and LUP Bangalore is done. Identification of the fungus on the basis of morphological characteristics has been initiated.

2.6 Insect pests and their control

Studies on diversity of egg parasitoid wasps *Trichogramma* spp. from Punjab and Haryana and their application in biological control of important forest insect pests

150 specimens of *Trichogramma* were recovered from five agro climatic zones of Punjab out of which eleven were identified up-to species level and their morphological and taxonomic characters studied. *Corcyra cephalonica* culture was developed and maintained for utilizing its eggs for multiplication and maintenance of *Trichog-ramma* culture. Two cultures of indigenous species of *Trichogramma* spp. (*T. chilonis, T. japonicum*) have been taken from the fields of Punjab, identified and are being maintained.

Trichogramma chilotraeae (♂): antenna



Trichogramma chilotraeae (♂): fore wing

Trichogramma chilotraeae (♂): genitalia

Biology of hispine bamboo borer- *Estigmena chinensis* Hope. (Coleoptera: Chrysomelidae) damaging green standing bamboo and its management

Collection of bamboo specimens damaged by *E. chinensis* was done in Timli, Jhajra, Thano, Choharpur Forest Range areas to find out periods of mature and immature stages and feeding pattern of adults and larvae. Young beetles eat the tissue of bamboo walls. Seven bamboo species viz- *Dendrocalamus longispathus, D. giganteus, D. asper, D. calostachyus, Bambusa wamin, B. tulda* and *B. multiplex* were found to be attacked for the first time by *E. chinensis*.

1 *E. chinensis;* 2&3
Feeding pattern of adult and larvae

Biological control of Eucalyptus Gall wasp, *Leptocybe invasa in Punjab*

Eucalyptus gall wasp, *Leptocybe invasa* (Hymenoptera: Eulophidae), an exotic insect of Aurtralian origin, devastats young eucalyptus plantaions. Biological control work using *Megastigmus viggianii* (Hymenoptera: Torymidae) to manage the pest population was started for which it was reared in the insecatry on *L. invsasa* galls and was released in gall infested eucalypus plantations in Hoshiarpur district.

Screening of Eucalyptus germplasm for disease resistance against *Cylindrocladium* leaf and seedling blight

The eucalyptus germplasm was screened for disease resistance against *Cylindrocladium quinqueseptatum*. Leaf and Twig Blight (L&TB) disease resistance was recorded on different germplasm inoculated with different pathogen isolates and their resistance / susceptibility was tested. The DNA fingerprinting of Eucalyptus germplasm was done using RAPD primers and polymorphism recorded.

Development of molecular diagnostic kits for identification and early detection of nursery and plantation pathogens of Eucalyptus

For the amplification of nrDNA, different isolates of pathogen *Pestalotiopsis* sp were isolated from diseased samples, pure cultured and multiplied. nrDNA amplification of different isolates of three more pathogenic fungal isolates were successfully done. After sequencing and primer designing, it will be extremely helpful in quickly authenticating the collected isolates.

Shisham mortality – Finding solutions for future plantations

Eight clones of *D. sissoo* have been performing well in the sick plot suggesting possibility of disease resistant clones against *F. solani* wilt disease. The new stem canker disease caused by *Lasiodiplodia theobromae* was found increasing at Malekan, Sirsa (Haryana) and Mansa (Punjab) from 13% to 18% up to last six months.

Anti-insect secondary metabolites from fungal endophytes of selected tree species

Fungal endophytes such as *Botryo* sps., *Phoma* sps; *Aspergillus flavus and Nigrospora sphaerica* species were extracted from age correlated young and mature leaves of teak and *Ailanthus* and spore suspensions made and evaluated for bioefficacy against the defoliators of teak and *Ailanthus*.

Biopesticide against papaya mealybug

The prospecting bioactive compounds from certain flora viz., *Vitex negundo, Aristalochia brachteata, Pongamia pinnata, Adathoda vasica* and *Melia dubia* could be seen to manage to contain the population and damage to papaya by papaya mealy bug in different districts of Tamil Nadu. Based on the promissory results obtained in the laboratory, the field bioassay studies were conducted at various concentrations to confirm the bioefficacy and to finalize the dose for the management of *P.marginatus*.

Contributory factor in the establishment of *Leptocybe invasa*

Survey was conducted in TAFCORN and TNPL Eucalyptus growing areas of the thirty eight clones and clones such as C10, C3, C7, C271, T61, C283, and KK5 were found infested with gall insect, *L. invasa*. Species in high altitude zone are free from gall insect. Survey on gall infestation in eucalyptus seedlings and IFGTB clones were made at IFGTB Central Nursery and Bharathiar University and observed no gall infestation. Locally produced seedlings were found to be more susceptible to gall insect incidence. During the survey, it was found that the density of eucalyptus gall was high during April-June.

Biological control of weeds

Study on the biology of newly prioritized Green colour leaf webber *Phycita* sp. B on cut foliage and live plants of prickly *Acacia* revealed that the total life span of the species was 30-38 days during the months of July to October. The species was observed to inflict considerable damage on the foliage of seedlings and saplings of *Vachellia (Acacia) nilotica* sp. *indica*. Host specificity study for four prioritized insect species was done on 9 more Australian Acacia species. Further, the host specificity tests by choice method was carried out for the prioritized species.

Influence of Eucalyptus species on the natural enemies incidence on the gall wasp *Leptocybe invasa*.

Parasites did not show variation in growth on different clones but preference in stage of galls for oviposition. Through electrophysiological studies, and analytical studies it was proved that both *L. invasa* and *Q. mendeli* use the same volatiles for the identification of host plants. Identified a mixture of compounds as attractants for *L. invasa*. The dispenser along with the delta trap gave satificatory results in multilocational trials in Karnataka and Tamil Nadu. The product and the process is being patented. Several important compounds were identified from *Croymbia citriodora* which can act as very good repellent for *L. invasa*.

Assessment of disease problems of selected fast growing indigenous tree species in Tamil Nadu

Pathological problems were enumerated in SFD nurseries in 20 different districts in Tamil Nadu and recorded foliar, stem and root diseases on important tree species caused by both fungi and bacteria. The study also highlighted that the level of secondary metabolites was high in uninfested leaf samples, as compared to seedlings affected by diseases in most of the nurseries. Hence, more in-depth studies are needed. Details

about method of preparation of fungicide solutions and its application were also provided for effective management of different disease problems in nurseries and young plantations.

Screening and evaluation of selected members for Rutaceae from Southern India for anti-malarial activity

The extracts of plants are evaluated and mosquito repellent property assessment completed at NIMR. LC 50 values have shown that some extracts of *Toddalia asiatica, Ruta graveloens* and *Zanthoxylum rhetsa* can be potential larvicides and mosquito repellents.

Development of botanical pesticidal formulations and demonstration of application in forest nurseries and plantations

Extensive work was carried out and a formulation by name "PESTILL" was developed using the weed *Lobelia nicotianeafolia* which was applied in field condition in some of the selected KFD nurseries in Sirsi and Mysore against some forest pests of teak plantation, where we recorded up to 50% mortality at 5% concentration of the formulation. In all the experiments, neem was used as control for comparison along with the additives as control. Results showed the weed, *Lobelia nicotianeafolia*, which is developed into a liquid formulation, could be recommended as insect pesticide along side neem products.

Population dynamics of pests and suitable control measures in selected silvi-horticultural models in Karnataka

Management of sap-suckers in sandal using Imidacloprid was effective in controlling the population followed by Chlorpyriphos and Metasystox. The use of plant product Nimbecidine indicated increase in nymphal population and recorded negative percent reduction (-26.59). The host plants of sandal viz. *Mangifera indica* and *Pongamia pinnata* shared many insect pests of sandal and considered not an ideal host of sandal. Three new stem borers, 1 seed borer, 5 defoliators, 2 pollen feeders, 9 parasites on coccids were all new records on sandal and the check list on sandal was updated. The important disease associated with sandal was the root rot of sandal saplings.

Microbial biosynthesis of polyhydroxy alkanoates (PHA) from wood waste

The main objective of the project was to obtain a bacterial strain which could synthesize polyhydroxy alkanoates (PHA). *Pseudomonas lignicola* was the only strain which was able to synthesize PHA, when compared to other bacterial strains.

Development of coccinellids based biocontrol programmes for the management of sandal scales and mealy bugs

Among the 20 species of coccinellids found breeding on scales and mealy bugs infesting sandalwood plantations, *Cryptolaemus montrouzieri* Mls and *Chilocorus nigrita* (Fabr.) were found more prevalent. Release of *C. montrouzieri* against *Nippaecoccus viridis* and *C. nigrita* against *Ceroplastes actiniformis* were found very effective.

Studies on hard substratum fauna in five major ports on the East Coast of India

Under this ongoing project, marine exposure trials at four major ports, i.e., Chennai, Tuticorin, Kolkata and Haldia were continued and observations were made on percent cover of fouling on the test panel surface, species recruited, sizes attained and biomass built up. Collected water samples were processed for analysis of hydrographical parameters; digital photographs of panels obtained and analyzed using *Photogrid* software. Species of wood borers were identified.

Bionomics and management of *Purpuricenus sanguinolentus* Oliver (Cerambycidae: Coleoptera) the stem borer of Sandal (*Santalum album* L.) in Karnataka (2012-2015) Funding Agency: DST

Roving survey conducted in nine districts of Karnataka covering naturally growing and plantations of sandalwood revealed moderate level of infestation by *P. sanguinolentus* only in Jarackbandae in Bangalore while other wood borers viz., *Aristobia octofasciculata* and *Zeuzera coffeae* were found more prevalent on sandalwood in Mysore, Sagar, Shimoga, Hassan, Raichur, Gulburga and Tumkur districts. So far, four different types of hymenopteran parasitoids were collected and they were sent to experts for identification.

Biological control of insect pests of medicinal plants-*Abelmoschus moschatus, Gloriosa superba* and *Withania somnifera*

Larvae of *Anomis flava* feeding on leaves of *Abelmoschus moschatus*

Five insect pests on *A. moschatus, four* on *G. superba* and two on *W. somnifera* were identified from different localities in Madhya Pradesh, Chhattisgarh and Maharashtra. Seasonal history of key insect pests and sampling of natural enemies was also done. Two parasites *Ichneumon spp* and *Stermia sp.* were recorded on *P. gloriosae*. Experiments revealed that *B. thuringensis* 1% and combination of Bt + neem based Gronim 1% were most effective against *P. gloriosae* and *A. flava*. In another experiment predator *C. cornea* was found to be most effective for reduction of the larval population. Also, neem based Gronim 1% followed by Bt 1% was found most effective against *D. cingulatus*. One day training programme on "Insect pests of important medicinal plants and their biological control measures" was organized at CFRHRD on 19 December 2013 for SFD officials and farmers.

Standardization of management practices for tendu leaf gall forming insect and diseases (a sub project of 'Standardization of technique to enhance the quality and sustainable production of *Diospyros melanoxylon* leaves in Chhattisgarh')

Status of gall forming insect, *Trioza obsoleta* and foliar/leaf spot disease, *Pseudocercospora hellert* and *Pestolotiopsis versicolor* on, *Diospyros melanoxylon* (tendu) was monitored in nine different sites in Chhattisgarh. About 50-60% incidence of *T. obsoleta* was recorded. *P. versicolor* was major pathogen causing leaf blight in tendu. Field experiment to study the effect of different pruning periods against *T. obsoleta* / foliar diseases revealed that first pruning including control fire in first week of March (06.03.2013) was found to be most effective in less incidence of *T. obsoleta* and also increase the weight and leaf area.

Status of sal heartwood borer, *Hoplocerambyx spinicornis* Newman and its management

In the study to monitor sal borer incidences in Dindori Forest Division, North Balaghat Forest Division, and East Mandla Forest Division in MP,

39554 sal trees were marked under different categories of borer attack. Recorded ant as a predator found feeding on grubs of borer inside the sal tree. Carried out 'Trap Tree Operation' for management of sal borer beetles in Dindori Forest

Infestation of Sal heart wood borer. A- Sal borer affected tree of T, category, B-Sal borer grub in heart wood of tree, C-Sal borer grub.

Division. Examined borer incidences and facilitated subsequent management of sal borer. Distributed leaflet on sal heartwood borer to front line staff and organised training.

Eco-friendly management of bark eating caterpillar, *Indarbela quadrinotata* on aonla (*Emblica officinalis*) in plantations

Study was conducted in TFRI, campus Jabalpur, Balaghat, Chhindwara, Research Extension circles on bark eating caterpillar, *Indarbela quadrinotata* in aonla plantations. Three entomopathogenic fungi were isolated and identified. Thirteen varieties were screened against *I. quadrinotata*. Observations and field experiments showed that crude extract of *C. collinus* + cow urine + vermiwash was most effective against I. *quadrinotata* in first trial. Solvent extract of C. collinus in petroleum ether was found most effective in second trial and application of fungal suspension of *Fusarium moniliformae* $1.5x10^{-4}$ was most effective against this pest in third trial.

Development of rearing technique for production of insect predator, *Canthecona furcellata*, as biocontrol agent for larval defoliators

Eggs, nymph and adult of C. *furcellata* was collected from nurseries and natural forests of teak, shisham, khamer, anjan and bamboo at various locations in M.P. Also surveyed teak SPA compartment no. 421 Range Rukhar and Dudhiya nursery, SFD nursery at various locations in Maharashtra, visited Entomology Division, Punjab Rao Deshukh Agriculture University, Nagpur and TFRI nurseries and plantations. Observations recorded on predation behavior and life cycle of *C. furcellata* on larvae of *E. machaeralis and Caveria sericia* at different temperatures regimes (20±1, 27±1 and 35±1°C) in the laboratory.

Studies on insect biocontrol agent, *Chrysoperla carnea* and its potentiality as insect predator

Periodical surveys were carried out in teak, sal and bamboo forests of Madhya Pradesh, Chhattisgarh and Maharashtra for collection of predator, *Chrysoperla carnea* and its habit and habitat were recorded, specimens identified and preserved in insect reference collection of Forest

Entomology Division, TFRI, Jabalpur and ZSI, Jabalpur. The rearing of this predator carried out on the respective host insects in the laboratory. An investigation on predation potential along with the detailed life cycle of the predator has been initiated. Further work is in progress.

Studies on the effect of introduction of honey bee on seed production of teak seed orchards

Selection of Teak Seed Orchards (TSOs) has been initiated for artificial establishment and further monitoring the bee hives, established artificially in these sites.

Biocontrol potential of native isolates of entomopathogenic nematodes, for management of insect pests of teak.

Maintained laboratory culture of EPN host waxmoth, *Gallerla mellonella and* native EPN isolates from central India and *H. indica, S. carpocapsae* (NABII populations). Determined and compared biocontrol potential of six native Steinernematid and Heterorhabditid EPN isolates against teak defoliator and skeletonizer. Results indicated that EPN 50, 56 and 57 were infective at above 10 IJs/ Larvae dose in laboratory. Field experiments carried out with individual and combination of EPNs with insecticides proved that EPNs were tolerant to insecticides and can be combined with desired concentration of insecticides for spraying in field on seedlings.

Evaluation of non edible oil seeds for development of surfactants and their utilization in pest management

Seed biochemicals from *Pongamia pinnata, Schletochera oleosa, Jatropha curcas* and *Sapindus mukrossi* were isolated and modified. Amide formation was standardized at different temperature and free amine content was estimated. The properties of surfactants at different dilution, the phytotoxicity, and pesticidal activities of product formulations were assessed against forest insect pest of *Tectona grandis* and *Albizia* spp. i.e. *Eutectona machealaris* and *Spirama retorta, Heliothis armigera* and fungicidal activities against wood decaying fungi.

Potential pathogens and insects responsible for the low seed production in teak seed orchards and their management

Spermoplane micro flora of Teak seeds was recorded in the inflorescence, immature and mature stages of fruits, wherein, it was seen that *Fusarium* sp. systemic infection during seed setting and seed boring insects like *Pagyda salvalis, Dichocrosis punctiferalis and D. pendamalis*, caused less fruiting in TSO's and SPA's. One field experiment, using biopesticides, insecticides, fungicide, trace elements and growth hormone applied in 16 years old TSO in Nandigram Seoni, M.P. showed that application of Monocrotophos (0.05%) + Bavistin (0.02%) in

Spraying in teak seed orchard for enhanced seed production at Nandigram, Seoni, MP

Comparative seed yield in different treatments

the month of July and 2nd dose during 1st week of August could enhance fruit productivity in TSO's.

Biological control of teak leaf skeletonizer *Eutectona machseralis*

Studies in Choral Range of Indore Forest Division, where large scale epidemic defoliation of leaf skeletonizer in teak forests was observed, showed that release of biocontrol agent, *T. raoi*, @ 1.25 lakh ha^{-1}, effectively reduced the larval, pupal and adult population of teak leaf skeletonizer in TFRI Tricho cards released sites of teak forests, demonstrating the potentiality of egg parasitoid, *Trichogramma raoi*, as biocontrol agent for management of teak pest.

Studies on the incidence and management of Pine mortality in Manipur

An experiment laid out in the most affected area i.e., at Ukhrul, Manipur to study mortality of Khasi pine using three fungicides and two biocontrol agents i.e., *Trichoderma viridi* and *T harzianum* revealed that Carbendazim (Trade name-Zoom) was most effective fungicide in checking further spread of the disease

Studies on the economically important diseases of medicinal and aromatic plants of Assam to develop management practices through organic approach

Plant pathogens causing leaf spots, leaf blight, anthracnose, damping off and tip blight in medicinal plants at Rani Nursery, RFRI and North Eastern Development Finance Corporation Ltd (NEDFi) in Guwahati and nearby areas were isolated, identified and pure cultures were maintained. Isolated *Trichoderma* sp. was found effective against *Curvularia andropogonis* in dual culture and field testing. A new leaf necrotic disease of *Curculigo orchoides* was observed.

A new leaf necrotic disease of *C. orchoides*

Studies on seed insect pests of indigenous and exotic forest tree species and to develop IPM package for major insect damages in Gujarat

Studies on fluctuation in seasonal population of important seed pests were carried out. For the IPM studies, two experiments have been laid down at Basan Research Centre, Gandhinagar of Gujarat Forest Department to test the efficacy of various containers for seed storage on seeds of *Acacia nilotica*, *Prosopis cineraria* and *Ailanthus excelsa* showing least infestation in tin containers. Another experiment was conducted to test the efficacy of various botanicals against the insect pests of stored seeds. Out of these, three botanicals were found effective viz;. Rockon, Weapon and Ryder.

Biology and Management of Insect pests of seeds of *Juniperus polycarpos* C. Koch and evaluating the Insectpests resistance perfo-rmance in nursery

Trials were initiated with neem based pesticides, safer chemicals to analyze the control of insect pests during storage in berries of Juniper collected from Lahaul and Kinnar, Himachal Pradesh. Extracted larvae were kept separately for detailed observations. Nursery trials of the healthy, infected and treated seed were taken up to study the impact of insect- pests in developing nursery stock.

1.&2. Larvae & Pupae of infected berries
3. Adult emergence 4. Pupae

Biological Control of *Thysanoplusia orichalcea* (F.) (Lepidoptera: Noctuidae): A potential insect-pest of *Saussurea costus* in northwestern Himalayas and extension of protection technology to local communities

Surveys in this ongoing project were conducted in Chenab and Lahaul Valleys for identification of the sites and collection of base line information of *Saussurea costus* (Kuth). Nursery established and trials laid in 10 beds of the size 10 m^2 each at Bruhandhar, Manali to raise the planting stock of the species for subsequent experimentation. Efforts were made to record the incidences of *T. orichalcea* on other alternative host around Shimla and in the nursery conditions as well.

Survey and identification of insect pest associated with *Dalbergia sissoo, Gmelina arborea and Shorea robusta* of eastern states of India

Collection of insect pest stages and plant samples of *D.sissoo, G.arborea* and *S.robusta,* their observations were done. The identification of the insects is completed.

Treerich Biobooster: A novel approach to synergise growth and pest management

About twelve treatments of bioinoculants along with coir pith and vermiculite as base material were prepared to study the effect of mixture along with biomanure on growth of casuarina and eucalyptus. FYM, effluent compost, vermicompost, and green manure along with vermiculite and coir pith as base material were prepared for making pellet, Treerich Biobooster. The growth performance was found to be significant from 30 to 60 days after treatment which reduced the use of chemical fertilizers. The combined effect of bioinoculants with organic biocompost significantly increased the germination percentage, survivability and biomass yield. Hence, the organic biocompost product, *Growth Promoting Treerich Biobooster* may be considered as a potential potting media as an alternative to conventional potting mix for production of healthy quality planting stock of Casuarinas.

2.7 Pulp and Paper

Evaluation of *Sesbania grandiflora* and *Lannea coromandelica* for paper making

Bleaching of craft pulp of *Lannea coromandelica* with targeted kappa number 25.00 was done using conventional CEHH and eco friendly DEpD sequences. The effluent analysis of each stage of bleaching was carried out and results indicated that eco friendly bleaching sequence DEpD produces less pollution load. In experiments, it was seen that eco friendly DEpD bleaching sequence resulted in paper with much better physical strength properties. The blending of bleached chemical pulp of bamboo (5-15%) with bleached pulps both by CEHH and DEpD bleaching sequence further improved the physical strength properties. The project was completed with the recommendation that *Sesbania grandiflora* was suitable for making strong craft paper and *Lannea coromandelica* is suitable for making bleached grade writing and printing paper.

Chemical derivatization of α-Cellulose into value added products

New route has been developed for synthesis of value added product of cellulose. The standardization of etherification/ esterification / protection/ and deprotection protocol of alkali or pre-dissolved cellulose or cellulose derivatives

were carried out with respect to temperature, concentration, reaction (pH) and nature of alkalizing agents.

Evaluation on phyto-polymers as eco-friendly bioadhesives

Starch and crude protein were isolated from *S. robusta, J. curcus, M. indica, C. aungustifolia* and *P. acularis* for the preparation of bioadhesives by alkali and acid hydrolysis at different concentration and its effect on adhesive properties were evaluated. Water holding capacity of *M. indica* and *A.companulatus* was determined. Adhesiveness, drying time and effect of storage was assessed on different adhesives. The pH and viscosity of protein adhesives were increased after storage. Similarly, effect of quantity of different additives were also assessed.

2.8 Bio oils and Biodiesel

Study on the effect of microwave assisted heating and seed storage conditions on quality of *Pongamia pinnata* (L.) seed oil for cost effective production of biodiesel

Cleaned seeds were irradiated to microwave for different time and stored at different storage temperatures. The oil from the seeds (treated and untreated) was extracted to estimate the initial physical and chemical properties of the treated and control oil sample. Periodic assessment of viability of stored seeds by germination was carried out along with biodiesel production from different acid value oil and assessment of yield and quality of biodiesel.

Production of synthetic biodiesel from wood wastes

Physical properties of biomass wastes collected from AWTC were measured, calorific value determined and proximate analysis done. TGA analysis was done for bamboo and wood wastes. Saw dust pellets were used to produce the producer gas and it was cleaned and tested in GC. Tar cracker was used to increase the production of CO gas production. Required producer gas for FT reaction was filled in the 500 litre cylinder at 30 bars. Yield of reactant was not in appreciable level due to more concentration of CO2 and other pollutants.

Refining of process for detoxification studies of Jatropha seed oil

The oil extracted from the seeds of *Jatropha curcus* was fractionated using different techniques for the removal of phorbol. Laboratory analysis by TLC showed that the phorbol can be removed using a simple method.

Evaluation of *Santalum album* grown in plateau area of Uttar Pradesh adjoining Madhya Pradesh and Uttarakhand for yield, quality and composition of essential oil

For the first time *S. album* trees were infected by fungi for better yield of oil and also for improvement in oil quality. Samples of heart wood of sandal wood which were infected by fungi were extracted using organic solvents.

Field evaluation of superior accessions of *Jatropha curcas* under micro-mission programme in Himachal Pradesh

Evaluations of superior accessions of *Jatropha curcas* were undertaken in Bilaspur and Kangra district of Himachal Pradesh wherein, the plantation established at Jawalaji, in Kangra district, showed comparatively better results for its growth and seeds parameter. Various fruit and seed parameters were measured, analysed and compiled.

Building upon the above observations,

Half-eib Jatropha plantation at Shri Jawalaji

Fruiting in half-sib trial of Jatropha

maintained the trials at Jawalaji, distt. Kangra recording growth, survival, fruiting and flowering data. Various parameters pertaining to physic-chemical characteristic of soil analyzed and a detailed technical report prepared.

Establishment of multilocational trials of 100 superior accessions of *Jatropha curcas* under the network programme of DBT

A multilocational trial, comprising of 100 superior accessions of *Jatropha curcas* was established in July-August 2010 at GRC, Jabalpur. The trail in experimental field of 400 equal sized plots and 9 plants per plot at 3m x 3m was performing well with more than 78% survival. Regular observations on various growth attributes were recorded and data sent to Biotech Park, Lucknow for compilation.

3. Biodiversity Conservation and Ecological Security

Biodiversity is the variety of life on earth and, a steady stream of ecosystem services supported and maintained by it is essentially required for the ultimate benefit of human welfare and survival. ICFRE is actively engaged in a variety of activities in the area of biodiversity conservation and ecological security including participation in national and international workshops, meetings, symposia, seminars etc, observing International Biodiversity Day, capacity building through trainings, awareness and extension programmes on biodiversity and its conservation, organizing seminars/workshops on biodiversity related issues, publication of biodiversity related books/ brochures, etc.

3.1 Biodiversity Conservation

Studies on Taxonomy of the Family Eulophidae (Hymenoptera: Chalcidoidea) present in National Forest Insect Collection (NFIC) except Doon Valley.

NFIC holds a lot of unidentified parasitoid fauna reared from various forest insect pests and general sweep collection both in dry and wet conditions. Alcohol preserved collections were sorted out for eulophids. In the present work, wet collections from Uttarakhand, Punjab and Karnataka were studied. Specimens were air dried and card mounted; taxonomically important parts of specimens like antenna and wings were dissected and permanently slide mounted in Canada balsam. Identification work on species collected from Sitabani (Ram Nagar) and Mandal localities in Uttarakhand was carried out and following species identified as *Aprostocetus spp. Pediobius* spp., *Tetrastichus tunicus* and *Tetrastichus spp.* From Punjab, parasitic eulophid material was identified as *Diglyphus* sp.1 and *Diglyphus* sp. 2. Identified new species of *Aroplectrus* collected from Karanataka and its antenna and wings were mounted on a slide. Its head, thorax, propodeum, wings and antenna were photographed for taxonomic details, using automontage imaging system.

Parasitic Hymenoptera collected from the tree canopy of *Vateria indica*, preserved in alcohol was air dried and 30 specimens of Eulophidae were card mounted and labelled. Ten Eulophid species collected from Tamil Naidu were also card mounted and identified as *Elachertus* spp, *Tetrastichus* sp., *Pediobius elasmi*, *Pediobius* sp.1, *Pediobius* sp. 2, *Platyplectrus* sp., *Aroplectrus* sp., *Euderus* sp. and *Aprostocetus* spp. Following 39 holotypes and paratypes of Eulophidae were studied at Western Ghat Regional Station of Zoological Survey of India, Calicut, Kerala: *Elachertus adimalicus, E. malabaricus, E. lanotus, E. nedumbassericus, E. kashmiricus, E. propodiatus, E. dericus, E. kainophanestus, E. nuperus, E. jurus, Euplectrus stoms, E. umbrocaxatus, E. yaloticus, E. zammoorini, E. mangericus, Cirrosplilus acadius, C. abalus, C. brevicorpus, Notanisomorphella manjaerica, Pnigalio anoti, Platyplectrus baricus, P. ericatus, P. daricus, P. nilumburicus, Hemiptarsenus orizae, H. banati, H. aditu, Sympiesis acicus, S. kazmii, S. hiplopsis. Aroplectrus contheylae, Deutereulophus tunctatus, Diglyphomorphomyia ebifurcata, D. kairali, D. sholayarica, D. plodica, D. scolofronta, D. nexius* and *D. sringeriensis.*

Studies on Taxonomy of the Family Encyrtidae (Hymenoptera: Chalcidoidea) present in National Forest Insect Collection (NFIC) except Doon Valley

Described a new genus and three new species of Encyrtidae: The new genus *Noyesencyrtus* was compared with *Acerphagoides* and found different from it. It was also compared with the identified material of *Zaommoencyrtus submicans* obtained on loan from Natural History Museum, London and was found different from it. *Noyesencyrtus brachyoculus* was the type species of this new genus. Another species, new to the science, *Psyllaephagus kundapurensis*, was compared with *P. Mesohomotomae* Singh and found to be completely different species. Third species, *Ooencyrtus hayatii* sp. nov. was

compared with closely related species *O. macula* and *O. nanus* and was found different from both. Following species of encyrtids identified: *Blepyrus insularis*, *Trechnites aligarhnsis*, *Syrphophagus* sp., *Leptomastix* sp. and *Encyrtus* sp. from the collection from Tamil Nadu; *Psyllaephagus garuga*, *Psyllaephagus phacopteron*, *Trechnites aligarhensis* and *Metaphycus zabratus* from Uttarakhand *Psyllaephagus virdis*, *Syrphophagus aeruginorum* and *Copidosoma* sp. collected from Punjab *Psyllaephagus virdis* was a new record from India. They were dried, card and permanent slide mounted. Their photographs were also taken with automontage system.

Studies on thrips of forest and medicinal plants, problems caused by them and their management in Uttarakhand.

Survey of thrips was carried out from Gwaldam, Bageshwar, Karanprayag, Gaucher, Herbal Garden (Muni ki Reti), Rishikesh, Forests of Thano, Timali and Karvapani, Chiriyapur Nursery, Kalsi Nursery, Yamkeshwar (Pauri Garhwal), NWFP nursery and Botanical Garden F. R. I. Campus.

Thrips of forest tree species and medicinal plants were collected from various nurseries and forest plantations of upper, middle and lower Himalayas including Shivalik range of Uttarakhand. *Gynaikothrips uzeli* was collected from *Schefflera actinophylla; Scirotothrips dorsalis* and *Thrips tabaci* from *Plumbago zeylanica* (Chitrak); *Thrips flavus* from *Ocimum sanctum; Mycterothrips ravidus* from Eucalyptus galls; *Thrips tabaci* from *Terminalia chebula; Haplothrips gowdeyi* and *Scirtothrips dorsalis* from *Aloe barbadensis. Lefryothrips lefroyi*, from *Tagetes erecta. Anaphothrips flavicinctus* from *Perilla frutescens. Taeniothrips major* from *Murraya koenigii* and *Ecacanthothrips sanguineus* from *Pterospermum acerifolium. Scirtothrips dorsalis* and *Hoplothrips gowdeyi* were collected from *Aloe barbadensis*, *Ginaikothrips uzeli* was collected from *Schefflera actinophylla* (Umbrella plant), *Scirtothrips dorsalis & Thrips tabaci* from *Plumbago zeylanica* (Chitrak), *Anaphothrips flavicinctus* (Karny) from *Perilla frutescens* (Bhanjeera), *Thrips tabaci* was carried out on *Terminalia chebula*, *Mycterothrips ruvidus* was collected on Eucalyptus galls. Identification of thrips collected from the host plants, *Rhus cotinus*, *Calendula officinalis*, *Occimum sanctum*, *Mimosa pudica*, *Calendula officinalis*. *Artemisia roxburghiana*, *Sida cordifolia*, *Pogostemon*, *Nerium indicum* and *Terminalia arjuna* is in progress.

Anaphothrips flavicinctus

Digitization of the type material (E-typing) present in National Forest Insect Collection, F.R.I., Dehradun, using Auto -Montage 3-D imaging system.

NFIC currently comprises about 1800 type species of different orders. Faisal *et al.* (2013) have documented buprestid type collections deposited in NFIC. Type collection of two other families, Carabidae and Cleridae, have also been updated and documented by Faisal & Singh (2014) and Faisal *et al.* (2014), respectively. Original descriptions of type species present in NFIC were collected from different sources including books, journals and monographs. The information that was available in the hard copy was first digitized using a scanner and then converted into PDF format and entered digitally into the database which was developed in windows application.

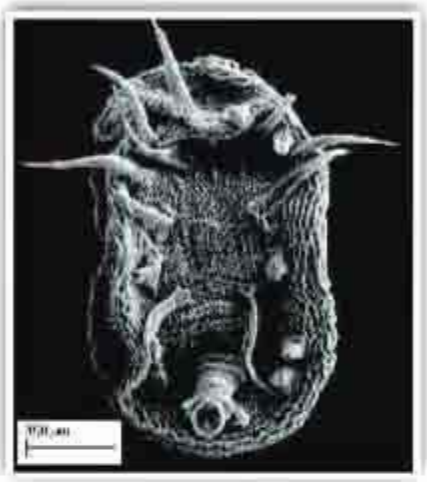
The various records of type specimens have also been entered into the database which

includes many relevant information such as name of species, its accession number, collection data, holotype/ paratype, male/ female, taxonomic position, hosts, collector, identifier etc, which were earlier hand written in various records like accession register record, index cards etc. The information on scientific name of the specimen, collection locality, collection date, collector name(s), etc given for each species was taken from original hand written labels and where ever necessary, corrected with original description or published articles. The digital photographs of type specimen were taken by Automontage 3-D imaging system mounted on Olympus SZX-16 stereozoom microscope. The pictures of these associated handwritten data labels of specimens have also been captured with the help of digital camera.

Morphological taxonomy of the family Aleyrodidae Westwood (Hemipters: Sternorrhyncha) of India: revisions of the genera and species.-

A total of 120 plants infested with whitefly puparia were collected from natural forests of Uttar Pradesh and Uttarakhand. A total of 468 permanent mounts of whitefly pupria were prepared and remaining 45 samples were preserved in 80% ethanol and 10 on dry leaves. Three pest species i.e. *Aleurodicus dispersus* Russell, *Aleurolobus barodensis* (Maskell) and *Bemisia tabaci* (Gennadius) and adults (71 males, 18 females) of *Singhiella bicolor* (Singh) were also mounted. Thus twenty one species of whiteflies belonging to 13 genera were identified.

The genus, *Acanthaleyrodes* Takahashi was reported for the first time from India. A new species of the genus *Acanthaleyrodes* infesting *Bridelia retusa* has been described. The holotypes of 24 species of 8 genera, and 116 microscopic slides bearing unidentified whiteflies were taken on loan from NPC, New Delhi. Of these, one new species of the genus *Tetraleurodes* was described. Holotype was designated for *Dialeurolonga ficl* David and Subramaniam. The type specimens (50 holotypes and 3 paratypes) of 51 species of the genera *Acanthaleyrodes* Takahashi, *Aleuroclava*



Scanning electron micrograph of ventral side of whitefly pupa, *Acanthaleyrodes* sp., found infesting leaves of *Bridelia retusa*

Singh and *Tetraleurodes* Cockerell were examined which include 16 species from National Forest Insect Collection - Forest Research Institute, Dehradun and 33 species from National Pusa Collection, IARI, New Delhi. A total of 223 Camera Lucida drawings of 51 species were made, which includes 51 major and 172 minor drawings of important taxonomic characters and a total of 230 microphotographs of 51 species were taken. In addition four species were taken on loan from Animal and Plant, Quarantine Agency, South Korea and 8 species from the Natural History Museum, London.

SEM studies have been carried out for eight species and their microphotographs taken. The studied species were: *Acanthaleyrodes* sp and *Crescentaleyrodes semilunaris* (Corbett), *Aleuroclava murrayae* (Singh), *Dialeuropora decempuncta* (Quaintance & Baker), *Viennotaleyrodes megapapillae* (Singh), two species of genus *Aleuroclava* and *Trialeurodes vaporariorum* (Westwood). Microphotographs of biological stages have been taken for two pest species, *Neomaskellia bergii* and *Aleuroclava jasmini* (Singh).

Butterfly diversity in relation to landscape changes in the Walayar Valley, at Palakkad Gap in the Western Ghats

The diversity of butterflies was studied in Walayar Valley, covering different forest types /landscape elements occurring both in Kerala and part Tamil Nadu. The forest types covered in Kerala part included semi-evergreen forests, moist deciduous forests, dry deciduous forests, riparian forests and grasslands. Teak was the major forest plantation species available in Kerala part of the valley, which was also taken up for the study. In Tamil Nadu part, the forest types covered were dry deciduous forests and thorny scrub. Tamarind was the major forest plantation species raised in Tamil Nadu part of the valley. Two limestone mine areas located in the valley within the forest areas and agricultural landscapes available adjoining the forest areas were also studied.

About 65 species of butterflies were recorded from moist deciduous forests, 41 species from semi-evergreen forests, 49 species from dry deciduous forests, 28 species from riparian forests, 24 species from grasslands and 22 species from thorny scrub forests. The teak plantations raised in the forest areas and the agricultural areas located in the forest fringes were found to harbour a good number (over 45) of species, while the Tamarind plantations contained about 35 species. The mined out areas were found to be very poor in butterfly diversity. Altogether, about 110 species of butterflies were recorded from the Walayar Valley. Occurrence of some of the endemic, rare and endangered species of butterflies like Malabar Tree Nymph (*Idea malabarica*), Southern birdwing (*Troides minos*), Malabar banded peacock (*Papilio budha*) and Great evening brown (*Melanitis phemida*) and several species included in the Schedules I & II of the Wildlife (Protection) Act 1972 in the study area, was very interesting.

Studies on the species diversity of whiteflies (Aleyrodidae: Homoptera) and their natural enemies in Mangrove habitats of India".

Surveys were conducted in mangrove habitats of south India viz., Muthupet (Tamil Nadu), Vypeen Island (Kerala), Udupi, Karwar and Honnawar (Karnataka), Coringa (Andhra Pradesh) Chorao (Goa) and Thane (Maharashtra). 11 species of mangrove plants were found infested with whiteflies. All the whiteflies were identified at the genus level. In addition, 20 species of coccinellids and 13 species of spiders were found feeding whiteflies in the mangrove habitats.

Ecological studies on the distribution patterns and food plant resources of butterflies along altitudinal gradients in different forest ecosystems of the Eastern Himalaya (Arunachal Pradesh)

Surveys were carried out in forest areas of Arunachal Pradesh covering Namdapha and Pakke Tiger Reserves and Dibang Valley district during the year and data were collected on 60 more species of butterflies. Database being prepared on 365 species of butterflies sampled

Field surveys being carried out in Namdapha Tiger Reserve (bottom) and the north-eastern endemic butterfly- the Jungle Glory, *Thaumantis diores* in Namdapha (top)

so far from different forest ecosystems in 13 districts of Arunachal Pradesh' and data for each species were being incorporated in the GIS platform at RFRI. As project extension component, a three days training programme was organized for Forest Officers of 6 North-Eastern states on "Identification, Ecological values of butterflies and potential of butterfly's inclusive ecotourism as a source of livelihood in north eastern India" from 3 to 5 March 2014. A poster entitled –'Butterflies of North-east India-Butterfly Inclusive Ecotourism', was prepared and published.

Genetic diversity of *Trichoderma* strains prevalent in Forest types of North Eastern India and Pure cultures of *Trichoderma* species isolated from different rhizosphere soil samples

Field tours to Mokokchung, Kohima and Meghalaya were conducted for the collection of rhizospheric and non rhizoshperic soil samples. A total of 150 soil samples were collected. Using soil dilution plate technique, *Trichoderma* strains were isolated. The isolated *Trichoderma* species

Pure cultures of *Trichoderma* species isolated from different rhizosphere soil samples

were identified as T. *asperellum* and *T. harzianum* on the basis of microscopic studies. Isolated *Trichoderma* species was found effective against *Curvularia* species. and *Fusarium* species. in dual culture and field testing.

Screening, identification and preparation of a comprehensive check- list of the Lepidopteron fauna of Sasan Gir National Park of Gujarat state

Periodical surveys (six) had been conducted in the Gir Wildlife Sanctuary (GWS) in order to collect samples of butterflies and moths in hundred five locations. Light trapping method was followed for moth collection in the thanas of GWS. The checklist of the lepidopteron fauna recorded and identified from Gir showed that Pieridae was the most dominant family, followed by Nymphalidae, Papilionidae, Lycaenidae and Hesperiidae in GWS. For the moth population, the most dominating family was Noctuidae, followed by Arctiidae, Geometridae, Sphingidae, Lymantridae, Limacodidae, Lasiocampidae, Hyblaeidae, Drepanidae, Uraniidae and Notodontidae. Identified 21 species of Nymphalidae, 34 species of Pieridae, 13 species of Lycaenidae, 14 species of Papilionidae, 5 species of Hesperiidae as butterfly fauna. Whereas, 13 species of Noctuidae, 9 species of Arctiidae, 7 species of Geometridae, 6 species of Sphingidae, two species each of Lymantridae and Limacodidae and, 1 species each of Lasiocampidae, Hyblaeidae, Drepanidae, Uraniidae, Notodontidae have been identified as moth species from different Gir Wildlife Sanctuary. The host range in the form of nectar plant species and larval food plants, preferred by the butterflies and moths have been identified in sixty numbers. The most common plant species being *Tridax procumbens, Celosia argentea* and *Lantana camara*. Besides, plants of family Fabaceae and Asclepiaceae were frequently visited by the butterflies. Screening and listing of most important rare and endangered species of lepidopteron fauna showed that *Castalius rosimon* was enlisted in Schedule-I, *Hypolimnas misippus* in Schedule-I and II and *Euploea core* in Schedule-IV of the Indian Wildlife Protection Act, 1972 (red data list). Influence of abiotic factors causing changes in natural population of butterflies and food habits studied. and found that monsoon to late winters was the preferred season for the lepidopteron fauna. The interaction of host-plant species, species abundance, richness

and evenness were calculated for each habitat with grassland habitat was found the best.

Appias nero galba
(Pieridae)

Junonia iphita
(Nymphalidae)

Celaenorrhinus annara
(Hesperiidae)

Zetides sarpedon teredon
(Papilionidae)

Tridrepana albonotata
(Drepanidae)

Hippotion boerhaviae
(Sphingidae)

Diversity of butterflies in Sasan Gir National Park of Gujarat

Study on grasses of Uttarakhand and Himachal Pradesh

Exploration-cum-collection tours were conducted to collect the grass specimens in the Kangra and Chamba Districts of Himachal Pradesh and Khirsu and Pauri in Uttarakhand. Ca. 250 grass specimens were collected from the visited areas. Identification of the collected specimens was in process. Some of the identified specimens prevalent in the study area were *Apluda mutica, Andropogon monticola, Arundinella benghalensis, A. nepalensis, Arundo donax, Avena fetua, Coix lacrym- jobi, Cymbopogon distans, Digitaria ciliaris, D. sanguinalis, D. stricta, Echinochloa colonum, E. crus-galli, E. procera, Eleucine compressa, Eragrostis nigra, E. tenella, E. unioloides, E. ciliansis, E. minor, E. trimula, Setaria sphacelata, S. viridis, S. glauca, Isachne albens, Poa pratensis, Pennisetum purpureum, Cenchrus ciliaris, Bromus unioloides, Paspalum flavidum, Thysoleana maxima, Heteropogon contortus, Hemarthria altissima, Rottboellia cochinchinensis, Eleusine indica, Phalaris minor, Dactylis glomerata* etc. 250 herbarium specimens are prepared and others were in the process.

The study of biology and conservation of endemic plants of Kalakad Mundanthurai Tiger Reserve, Tamil Nadu

Intensive field surveys were carried out to locate five endemic species and to study their distributions, association, population and phenological status by repeated perambulation in the Kalakad Mundanthurai Tiger Reserve (KMTR), Tamil Nadu. Phenological observations, distribution and recording of plant associations for the species *Eugenia singampattiana, Phyllanthus singampattianus, Palaquium bourdillonii* and *Sonerilla kanyakumariana* were carried out. Only few individuals could be recorded in case of *Sonerilla kanyakumariana* in KMTR. Vegetative propagation and seed germination trials were also conducted and among the species tried, only *Phyllanthus singampattiana* showed successful rate for root formation. Seed germination trials were conducted repeatedly but no encouraging results obtained for any of the species tried. Soil samples were collected and analyzed for various physical and chemical properties in addition to phytosociological analysis of the associated species.

Impact of Forest plantation on ground flora diversity under soil characteristics including the prescription of management practices

Enumerated ground flora diversity in two teak plantations in Sadivayal, collected soil samples and analyzed them for soil micro flora and fauna soil properties. Analyzed the data ground flora

from all the plantations for phytosociological parameters. A total of 47 species were enumerated under different categories such as herbs, shrubs and tree regeneration. *Oplismenus compositus* was the dominant herb species found under the category. Teak plantations in Sadivayal and Nilambur supported good number of ground flora with more than 60% of them having good medicinal values. The study indicated that if the ground flora and regeneration under plantation were managed properly, it could be converted into ploly-crop stand especially in protected areas for environmental services.

Structure, diversity and regeneration studies in permanent preservation plots in moist deciduous and evergreen forests of Western Ghats in Karnataka

This study was undertaken to throw some light on structure, diversity and regeneration status in permanent preservation plots of tropical Wet Evergreen Forests in Ketlekan, Uttar Kannada district and in moist deciduous forests of Western Ghats in Karnataka in Karka, Bhagavati, and Kuligi in Dharward and Belgaum districts. Secondary data in PPP records of these five sites was utilized as baseline data and past data on history and management. Parameters related to structure, diversity and regeneration were quantified. Each plot (between 3.0 and 3.7 ha. in size) was completely enumerated. Later, secondary data recorded since 1936 at periodical intervals, were collated and compared. Trends revealed considerable changes in tree density, basal area and girth increment. There were discernible and unique changes in the diversity as revealed by various indices such as Species richness, Shannon's index, Evenness index, Similarity index and species composition. Dominance relationship between species, with respect to density and basal area, also changed within this time frame. Constraints in the establishment of regenerates at pole stage in some species were noticed. Overall changes in species composition, over the past 75 years could not be attributed to normal vegetational succession trends alone. If these trends truly reflect the current status of forests in Western Ghats, it could well be a cause for concern.

Investigation on floristic diversity in teak plantation of various age groups in Barnawapara Project division, Raipur, Chhattisgarh.

Plantations promote understory regeneration by shading out grasses and other light demanding species, changing under storey microclimates, improving soil properties and increasing vegetation structural complexity. Studies were carried out to determine the changes in plant diversity and soil properties in teak plantations of different ages. Phyto-sociological studies were undertaken in teak plantations by laying out quadrats in 25 compartments of Rawan, Raikera and Sirpur Range of Barnawapara Project Division, Raipur Chhattisgarh. 48 trees, 12 shrubs and 36 species of herbs were recorded from these plantations.

The results indicated species richness and diversity in tree layer of the plantations increasing with the age of plantations. The dominant trees of Rawan range were *Tectona grandis, Lagerstroemia parviflora, Cleistanthus collinus, Terminalia tomentosa, Buchanania lanzan, Pterocarpus marsupium, Madhuca indica, Diospyros melanoxylon, Anogeissus latifolia, Bridelia retusa, Semecarpus anacardium, Schleichera oleosa, Lannea coromandelica, Terminalia bellerica, Careya arborea, Cassia fistula, Grewia tiliifolia, Ziziphus xylopyra* and *Bauhinia pururea.* In Raikera Range, dominant tree species were *Tectona grandis, Largerstroemia parviflora, Anogeissus latifolia, Diospyros melanoxylon, Cleistanthus collinus, Madhuca indica, Chloroxylon swietenia, Lannea coromandelica* and *Wrightia tinctoria.* In Sirpur Range, dominant species were *Tectona grandis, Chloroxylon swietenia, Largerstroemia parviflora, Terminalia tomentosa, Anogeissus latifolia, Madhuca indica, Cliestanthus collinus, Gardenia latifolia* and *Bridelia retusa*

Species richness and diversity in herb layer was found to be higher in younger plantations. Physico-chemical properties of soil showed no significant changes under different aged plantations, This completed project is under writing.

Team at work in Barnwapara Forest Division

Teak plantation with under growth in Barnwapara

Monitoring the impact of Climate variables on plant diversity in Bhimashankar permanent plot of Sub-tropical Hill Forest of Maharashtra

One of the goals of the ecology is to study the succession in the forest community and predict future trends. Permanent preservation plots provide such an opportunity. Studies were therefore conducted on vegetation parameters in Bhimashankar permanent preservation plot of Sub-tropical Hill Forest of Maharashtra. Enumeration of vegetation was carried out in three permanent preservation plots. 30 quadrats of 20x20 m by laying. 120 quadrats of 5mx5m size were laid out for the study of shrubs and saplings along with invasive species and 120 quadrats of 1m x 1m for herbs and grasses.

Lasiosiphon eriocephalus

Maytenus rothiana

Callicarpa tomentosa

Xantolis tomentosa

Prominent flora found in compartment 200A of Bhimashankar

Vegetation change matrix, determining temporal change in the structure and composition of the vegetation in preservation plots of Bhimashankar was prepared. 14 new species (with no historical record) were recorded from the preservation plots. Regeneration status of dominant trees was determined using size class distribution curves. Based on the study, succession trend and future trends in vegetation pattern of the preservation plot was determined. The completed project is under the process of writing.

Impact of *Prosopis juliflora* on biodiversity, rehabilitation of degraded community lands and source of livelihood for people Rajasthan

Extensive studies were carried out in Bhilwara, Dholpur, Jhalawar, Jodhpur, Kota, Rajsamand and Sawai-madhopur districts of Rajasthan to study the impact of *P. juliflora* on biodiversity, rehabilitation of degraded lands and source of livelihood. 42 exotic & indigenous floral diversity found associated with *P. juliflora*. Thirty five species of invertebrates including, seed bruchids were found feeding on *P. juliflora*. Eighty two species of vertebrates were also found associated and dependent on *P. juliflora*. The main utilization of *P. juliflora* in the region as fuel wood & for bio-fencing. Pods are utilized by herbivores as food. Leaves were eaten by Hanuman Langurs. The trees utilized by aves including 29 species of raptors for perching. Studies on plant species revealed that both exotic as well as indigenous tree species were growing in the areas of *P. juliflora*. Some of the important tree species documented were; *Acacia nilotica*, *Albizzia lebbeck*, *Azadirachta indica*, *Anogeissus pendula*., *Butea monosperma*, *Dalbergia sissoo*, *Ficus bengalensis*, *Prosopis cineraria*, *Salvadora* spp., *Acacia tortilis* and *Leuceana leucopholea*.

Avian species using *P. juliflora* for perching

Prosopis juliflora as a source of fuel wood

Ecological and economical (source of firewood) uses of *Prosopis juliflora*

Documentation of sacred groves of Rajasthan and assessment of biological diversity in some of them for improved management and people's livelihoods

Sacred groves (Oran in western Rajasthan) are scattered and do not enjoy protection via a federal legislation. While these lands have not even been declared as forest lands, effective legislation can not be applied in the case of offenders. Developmental activities and encroachments affects community forests. In view of the above, this project has been taken up: (i) to document and assess floral diversity of the important 'sacred groves' in different districts of Rajasthan; (ii) to identify and record faunal diversity countered in the above-mentioned 'sacred groves'; and (iii) to suggest suitable management strategies to increase, diversity and productivity for improved local benefits and climate change adaptation.

A total 118 sacred groves throughout Rajasthan (all districts) were surveyed and their plant and animal diversities recorded. In addition, people's perceptions was also recorded about the

problem and to act up on it. Calculation of diversity variables and Importance Value Index (IVI) indicates that these sacred groves represent varying subgroup of forests. Some of them were not even available in forests. *Salvadora oleoides, Capparis decidua, Anogeisus serecea, Acacia leucophloea, Prosopis cineraria, Ziziphus* spp. were dominating in arid areas, whereas, *Tectona grandis, Anogeissus pendula, Acacia nilotica, Holopetelia integrifolia, Phoenix sysvestris* were dominating in semi-arid regions. Some of the sacred groves were of mixed vegetation category like; *Acacia nilotica* and *P.cineraria* or *Holoptelia integrifolia*; whereas, others were of pure patch of single species like *Anogeisus pendula* in districts covering Aravalli. A combination of *S.oleoides, Azadirachta indica, Acacia leucophloea* and *P. cineraria* spp. was also observed in Alwar district.

Some of the sacred groves were important habitats even for the birds and wildlife. For example, at village Kala kho (Kalu Das Ji ki Dungari) in Dausa districts, *Anogeissus pendula* was the dominant species. Its over aged trees facing towards up hills have developed cracks. Other interesting observation was availability of large population of parakeets with their nest/ burrow in more than 80% of the trees (burrow ranging from 1- 4 in numbers). Lots of threats are there putting pressures on these valuable common resources that needs effective management with people participation.

Anogeisus pendula sacred grove covering a hill in Dausa

Anogiessus pendula-Dear Devi Oran, Kota

Acacia nilatica species in Alwar

Taxonomy and Molecular Analysis (through RAPD-PCR) of moths (Lepidoptera) of Cold Deserts (Spiti and Leh) of Indian Himalayas

After finalization of the sites for collection of identified faunal elements at Keylong, Pooh, Tabo, Kaza and Leh, necessary ecological observations were recorded and moths were collected, stretched and stored for permanent preservation. Some duplicate specimens were also kept at -20°C for RAPD-PCR study. Morphological study of moths was carried out for their taxonomy and identification.

During the year, remaining data, collected in the past were analyzed including wing preparation. Genitalia of 25 species was also carried out in the laboratory from the preserved

material. Species identified includes i. e. *Agrois ypsilon, G. operculella, Y. rorella, S. litura, Plusia orechalsea,* Diamond back moth, *Polyphaenis confecta , Helicoverpa armigera, Xestia C-nigrum, Ochropleuravallesioca.* RAPD-PCR analysis continued in the laboratory and 20 specimens of moths were treated for molecular analysis. Work on the PCR analysis of moths is in progress including new initiative of analyzing the moths of Cold Deserts for molecular characterization. All four sites i.e. Keylong, Pooh, Tabo, Kaza and Leh were visited for collection of moths. Data on vegetation & environmental factors were also collected. Moths has been collected and stretched and stored for permanent preservation. Some duplicate specimens have been kept at freezing temperature for PCR study.

It was found that all the three species showed the band variance when applied with OLA6 primer whereas, when applied with OLA7 only *Helicoverpa armigera* produced bands. The others did not produce the variance. The results reflects OLA6 as much better primer to carry out the RAPD-PCR studies.

Morphological studies of moths were carried out for taxonomy and identification of moths. A total of 170 specimens of moth (Lepidoptera) species were collected from various localities of cold deserts of Leh and Spiti. 10 species moths identified as *Agrotis ipsilon, G. operculella, Y. rorella, S. litura Plusia orechalsea,* Diamond back moth, *Polyphaenis confecta, Helicoverpa armigera, Xestia C-nigrum, Ochropleura-vallesioca.* All these species were identified taxonomically and a comparative data of the genetic variance established through RAPD –PCR.

Ecological diversity of Kawal Tiger Reserve in Andhra Pradesh-A benchmark study

Field tours for ecological monitoring of the project site was conducted along with tree inventory study and for preparing check list of flowering plants, grasses legume fodders and other fodder species. Similarly, direct and indirect evidence of macro fauna population was estimated using standard procedures which were identified. Photographic evidence of specimens collected was done wherever possible.

Networking Projects on Restoration and Reclamation on degraded site (Nodal:FRI)

Monitoring of the changes in flora and fauna in the Reserved Forest along the Thellavagu Nallah, Kothagudem, and A.P was undertaken.

Among tree species, *Pongamia pinnata* was the dominating plant species occurring in the study area with higher IVI. Other tree species found in the area were *Prosopis juliflora, Mimosa himalayana, Simarouba galuca, Syzygium cumini, Holoptelea integrifolia.* Among herbs, shrubs and trees *Aristida setacea, Waltheria indica, Hyptis suaveolens* were dominating in the study area. Various birds such as weaver birds, parrots, grey francholin, koyal, myna were observed during the entire part of the project period. Monkeys, monitor lizard (*Veranus* sp.), Butterflies (*Lepidopteran* sp.) were cited directly. The presence of wild boars was noticed through the symptoms of soil disturbance. The present study showed that, among the plant species, the number of herbaceous species, shrubs and trees had increased to indicate ecological improvement and increased plant diversity.

3.2 Forest Botany

Inventorization, characterization and conservation strategies of selected rare and endangered plant species of India

Rare and threatened species of Uttarakhand were selected for project. Species like, *Ilex pseudo-odorata, Catamixis baccharoides, Sophora mollis and Pittosporum eriocarpum* were studied. Herbarium was consulted to trace location of occurrence of above rare and threatened species. Extensive field survey was carried out in Mussoorie, Jhari Pani, Hathi Paon,

Rishi Kesh and adjoining areas, Rajaji National park etc. Belt transect method was used in the study. *Pittosporum eriocarpum* was found in the Jhari Pani and Hathipaon areas. Population of the species was very much less in the area and were found in the slopy terrain from where seeds of the plants were collected. *Ilex pseudo-odorata* was found in the Hathipaon, only 5 trees could be traced in whole Mussoorie and adjoining areas. *Sophora mollis* was found in the Sahastradhara area but the population was very less. Flowering was observed in the month of March. Seed and stem cutting of above species were collected and planted in polybags in the Botanical Garden for *ex-situ* conservation. Population structure and regeneration potential of *Indopiptadenia oudhensis* was carried out in Champawat Division of Uttarakhand and adjoining areas. Overall good regeneration was observed in the area.

3.3 Ecology & Environment

Ecological study of watershed in Mussoorie Hills (Dehradun)

The study was conducted in protected plantation, degraded plantation, degraded natural forests of Mussoorie area and protected natural forests during summer, rain and winter seasons to understand phytosociological attributes of herbaceous species. Grasses diversity was observed maximum in degraded landscapes. Degraded natural forest was burnt during June 2013 and, therefore, impacted herbaceous plants diversity *vis-a-vis* infiltration capacity. Microclimatic data showed more relative humidity (%) and less temperature (°C) under protected plantation and protected natural forest than that under open land data. For determination of soil moisture in all landscapes, soil samples from the depth of 0-30 cm and 30-60 cm were collected. Results revealed that soil moisture (%) under 0-30 cm depth, from all landscapes, except protected natural forest were more, than that under 30-60 cm depth whereas under protected natural forest it was vice-versa. Infiltration study under protected plantation, degraded plantation, degraded natural forest and protected natural forest were carried out during winter season. The rate of infiltration capacity was found in the order of protected natural forest> plantation> degraded natural forest> degraded plantations. Due to forest fire under degraded natural forest during summer, infiltration capacity, during winter got reduced manyfold in comparison to spring season. Hourly infiltration capacity revealed that in 1st hour, infiltration under protected natural forest was 39.17%, 563.58% and 219.80% more than in the protected plantation, degraded plantation and degraded natural forest, respectively whereas during 2nd hour it was 13.17%, 583.13% and 241.57% and during 3rd hour it was 21.67%, 610.98% and 259.67%. Results showed that during 3rd hour the infiltration capacity under protected natural forest was rapid in comparison to 2nd hour and than in the protected plantation, degraded plantation and degraded natural forest. Result also showed that protected natural forest was hydrologically more sound as compared to other forests.

Impact of human induced disturbances on regeneration and population structure of *Rhododendron arboreum* and *Myrica esculenta* in mid-hills of Garhwal Himalaya

Seed germination of *R. arboreum* and *M. esculenta* was recorded higher under open exposed sites than that under thick canopy cover in the field. Seeds of *Rhododendron arboreum* were collected from the field, and stored in laboratory to develop storage protocol. Seed viability of *R. arboreum* was found declining over the years from the date of seed collection. The germination percentage of *R.arboreum* was also found declining from 80-90% to 40-50% over the years from the date of collection /storage of seeds.

Identification of extent of forest lands in forest fringe villages

The major components of the projects were socio economic survey of the selected villages,

ecological survey of the forests area, data storage and interpretation. Therefore, the socio economic and ecological survey work in 10 districts of Tamil Nadu, one district in Kerala and one district in Andaman was done. The data of all the surveyed districts was entered in the Web portal. The draft report with respect to socio economic and ecological survey also has been prepared. As regards Kerala state, the survey has been initiated in three districts viz. Malappuram, Palakkad and Ernakulum. Ecological and socioeconomic reports for 12 districts have also been prepared and sent to FRI.

Study on beneficial microbial interaction with trees in heavy metal polluted sites in Tamil Nadu

Reclamation and rehabilitation of polluted sites is very much essential to save life on the earth. It is necessary to apply an integrated approach, involving suitable chemical and biological amendments such as plants and beneficial microbes, for the successful remediation of heavy metal contaminated soils. In the present study, attempts were made to investigate diversity status of different plant species occurring in and around different industries. Among different plants, the herbaceous plants were found very common in all the study sites, followed by shrub species. Among shrub species, *Calotropis gigantea, C. procera* and *Prosopis juliflora* were found in all the study locations. In tannery effluent treatment area at Dindugal, *Suaeda maritima* was found to grow well in the sludge and in the surrounding areas. Status of heavy metal elements was found high in non-rhizosphere soil samples rhizosphere ones in afforested site at Tirupur. Among different study locations, tannery effluent treatment site showed maximum amounts of heavy metals. In this study, total of 137 isolates of PGPRs and other heterotrophic bacteria were isolated from different polluted sites and maintained in the germplasm bank of IFGTB. PGPR isolates, producing highest growth hormone (IAA) and showing maximum phosphate solubilization were selected for molecular characterization. Genus and species level identification of different PGPR isolates was also done. The sequences of all these isolates were submitted to European Molecular Biology Laboratory (EMBL) and accession numbers obtained. Some of the PGPR isolates *viz., Achromobacter xylosoxidans, Micrococcus luteus, Bacillus subtilis, Azotobacter vinelandii* and *Azospirillum lipoferum* showed maximum production of IAA, ammonia, catalase, P solubilisation and heavy metal tolerant potential under *in-vitro* condition. Efficacy of all the selected PGPR and AM fungi on growth of tannery sludge samples in nursery was also studied. The results of the study indicated that seedlings treated with PGPRs and AM fungi had better growth performance as compared to uninoculated ones (control). The seedlings of *Callophylum inophyllum* and *Casuarina equisetifolia* withstood the presence of tannery sludge samples treated with PGPRs as compared to other tree species. Among different treatments, combined application of PGPRs and AM fungi treated seedlings in tannery sludge samples showed maximum plant growth and survival as compared to other treatments.

Population structure, regeneration status and pollination ecology of *Dalbergia latifolia* and *D. sissoides*

The population status of Dalbergias was assessed in Salem Forest Division (Tamil Nadu) and Nemmara Forest Division (Kerala). In Salem Forest Division, which is situated in the Eastern Ghats, *D. latifolia* alone was present, but, its population was very sparse, with poor height and diameter. The regeneration was also very scanty. The habitats of the species in this Eastern Ghats portion were more or less rocky slopes of the hills. In Nemmara Forest Division, which falls in the Western Ghats, both *Dalbergia latifolia* and *D. sissoides* were found together, in almost equal numbers. There was a preponderance of mature trees of higher girth classes in all the locations studied, with very less number of pole stages and saplings. The regeneration was found scanty.

Phenological studies of both the species were also conducted in the area.

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

Experimental trials established at four sites in Attapaddy Reserve Forests (Siruvani, Pudur and Thathengalam) and Silent Valley National Park buffer zone (Panthanthodu) with selected pioneer and canopy species as given in the table.

Wet site (Siruvani & Panthanthodu)	Moist site (Thathengalam)	Dry Site (Pudur)
Pioneer species		
Maesa indica	*Helicteres isora*	*Tarenna asiatica*
Macaranga peltata	*Macaranga peltata*	*Dodonaea viscosa*
Clerodendrum viscosum	*Clerodendrum viscosum*	*Clausena dentata*
Olea dioca	*Holarrhena pubescens*	*Mundulea sericea*
Syzygium cumini	*Glycosmis mauritiana*	*Glycosmis mauritiana*
Canopy species		
Palaquium ellipticum	*Terminalia bellirica*	*Holoptelia integrifolia*
Dimocarpus longan	*Haldina cordifolia*	*Azadiracta indica*
Mesua ferrea	*Gmelina arborea*	*Chloroxylon sweitinia*
Prunus ceylanica	*Xylea xylocarpa*	
Euodia lunu-ankenda	*Pterocarpus marsupium*	

Better survival of pioneer species, *Sysygium cumini* (67%), *Olea dioica* (56%) and *Measa indica* (70%) in wet sites; *Helicterus isora* (63%) and *Macarenga peltata* (52%) in moist site; *Tarenna asiatica* (64%) and *Dodonaea viscosa* (55%) in dry site was observed. Among canopy species planted, very few individuals of *Melicope lunu-ankenda* and *Dimocarpus longan* in wet site; *Xylea xylocarpa, Terminalia bellirica* and *Gmelina arborea* in moist site; *Chloroxylon sweitenia* in dry site survived. Growth performances of these species indicate that certain canopy species can be utilized for speeding up of eco-restoration measures in similar degraded forests for the first time. Information on seed handling of different pioneer species has been generated.

Pollination entomology: Dynamics and role of insect pollinators in fruit set of species of Sonneratiaceae and Avicenniaceae in Mangroves of Karnataka

Surveys were conducted in different selected sites located in three forest divisions namely, Karwar, Kundapura and Mangalore on a bimonthly basis during 2011-13 & floral morphology, flowering season, different floral phenomena and pollination biology were studied. Flower visiting insects were collected from five major mangrove species namely *Avicennia officinalis, A. alba* and *A. marina* (Avicenniaceae) and *Sonneratia caseolaris* and *S. alba* (Sonneratiaceae), processed and identified. In the present study, a total of 72 species of flower visitors were documented.

Detailed studies were conducted in two species, one from Avicenniaceae (*A. officinalis*) and one from Sonneratiaceae (*S. caseolaris*). The experiments revealed that *A. officinalis* can reproduce through both cross pollination and selfing, with preference for cross pollination. Twenty three species of flower visiting insects belonging to 15 families of four insect orders were found to visit the flowers of *A. officinalis*. The peak insect foraging time was recorded between 6.30 a.m. and 11.30 a.m. Ants were recorded to spend maximum time while foraging whereas as Lepidopterans visited flower for a very short time. Percentage of stigma contact during foraging was found higher in case of Dipterans and visitors belonging to Apidae (Hymenoptera).

S. caseolaris peak flowering was encountered in the months of January, February and March (39%, 62% and 29% respectively). Insect exclusion resulted in very less fruit set in

S. caseolaris. The study revealed that *S. caseolaris* offered both nectar and pollen to the visitors. Eight species of insects belonging to 4 families of 3 orders were recorded as flower visitors of *S. caseolaris*. The peak insect foraging time was recorded between 6.30 a.m. and 10.30 a.m. *Popilla propinqua* spent maximum time while foraging whereas as *Allobaccha amphithae* visited flower for very short time. *Apis dorsata* was found to forage for moderate stretch of time. Percentage of stigma contact during foraging was found higher in case of *Apis dorsata* and *Xylocopa* sp.

Assembling all the information in view of the selected key attributes of flowers and insect visitors, plant- wise major pollinating insects were determined for the selected major Mangrove species of Karnataka coast. A detailed study was done on pollination biology and the role of insects in fruit setting in two major species, *Avicennia officinalis* and *Sonneratia caseolaris* of families Avicenniaceae and Sonneratiaceae. Reproductive biology experiments clearly indicated outcrossing mode of reproduction in both *A. officinalis* and *S. caseolaris*. *A. officinalis* has trace amount of nectar and pollen to attract the visitors. Availability of copious rewards as pollen and nectar helped *S. caseolaris* to attract visitors within short floral life. Members belonging to Diptera and two species of Hymenopterans namely *Trigona* sp. and *Amegilla* sp. were found to be most frequent visitors of *A. officinalis*. Stigma contact was found higher for these species in comparison to the other flower visitors. *Apis dorsata* Fabr. was found one of the chief pollinators of both *A. officinalis* and *S. caseolaris*. *Xylocopa* sp. was recorded as the chief pollinator of only *S. caseolaris*. The project completion report has been submitted.

Population dynamics of threatened medicinal plants species growing in buffer and transition zones of Tadoba –Andheri Tiger Reserve

Matrices have emerged as an important tool to study age structured populations. Simulation and elasticity analysis for population projection matrices help us predict the fate of populations. The population dynamics of endangered species will help in devising effective conservation strategies. The study was undertaken on population dynamics of two vulnerable species growing in the buffer region of Tadoba Andheri Tiger Reserve.

For the selection of species, surveys were conducted in the villages of buffer zone of Tadoba-Andheri Tiger Reserve. Medicinal plants, harvested by the villagers and local traditional healers were enlisted. Information on the availability of the medicinal plants was also gathered. Based on the survey, two medicinal plants viz., *Uraria picta* and *Andrographis paniculata* were selected for the study. Density of these species in the study area was determined using adaptive cluster sampling. Populations were identified for the study purposes. Permanent plots were marked in belt transect along the gradient in the identified populations. Five permanent quadrats were laid in each population (9 populations). All the individuals in the sample were marked, and monthly growth data were recorded from each quadrat. Seed production of marked individuals in the population was determined, soil samples collected and analyses done for the physicochemical properties. Experiments to determine seed viability and soil seed banking carried out. The population growth rate will be determined with the use of matrix projection models

Marking of permanent plots for the study

Collection of growth and survival data

Conservation, management and utilization of selected rattans of Assam.

Six species of rattans of Assam were selected for the study survey, inventorization and documentation of rattan diversity of Assam; studies on population dynamics and demography; standardization of nursery techniques for multiplication of canes; correlation of soil characters with growth parameters; nutritional analyses of rattan shoots which were duly carried out. Rattan gerpmasm bank and rattan nursery were also established at Rain Forest Research Institute, Jorhat.

During 2013-14, field survey for rattans in North Cachar Hills, Karbi Anglong, Manas National Park and Guwahati Forest Division were carried out and recorded information on the distribution of species, phenology and population dynamic. Herbarium sample collected, were processed. Soil samples (40 no.) collected during survey were analyzed for physical properties-pH, texture, bulk density and chemical properties-macro and micro nutrition.

The nutritional analysis of shoots of *Calamus flagellum* and *C. floribundus* revealed the presence of proteins, carbohydrates, minerals, calories, and dietary fibres in higher amounts in comparison with other leaf vegetables and bamboo shoots, as reported in other edible rattan species. The low level of sodium, negligible amounts of fat, and the presence of high levels of vitamin B complex make rattan shoot more nutritious. Rattan shoots, used for consumption in India are at present, mostly extracted from the wild. As most of the species were facing severe declines in their natural populations, the cultivation of rattan on farm land and shifting cultivation land not only aids in their conservation but also generates additional sources of income to the rural populace.

Identification of soil-vegetation relations and indicator species for assessment and rehabilitation in lower Aravalli.

Five forest blocks namely, Trisulia, Motimori, Bara Nandra Kho, Sabalia and Borvad situated in Banaskantaha and Motimori districts in Gujarat and Banaswara, Rajasmand and Pali districts in Rajasthan, respectively with annual average

Wrigthia tinctoria in Trisulia forests of Ambaji Palanpur, Gujarat

Tectona grandis + *Nyctanthes-arbor-tristis* forest in Motimori in Sabarkantha

Indigofera astragalina at Baru Nandra Kho, Banswara

Anogeissus pendual + *Rhus mysorensis* at Borwad site, Pali

rainfall of 988 mm, 961 mm, 950 mm, 568 mm and 424 mm respectively were studied with objectives: (i) to study physical properties and nutrient status of soil derived from different parent material, and (ii) to study vegetation structure and indicator species on dominant soil types. Based on IVI values, these sites were found dominated by *Wrightia tinctoria*, *Tectona grandis*, *Lanea coromadelica* and *Anogeissus pendula* among tree species and *Nyctanthes arbor-tristis*, *Lantana camara*, *Rhus mysorensis* and *Euphorbia caudicifloia* among the shrubs, respectively. Alph-diversity for herbaceous vegetation for the respective site in 2013 was however, 82, 89, 89, 80 and 60 in which *Hyptis suaveolens* (IVI=29.9), *Apluda mutica* (IVI=57.9), *Apluda mutica* (IVI=76.8), *Heteropogon contortus* (IVI=74.5) and *Tetrapogon tenellus* (IVI=54.8) dominated at the respective sites. Gama-diversity of the herbaceous vegetation were however,142, 144 and 171 in 2011, 2012 and 2013, respectively.

Soil water content remained highest at Bara Nandra Kho site and lowest at Borwad site throughout the study period. Soil pH and electrical conductivity showed variations among the years. Soil organic carbon indicated an increasing trend from 2011 to 2013. Concentrations of NH_4-N, NO_3-N and PO_4-P showed variable trends due to variations in soil water availability, but increased to highest in 2013.

Phytoremediation of soil for productivity enhancement during land disposal of effluents

Survey was conducted of effluent disposal along Jojari river basin starting from Nandra Kurd, Doli in Jodhpur District and Bandi starting from Bumadra and ending Nehda Dam in Pali district (before monsoon) to document most efficient phytoremediation species. Thirty eight species were recorded, in the effluent disposal area, out of which 5 species of trees, 4 species of shrubs, 7 species of under shrub and 22 species of herbs.

A Lysimeter experiment (non-weighing type) was laid out in CRBD in 90 tanks of size 2 x 2 x 2 m^3 with seven forestry tree species. This experiment was conducted, employing irrigation with treated industrial effluent water of Sangaria with 3 irrigation levels (0.5, 0.75 and 1.0) and control (0.5). Effluent water given for irrigation in lysimeter tank was, analyzed and maximum pH 5.7, EC 18.49 $mScm^{-1}$, alkalinity 20000 mg/l, Chlorine 204.75 mg/l and hardness 5200 mg/l were recorded. Preliminary observations indicated that *Azadirachta indica*, *Eucalyptus camaldulensis*, *Prosopis juliflora*, *Salvadora oleoides*, *S. persica* and *Tamarix aphylla* exhibited better growth under the influence of effluent water. *Prosopis cineraria* however, exhibited better growth performance in control (ground water).

Field trials were laid out at Jodhpur. Four hundred eighty plant seedlings of ten forestry tree species *viz. Acacia nilotica, Ailanthus excela, Azadirachta indica, Eucalyptus camaldulensis, Prosopis cineraria, Prosopis juliflora, Tamarix aphylla, Tecomella undulata, Salvadora oleoides* and *S. persica* at 3 x 4 m^2 spacing were planted in Split Plot Design. One hundred fifty seedlings were planted in border row.

Gadwara Bandi river with effluent water

Jojari river having effluent water and association of *Argemone maxicana*

Lysimeter experiment for phytoremediation

Field experiment using ten selected tree species for phytoremediation

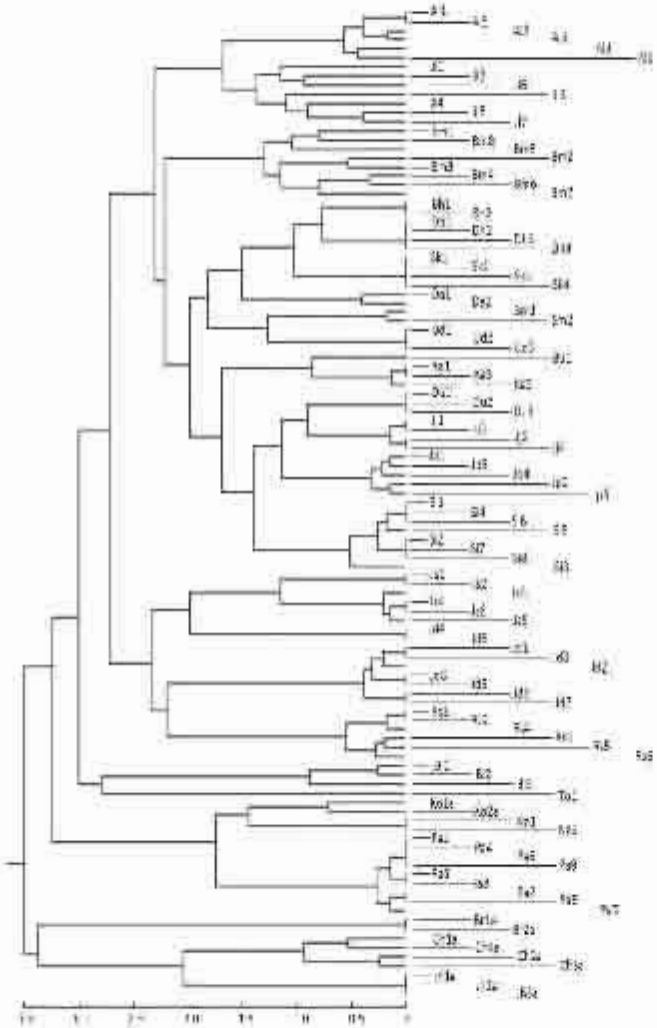
Phytoremidiation studies on effluent water

Assessment of guggul germplasm for studying population density, diversity, female-male plant's ratio for *in- situ* and *ex- situ* Conservation in Rajasthan.

Commiphora wightii (Guggal) is an important medicinal plant of arid region of Rajasthan & Gujarat. Many commercial products are marketed nationally and internationally. However, its ruthless exploitation and lack of cultivation practices of this species has led to decline in its population continnously making this plant vulnerable and category as 'data deficient' in assemblage of IUCN (2008). Government of India has included it under RET (Rare, Endangered, Threatened) category. Aim of this project was to study population density and assessment of genetic diversity in population for its conservation.

Selected genotypes from all over Rajasthan were vegetatively propagated and germplasm bank established in the fields of AFRI, Jodhpur. Left over area viz; Sariska and Bharatpur were

surveyed. Germplasm of Guggal was characterized by DNA marker studies. Guidelines were prepared for seed germination and vegetative propagation. The dendrogram shows genetic relationships among 109 genotypes of *Commiphora*. Out of these, 98 genotypes belong to *Commiphora wightii* and the rest of 11 genotypes to *Commiphora agallocha*. The dendrogram comprises of two major clusters: one cluster consisting 9 genotypes of *C. agallocha* and the other cluster having 98 genotypes of *C. wightii* and 2 genotypes of *C. agallocha*.



Genetic Distance by Jaccard's similarity coefficient

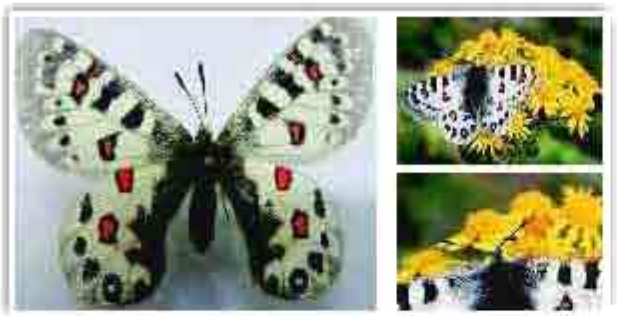
Dendrogram showing genetic distances amongst 98 genotypes of C. wightii and 11 genotype of C. agallocha genotypes.

Ecological Studies on Distribution Patterns and Food Plant Resources of Butterflies Along Altitudinal Gradients in Different Ecosystems of Western Himalayan Sub-Alpine Forests of Himachal Pradesh

Himalaya - one of the largest and youngest mountain chains in the world, covers aroughly 10% of India's total land surface. Variations in terms of its size, climate and altitudinal ranges have created environments those were unique and characteristic to this region only. The diverse climate and the varied environmental conditions of Himalaya supports diverse habitat and ecosystems with equally diverse life forms. It provides an important habitat to the flora and fauna including 9,000 species of angiosperms and, hence, considered as the hot spot of biodiversity.

Areas in the defined eco-systems were surveyed and six sites for carrying out in-depth studies selected at Chansal (Shimla), Marhi (Manali), Kalatop (Chamba), Bhangal (Kangra), Hatu (Narkanda), Chitkul (Kinnaur). Three sites i.e. Chansal (Shimla), Marhi (Manali) and Hatu (Narkanda), were visited for collection of butterfly fauna during the year and 32 specimens of butterfly from Marhi, 37 from Chansal and 40 specimens from Hatu were collected. Faunal material, thus, collected was stretched and stored and some duplicate specimens kept at freezing temperature for further taxonomic studies. GPS coordinates were also recorded from selected sites. Host plant of butterfly species was collected and identified. Data was statistically analysed adopting standard methodologies.

Dark Clouded Yellow / *Colias Fieldii (Menetries)*



Apollo Butterfly

This species of butterfly has been collected fromHattu alpine forest of Western Himalaya. The species flies close to ground seen basking on rock beds and meadows of Hattu.

Natural regeneration studies of important tree species of Nallamalais, Seshachalam hills and Kaundalinya wildlife sanctuary of Eastern Ghats of Andhra Pradesh

Local communities were consulted for identifying their priorities for certain important species and their perception about natural regeneration; identified reasons for low regeneration; in an species which they felt was economically important species. The frequencies, density, basal area of all important species in each of the forests of Nallmalai were studied in permanent quadrates set up for the purpose. Quadrates of three sizes 1000sq m (31.6 x 31.6 m^2) and 5 x 5m four plots for studying regeneration of seedlings and plots in each 1000 sq m quadrates were set up in all the four corners. The areas of Seshachalam and Koundinya are being tackled now.

Evaluation of performance of shola species of the Nilgiris under projected climate change conditions

Three sholas were identified for carrying out climatological, phenological and regeneration studies. Climate data for 20 years was consolidated for the purpose. Floristic diversity studies in progress. Phenological data and regeneration studies from the sholas identified for carrying out climatological studies is underway

Impact of invasive species on plant diversity in selected forest sites of Uttarakhand, Haryana and Punjab

Species such as *Lantana camara, Ageratum conyzoides, Eupatorium adenophorum, Parthenium hysterophorum* etc. were selected for impact assessment. Floristic survey of Mussoorie and adjoining areas was carried out. Biomass of *Eupatorium adenophorum* was estimated. *Stevia obovata* was a new record of invasive species, from Mussoorie area. This species was the native of North America. Impact of invasive species in the Jhajra Range and Asharodi Range was carried out. Dominant species of the area was *Shorea robusta*. Area was heavily infested by *Lantana camara*. *Ardisia solanacea*, an associate of wet Sal was dominant in the Jhajra and Asharodi range. Species was posing great threat to other species. Quadrat study was carried out in control and *Lantana* and *Ardisia* infested areas. Biomass estimation of *Lantana camara* was also done. Vegetative analysis by quadrat method was carried out in Champawat (UK), Darpur and Kaleshar (Haryana) Forest. Invasive species like *Ageratum, Argemone, Parthenium* etc were found in the area. In all the areas *Lantana camara* was found as major threat to the indigenous species. Analysis of data was in progress. Potential of invasive species such as *Eupatorium adenophorum, Ageratum conyzoides, Parthenium hyterophorum* etc. for paper making was being analyzed.

3.5 Seed Science & Technology

Standardization of techniques for germination, collection and maintenance of maximum viability of four important tropical species: *Bridelia retusa, Sterculia urens, Boswellia serrata* and *Saraca indica*

Study on seed maturation of *Boswellia serrata* shows that germination was best after full maturation at 68 DAA, when the colour of the fruit was light brown and seed was brown with moisture content of about 2-3%.

Study on seed maturation of *Sterculia urens* shows that germination was best after full maturation at 75 DAA, when the color of the seed was grey with moisture content of about 16%.

Boswellia serrata seeds can tolerate up to 4-5% moisture content and *Sterculia urens* seeds can tolerate 2-3% moisture content; therefore, they can be considered as orthodox seeds. However, viability of seeds of *Saraca indica* was lost if dried to 20% moisture content. Seeds may be of recalcitrant category. Further investigation was needed.

Seeds of *Sterculia urens* stored at all conditions were viable; thereby no deterioration occurs till six months of storage.

Effect of temperature, light quality and type and depth of soil on germination of *Sterculia urens* was studied. It was observed that white light was best for germination of seeds of this species, the seeds can germinate at 25-40°C temperature. The seeds can germinate better on the surface of mixed type of soil.

Development of agro- techniques for organic cultivation of *Tribulus terrestris* L. and *Cissus quadrangularis* L.-medicinal plants extensively used in traditional system of medicine (Ayurveda, Unani and Chinese)

Seeds of *Tribulus terrestris* were collected from Uttrakhand Forest Dept. at Haldwani. The germination percentage of the seeds in nature was very poor. Efforts were made to increase the germination capacity of the seeds by physical and chemical means. The results of these experiments are awaited.

In case of *Cissus quandrangularis*, shoot cuttings have been obtained from plants growing in Chamranga Forests near Ranchi District. The survival rate of the cuttings was as good as 60%.

3.6 Eco- restoration

Development of model plantation/eco-restoration in coal mined areas of Bharat Coking Coal Ltd (BCCL), Dhanbad (Ongoing Externally Aided Project (Consultancy)

In a span of three years, 12,500 saplings of 17 tree species were planted, while seven shrubs, seven grasses, three herbaceous and three bamboo species were propagated by means of seed broadcasting, seed mixed with soil, stem cutting, bulbils and culm/slip. Species selection was based on the prevailing site condition, climate, nativity and multi uses. Periodical monitoring of the growth performance in terms of height, diameter and survival indicated tree species like *Dalbergia sissoo, Albizia procera, Albizia lebbeck, Bauhinia variegata* and *Phyllanthus emblica* were highly successful, while grasses like *Pennisetum pedicellatum, Pennisetum purpureum Panicum maximum, Cenchrus ciliaris, Cenchrus setigerus , Cymbopogom martini* and *Arundo donax* could also adapt well. Horticultural species mainly *Mangifera indica, Syzygium cumini and Psidium guajava* were found to be suitable in coalfields.

Identification and reclamation of 10 hectare of degraded land & bio diversity development at NCL, Singrauli

In the months of February 2014, top soil spread done on overburden dumps, as a part of physical measures to restore mined over burden dumps in project site.

Restoration ecology and species recovery studies in Tsunami impacted mangroves of Andaman Islands

Surveyed both the upliftment and submerged Tsunami impacted mangrove areas of South Andaman, Baratang, Middle Andaman and North Andaman. Sample plots in each island group were selected based on stratification and the damaged areas were stratified as heavily damaged, moderately damaged and less damaged. 15 sample plots were selected and demarcated on ground for restoration. Vegetation survey in the impacted areas and also in the adjoining undisturbed areas, have been also done. Studies on tidal fluctuations and vertical zonation of mangroves species in the affected areas are going on. Mangrove nurseries have been established in South Andaman and Middle Andaman. At each

site 2ha area was selected and floral composition of the sites was assessed. Nursery capable of 3000 seedling 10X5m was established at selected sites for raising seedling of available species. Nurseries were established in the following sites viz. Indira Nagar (*Rhizophora* sp, *Ceriops* sp), Shoal Bay (*Rhizophora* sp) Yerrata (*Rhizophora* sp, *Bruguiera* sp, *Ceriops* sp), Mohanpur (*Rhizophora* sp, *Bruguiera* sp), Parangra (*Rhizophora* sp, *Xylocarpus* sp). Transplanting the Nursery raised seedling to selected sites will be carried out on rotational basis. Supplementation of natural regeneration by introduction of seeds directly into the selected sites and collection of seeds and establishment of nursery for rare Mangroves species mentioned earlier will also be carried out.

Development of models for conversion of plantations into secondary forests in Andaman Islands

Seedlings of early colonizers were raised and planting was done in teak and Padauk plantations in Rangat division. Tending operations thinning, weeding and cleaning were done in sample plots of teak and Padauk plantation in Rangat and Diglipur.

Reclamation of latertie lands using beneficial microbes in Kasargode District

This project has been initiated in Apr 2013. Under this project, the study site was selected at Bhavikonam Range of Kasargode district and from there the laterite soil samples collected to analyse microbial and nutrient parameters. The microbial status was very low, however, Azospirillum, AM fung, and Phosphobacterium were isolated and cultured. The N, P and K status of laterite soils was very poor particularly the K was 0 in laterite soils. The primary colonizers *Crotolaria juncea* was broadcasted in the study site at Kasargode and established the primary colonization site. One truck load of laterite soil was collected, brought to the Institute for nursery experiments. Seedlings of *Butea monosperma, Swietinea macrophylla, Gmelina arborea, Ailanthus trypysa* and *Holoptelia integrifolia* were grown in collected laterite soils (as potting media) and inoculated with beneficial microbes such as, Azospirillum, Phosphobacterium and AM fungi. The seedlings inoculated with these beneficial microbes, showed increased growth and biomass. The seedlings were being maintained in nursery for afforestation on latertie lands.

Butea monosperma (A) and *S. macrophylla (B)* grown in laterite soils inoculated with beneficial microbes

4. Forests and Climate Change

Climate change has multi-faceted implications and therefore, in order to address the related aspects a good scientific understanding of issues is required for maintaining the flow of goods and services from existing forests, both at the national as well as the global level. ICFRE is working on climate change related research and policy issues leading to international negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) and also various research projects at ICFRE institutes. A brief account of activities on forests and climate change has been given below.

Satellite based assessment of fire severity and its validation in Uttarakhand

Maps containing information on forest fire incidences in Uttarakhand state from 2001 to 2012 were prepared in GIS environment and data analyzed to get information on occurrence of forest fire at different forest administrative units i.e. state, forest circle, forest division, forest range and forest compartment on monthly and annual basis and also cumulative basis. The information on forest fire, in the form of maps and tables, was also compiled for different forest density classes, slope classes, aspects, altitudes and climatic zones. The study concluded in June 2013.

OTC's facility developed at FRI,Dehradun

Carbon, energy and water dynamics in Himalayan Chir pine forest

Six units of Open Top Chamber (OTCs) were installed at Forest Research Institute, Dehradun under ICFRE funded project "AICP on Elevated CO_2"

'Effect of elevated CO_2 on active principles of important medicinal plants'

Seedlings of *Andrographis paniculata, Adaothoda vasica, Phyllanthus amarus and Gymnema sylvestre* were kept under different elevated CO_2 levels at nursery stage. Periodical data on growth, total plant fresh and dry weight, root shoot ratio, number of leaves, primary and secondary roots, etc, were taken. Observations on physiological parameters were recorded from different treatments. Medicinal plants parts were dried for alkaloids estimation. In all the medicinal plants, the elevated CO_2 levels, production of biomass, bio-chemicals (including total protein, tannin, etc.) were higher.

Assessment of soil organic carbon under different land uses in Tamil Nadu

Extensive survey was undertaken in Virudhunagar, Madurai, Tirunelveli and Tuticorin districts, covering the Southern agro-climatic zone of Tamil Nadu. Soil samples (180 nos.) belonging to Padarnthapuli, Nanguneri, Vayalogam and Mayamankurichi soil series were collected from various land uses *viz.*, agriculture (sugarcane, maize, groundnut, cotton) agro-forestry (teak + coconut, teak + maize, ailanthus + maize, neem + sorghum, neem + fodder sorghum, teak + banana) and plantation (teak, *Casuarina*, neem, bamboo, eucalypts, *Melia*) for estimation of carbon stock. Soil samples were collected from three plots and at four depths *viz.*, 0-30, 30-50, 50-80 and 80-100 cm. The per cent of coarse fragments (>2 mm size) was calculated for each layer based on visual observation of the area occupied by coarse fragments. The samples were

fractionated into three aggregate size classes *viz.*, macroaggregates (250-2000µm), microagg - regates (53-250 µm) and silt and clay sized fractions (<53 µm). The carbon was estimated in the soil samples.

Response of mycorrhizae and microbial symbionts to elevated CO_2 in commercially important tree species

Rhizosphere soils samples of selected tree species were collected, *Rhizobium, Azospirillum* AM fungi, Phosphobacteria isolates were multiplied and maintained in laboratory. VAM fungi, *Glomus geosporum, G. viscose* and other microbial symbionts such as *Rhizobium* and *Frankia* were cultured and maintained in the laboratory. Nursery raised *Acacia auriculiformis, Melia dubia, Casuarina equisetifolia, C. junghuhniana, Eucalyptus camaldulensis* and *Neolamarkia cadamba* were inoculated with microbial symbionts such as AM fungi, *Rhizobium* and *Frankia* individually and in combinations. The seedlings were treated with 600ppm CO_2. After 15 days of incubation, it was found that the seedlings exhibit improved growth and stem girth as compared to those in uninoculated control ones during the same period. The rooted stem cuttings of *Acaica auriculiformis* inoculated with *Rhizobium* showed early nodulation at 600ppm CO_2. This is a new finding in the rooted stem cuttings of *A. auriculiformis*. The growth and biomass of *A. aruriculiformis* was also found improved. The seedlings placed in 600 ppm CO_2 chamber have shown improvement in growth and biomass, due to the inoculation of mycorrhizas and other microbial symbionts. The seedlings of *C. equisetifolia* and *C. junghuhniana* showed more number of nodules, inoculated with *Frankia* under 600 ppm of elevated CO_2. The seedlings of *Melia dubia* and *Neolamarkia cadamba*, inoculated with AM fungi showed increased height, stem girth and biomass as compared to the control seedlings under elevated CO_2. *Azospirillum* and *Bacillus* sp (PSB) found more effective in the seedlings of *Ailanthus excela, Neolamarkia cadamba* and *Gmelina arborea*. The growth and biomass was 2 times higher than in the control seedlings. Higher photosynthetic rates were also obtained under 600 ppm conditions as compared to uninoculated controls.

Soil, Vegetation – atmosphere carbon fluxes measurement and modeling (SVF) project

ICFRE is collaborating with the Indian Institute of Remote Sensing (IIRS) for its National Carbon Project (NCP) under Geosphere Biosphere Programme (GBP) of the ISRO to estimate the carbon pools and fluxes in different terrestrial ecosystems of India. In Betul (teak forest), data from the flux tower site is being recorded by IIRS. Forest inventory and soil physico-chemical properties like soil moisture (%), soil carbon(%), EC, pH, N, P and K were analysed from the tower site by TFRI. Studies on litter production and its decomposition were also conducted. Phyto-sociological studies and forest floor biomass (herbs and shrubs) accomplished. Leaf Area Index (LAI) and phenology of 10 major species were recorded.

Collection of herb shrub biomass, litter collection and litter decomposition bag

Measurement of LAI using ceptometer LP-80

Utilization of Automatic Weather Station (AWS)/Agrometeorological station (AMS) data for agriculture, forestry and hydrological applications in Madhya Pradesh

This is a multi-institutional project coordinated by Space Application Centre of ISRO, Ahmedabad, with the objective to quantify energy and carbon exchange using field measurement and remote sensing data in different ecosystems of Madhya Pradesh.

In the 1st phase of the project, allometric regression equations were developed for quantification of carbon in *Shorea robusta*. Data collected on seasonal variation in grass biomass, soil moisture profile, Specific Leaf Area (SLA) and Leaf Area Index (LAI) from selected sites near AWS and AMS in Kanha, Bandhavgarh and Madhav National Parks of M.P.

In the 2nd phase, 11 quadrats of 0.1 ha size each were laid out in Pench, Panna and Satpuda Tiger Reserves of Madhya Pradesh on the basis of floral diversity and canopy density. Regularly collected tree growth data and observed seasonal variation in herbaceous and litter biomass and soil moisture profile. Average GBH of the trees in Panna Tiger Reserve was found to be 64.2 cm, whereas average height was 14.1 m. *Tectona grandis, Acacia catechu, Anogeissus pendula, Chloroxylon swietenia, Zizyphus xylopyrus and Boswellia serrata* were main tree species recorded. In Pench Tiger Reserve average GBH was found to be 66.8 cm, whereas average height was 17.3 m. *Tectona grandis, Pterocarpus marsupium, Buchanania lanzan, Syzygium cumini, Zizyphus xylopyrus* and *Chloroxylon swietenia* were the abundantly available tree species. In Satpuda Tiger Reserve, average GBH of trees was found to be 69.4 cm, whereas average height was to be 13.9 m. *Shorea robusta, Soymida febrifuga, Diospyros melanoxylon, Emblica officinalis, Hardwickia binata, Saccopetalum tomentosum, Chloroxylon swietenia* and Gardenia latifolia were the main trees species of Satpuda Tiger Reserve.

Collecting litter in Satpuda Tiger Reserve

Kardhai forest in Panna Tiger Reserve

Carbon sequestration through afforestation at Rourkela Steel Plant (RSP), Odisha

Study sites in and around Rourkela Steel Plant (RSP), Odisha were selected for vegetation survey and quantification of carbon in vegetation,

Conducting vegetation survey at Rourkela Steel Plant (Odisha)

Conducting soil profile study at Rourkela Steel Plant (Odisha)

litter and soil. Quantification of vegetation, regeneration status of trees and estimation of litter and dead wood and soil profile studies were conducted. Atmospheric concentration of CO_2 at 15 sampling locations in and around RSP was monitored in the first season of the first year.

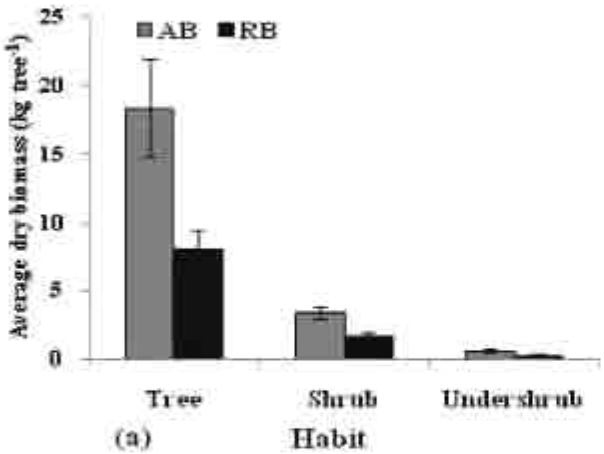
Studies on soil profile attributes under forest and Jhum land areas of some selected sites of Nagaland state

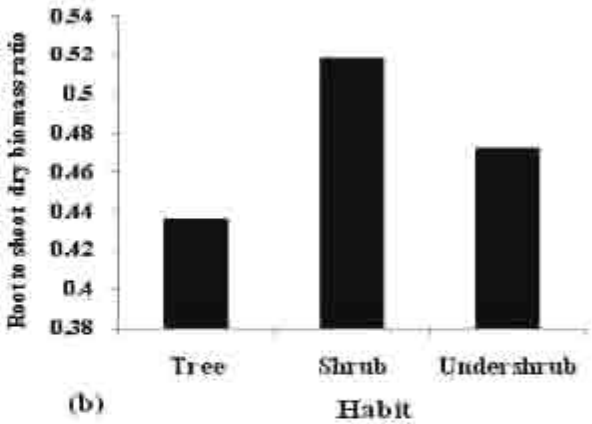
Soil profile attributes in three land use types i.e., jhum land, tea garden and forest areas of Nagaland state were studied. Under jhum land and tea garden, soil pH increases down the profile whereas under forest area soil pH decreases down the profile. Water soluble salt content in soil found decreasing down the profile from surface horizon under all the three types of land uses. Organic carbon content in soil showed increasing trend down the profile from surface horizon under all the three land uses. Available nitrogen content of soil found high in the surface soil and decreased down the profile under all the three types of land uses. Soils were sandy clay loam to clay loam in texture under forest land, jhum land and tea garden areas. Leaching of clay, due to the presence of clay films, down the profile was found in some profiles due to higher amount of clay content in sub-soil horizons. Soils were found heavy textured, bulk density in the range of 0.80 - 1.18 g/cc. Bulk density of soil increased down the profile under all three types of land uses.

Studies on carbon sequestration in different forest types of Rajasthan

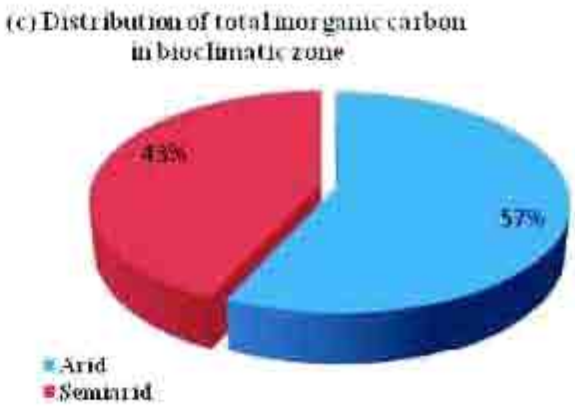
Project was started with objectives to estimate carbon stock in forest soils, forest litters, and in above ground and below ground biomass; with overall objective 'to provide an estimate of carbon stock in the forests of Rajasthan for its utilization in planning and execution of afforestation programmes. During the year 2013-14, data on dominant vegetation (trees/shrubs) in 903 forest blocks of all thirty three districts of Rajasthan were analysed and importance value index (IVI), diversity and carbon stock in soil (soil organic and soil inorganic carbon), dead material (litters and coarse woody debris), herbaceous biomass and live biomass (both above ground and belowground) of trees, shrubs, Euphorbias, bamboo and tree saplings estimated. There are 31 sub types of forests including plantation and types of *Prosopis juliflora* and *Mangifera indica* categorised in this study, though, some pure patches of *Madhuca indica*, *Diospyros melanoxylon* and *Anogeissus latifolia* have also been observed. Combined regression equations were developed to assess the standing dry biomasses (above ground and belowground) of shrubs, undershrubs, Euphorbias, trees and tree saplings and applied in biomass and carbon stock calculation. Overall ratios of average root biomass to above-ground dry biomasses are 0.518 for shrubs, 0.478 for under shrubs and 0.436 for trees.

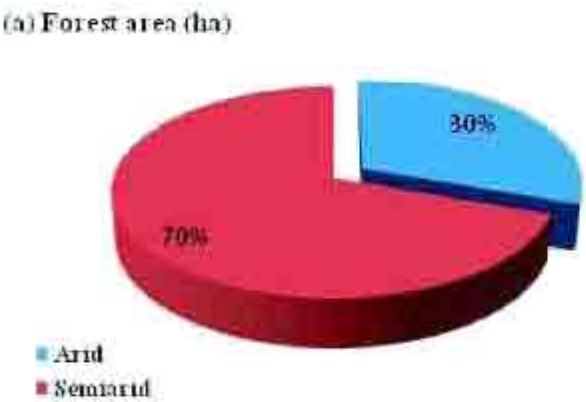
Study also revealed that average carbon densities of soil organic and inorganic carbon were 35.61 tonnes ha^{-1} and 43.26 tonnes ha^{-1} respectively for top 100 cm soil depth in Rajasthan forest (after gravel correction). Total soil organic and inorganic carbon stored in top 100 cm soil layer were 121.61 million tonnes and 142.62 million tonnes, respectively. Total carbon stored in dead plant material was 1.24 million tonnes and that of herbaceous biomass was 0.77 million tonnes. Distribution of forest area, soil organic carbon, soil inorganic carbon and total carbon in top 1 m soil layer indicated greater forest area, organic carbon and total carbon stored in semi-arid region, whereas soil inorganic carbon storage is highest in arid region.





Average above ground (a) and root (b) dry biomasses of the harvested trees, shrubs and undershrubs (left) across the species, and RB to AB ratios under different plant habits (right).





Distribution of organic (SOC) and inorganic carbon (SIC) stored in 100 cm soil layer in arid, semiarid and state as total depending in relation to forest area in the respective bioclimatic region

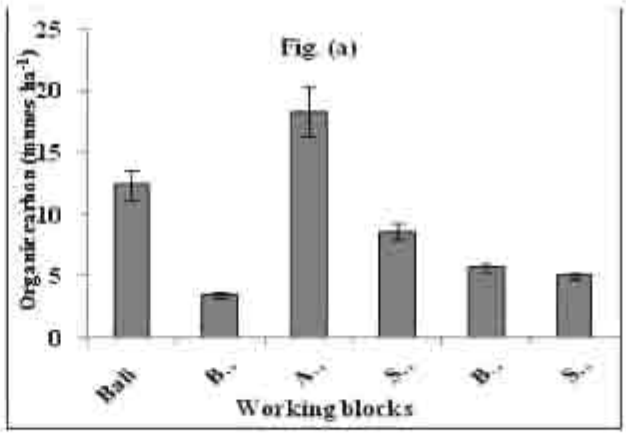
Carbon stock and soil classification mapping for Rajasthan forests

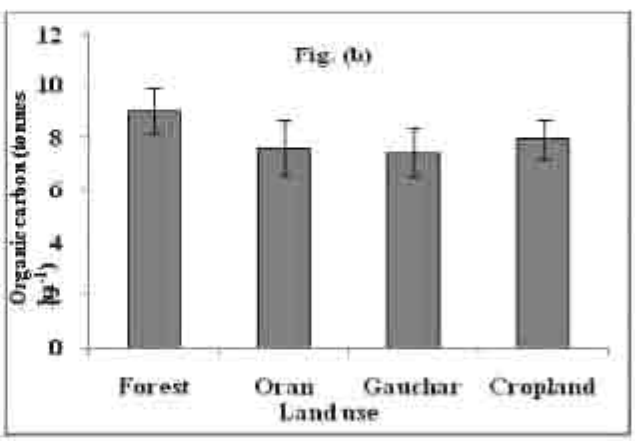
A GIS laboratory has already been established in the AFRI, Jodhpur equipped with Work Stations and facilities of like plotter and printer. Integrated GIS software was also procured having the capabilities of spatial analysis, image processing, RADAR analysis, hyper spectral analysis, photogrammetry, network analysis, GIS modeling, surface analysis, watershed modeling and atlas creation, publishing geo-referenced image/map in printable format and also in a format easily readable in the systems not having GIS software. Forest type maps of Rajasthan and Gujarat developed by the Forest Survey of India (FSI) were procured for base map. Data of soil physical and chemical parameters and site characteristics were compiled and entered for eight districts. District maps have been delineated for working on GIS.

Studies on the effects of MPOWER programme on mitigation and adaptation towards climate change in western Rajasthan

Mitigating poverty in Western Rajasthan (MPOWER) project is under implementation in six blocks, one each in Jaisalmer, Barmer, Jodhpur, Pali, Jalore and Sirohi districts of western Rajasthan for mitigating poverty of the target groups (households) through strengthened capacity, improved livelihood, sustainable enterprises, natural resources management and increased access to credit and markets. To monitor the impact of the project together with the changes in carbon stock (if any), adaptation strategies among the people in implementation area of this project was taken up. The basic objectives of the projects were (i) to identify best practice in terms of enhanced livelihood and adaptations among the villagers of the selected villages in western Rajasthan; (ii) to identify best practice supporting mitigation (i.e., carbon sequestration in soil) option of climate change in these villages and (iii) to document and suggest best practices of MPOWER in terms of climate change mitigation and adaptation for its further replication in large scale.

Field survey and data were collected from 102 selected villages. Questionnaire related to village profile data, socio-economic and people perception about climate change and adaptation were developed. Soil samples in 0-30 cm soil layer were collected for organic carbon, bulk density and gravel content estimation. Data analysis indicated that gravel content, soil carbon concentration and soil carbon density varied significantly ($P<0.01$) between different working blocks. Variations in these soil variables did not differ among the land uses; Duncan Multiple Range test indicated that gravel content was significantly greater in forests and sacred grove area as compared to gauchar and agriculture lands. Soil carbon concentration was highest ($P<0.05$) in forest lands (0.35%) and lowest in gauchar lands (0.21%). Soil carbon density was lowest (3.49 tonnes ha^{-1}) in Baitu (Barmer) and highest (18.32 tonnes ha^{-1}) in Abu-road area of Sirohi district.





Effects of site conditions and land use on soil organic carbon density

Assessment of carbon stock in forest types of Shimla Forest Circle, Himachal Pradesh

Studies continued in the already identified sites comprising of chir pine *(Pinus roxburghii)* forest, ban oak *(Quercus leucotrichophora)*, deodar *(Cedrus deodara)*, silver fir *(Abies pindrow)*, spruce *(Picea smithiana)*, kharsu oak *(Quercus semecarpifolia)* forest and alpine pasture in Shimla circle. Field studies were conducted for *Pinus roxburghii* forest at Dhami and Guma; for *Quercus leucotrichophora* forest at Taradevi and Koti; for *Cedrus deodara* forest at Koti; for *Abies pindrow, Picea smithiana, Quercus semecarpifolia* and *Betula utilis* forest at Larot (Rohru Forest Division). All the trees falling in the study plot (size 0.1 ha) were enumerated for height, diameter for biomass estimation.

Betula utilis

Rhododendron campanulatum

The biomass of under-storey (shrubs and herbs) was determined by destructive sampling by following standard methodology. Soil samples were collected from three depths for the estimation of organic carbon. The specific gravity of wood samples of chir pine, ban oak and deodar was 0.57-0.72, 0.70–0.90 and 0.77-0.84 respectively. The carbon content of plant samples of chir pine, ban oak and deodar varied from 52-56 per cent. The values for bulk density of soil collected from chir pine, ban oak and deodar varied from 0.92-1.28 g/cu cm. Soil organic carbon of chir pine, ban oak and deodar was 0.98-2.92, 1.22-3.90 and 1.90-2.78 per cent respectively. In chir pine forest, carbon stock in litter varied from 1.198 t/ha to 1.235 t/ha whereas, in ban oak forest it varied from 1.35 t/ha to 1.40 t/ha. Soil carbon pool in chir pine forest varied from 53.16 t/ha to 57.54 t/ha whereas, in ban oak forest it varied from 70.99 t/ha to 74.75 t/ha. Specific gravity of wood samples of spruce, betula, fir and kharsu oak was 0.92-0.95, 0.82–0.86, 0.88-0.94 and 0.89-0.96 respectively.

Fir & Spruce forest at Larot, Rohru Forest Division

Study on the influence of climate on bionomics of *Pityogenes scitus* Blanford (Coleoptera: Scolytidae) in Himachal Pradesh

Biological information on the species from 3 selected sites was collected and the abundance of different stages (egg, larva, pupa and adult) of this insect under field conditions estimated. It was observed that the larva feed chiefly on the past layer and their galleries do not get deep into the

sap wood. Full grown larva eats out a depression at the end of their galleries in sap wood and pupates. 4-5 adult beetles / 20 cm^3 were recorded on infested kail tree. Kail forest seems to be more susceptible; however, this needs further validation by continuing study further for one more year. Data on biological information and meteorological observations is being analyzed for their co-relation and other interaction.

High altitude transition zone in Himachal Pradesh: Long-term study to assess the effect of global warming and trails to rehabilitate degraded site in this zone

On the basis of field survey and literature consultation, three potential and appropriate sites viz. Satluj Catchment (Kinnaur), Beas Catchment (Kullu) and Ravi Catchment (Chamba) were selected for the study. During the year, floristic composition was studied carefully in the selected plots in high altitude transition zones of the project area. Reconnaissance survey was also carried out for obtaining the information on broad floristic composition, especially with respect to the occurrence of keystone treeline species, occurrence of any red listed plant species and their population status, incidence of biotic pressures and degradation status including recording of GPS coordinates for mapping purposes in the identified sites. Data loggers for recording ambient temperature and relative humidity at 2-hour intervals were installed at these sites i.e. Chakah, Ashiqui Park, Naradu (3 sites in Kinnaur) and Satrundi (Chamba)

.

Measurement of vegetation and biomass parameters under vegetation carbon pool assessment (VCP)

As part of the national programme, the assessment of the terrestrial vegetation carbon pool in Andhra Pradesh was undertaken to generate geospatial data of the terrestrial biomass and carbon. Studies were conducted in 54 forest sites in Nizamabad, Adilabad, Warangal, Karimnagar and Vishakhapattanam districts. Data on tree height, gbh, biomass collected as per standard research protocol approved by NRSC. The results of the study will help in assessing biomass and carbon sequestration, species composition and diversity over a time period, as these sites were already assessed during 2009-10.

5. Forest Genetic Resource Management and Tree Improvement

Forest genetics and tree breeding research in ICFRE is oriented towards demands of wood based industries and also to cope with changing climate. Selection of superior genotypes, their field evaluation, quantification of variability and genetic diversity, standardization of propagation methods, establishment and improvement of seed orchards and seed production areas are some of the conventional genetic improvement approaches being followed. The programmes ensure development and deployment of productive and adaptive populations and varieties across the sites for the benefit of end users. Developments of productive and abiotic stress tolerant varieties/ clones, adapted to harsh environments have also been attempted with priority. Field tested genetically superior clones of Eucalypts and Poplars are being used by wood based industries, pulp and paper mills and plywood/veneer factories in the country contributing effectively in our economy. Efforts are being made for other fast growing species like *Melia composita,* bamboos etc. Under-domesticated fast growing tree species needs to be evaluated and domesticated. Biotechnology tools are being further used to strengthen the conventional tree improvement programmes. Characterization of germplasm at DNA level helps in precise quantification of genetic diversity unaffected by the environmental effects of errors. The transgenic approaches are being used to transfer traits across the sexual barriers. Mass propagation through tissue culture is another biotechnological achievement especially for rare and endangenred forestry species and also for difficult to propagate tree species and hybrids. The work on forest genetic resource management was initiated to assemble, evaluate and conserve important genetic resource of the country's forest. Also research on genomics was carried out in various institutes of ICFRE for conservation and management of natural forest resources.

5.1 Tree Improvement

Eucalyptus

Eucalyptus tereticornis and *E. camaldulensis* shoots of thirty clones were collected from Sathyavedu, Karunya clonal trials and Vegetative Multiplication Garden (VMG) established. Thirty thousand ramets were produced and twelve clonal trials were established in Karaikkal (Puducherry), Warangal (Jakaram), Rajmmndhry, Hyderabad (Mulug) and Tirupathi (Sreevarimetta) in A.P., Badami, Gangargatti (Dharwad), Halbhavi (Belgaum) in Karnataka and Nachiarpettai (Ariyalur), Amaravatipudur (Karaikudi), Tiyagadurgam (Kallakurichi), Marakkanam in Tamil Nadu TAFCORN areas. Seven superior clones viz., 9, 10, 14, 17, 186,191,196 based on height and girth data were selected and these were officially released as varieties through Regional Variety Testing Committee (RVTC) and Variety Releasing Committee.

Second generation seed orchards were established and clones were selected for high productivity in Eucalyptus. Seeds were collected from the first generation (FG) seed orchard trials at Karunya and Puthukottai from 52 single trees for establishment of second generation (SG) seed orchards. Efforts were made to select SG clones from trials established at Chennai, Hyderabad, Nellore, Coimbatore, Karunya and Kandiyur. About 25 CPTs were selected and coppiced for mass multiplication of the selected plants. The clonal trial at Karunya was culled based on the growth performance of the clones planted in MLTs. About 25 poor performing clones were removed and seeds were collected from best performing 50 clones and tested for the progeny growth performance in Puthukottai (2 ha) and ANGRAU, Hyderabad (2 ha). The tested clones were also multiplied and CSO established in Salem (2 ha) and Nellore (9 ha). Seedling Seed Orchards at Coimbatore (2 ha) and Chennai (3 ha) are also established. Genetic gain trials were

established at Udumalaipet (3 ha), Kandiyur (4 ha) and Arimalam (3 ha). All the trials were assessed for growth parameters. Growth performance of all the tested half-families were ranked and genetic gain associated with establishment of seed orchards was estimated

Interspecies hybridization between *E. pellita* and *E. urophylla* was carried out at FRI Dehradun and F1 hybrids were produced. Successes have been achieved in production of ramets of *E. pellita x E. urophylla*. Clonal trials of FRI-PH4 have been laid out at four locations *viz*. Satyal, (Punjab), Haldwani (Uttarakhand), Bithmeda (Haryana) and Saharampur (Uttar Pradesh). Clones of hybrids *E. pellita x E. urophylla* and *E. pellita x (E. urophylla x E. grandis)* were planted in vegetative multiplication garden for further multiplication and deployment.

FRI-PH4

Eucalyptus hybrids FRI-14 *(E. citriodora* Hook. × *E. toriliana* F.Muell.) and FRI –EH001 *(E. camaldulensis* Dehnh. × *E. tereticornis* Sm.) multiplied through micro-propagation technique were field evaluated at three different agro-climatic locations of Punjab, Haryana and Uttarakhand. The study revealed better performance of FRI-14 in respect of growth- and wood-traits than FRI-EH001.

Validation of chemical markers conferring *Cylindrocladium* leaf and seedling blight resistance in *Eucalyptus* germplasm was carried out. Germplasm of seven clones of *Eucalyptus* was collected and artificially infected with fungus *Cylindrocladium quinqueseptatum*. Correlation of the marker constituents was observed with resistance.

IFGTB, Coimbatore imported seeds of around 25 *Eucalyputs mallee* species from the Australian Tree Seed Centre for testing in semi-arid regions of Tamil Nadu for suitability as a bioenergy crop. Seedlings have been raised from these species, undertaking multilocation field testing during 2014 planting season.

A project "A value chain on Industrial Agroforestry in Tamil Nadu" was initiated by IFGTB Coimbatore with the aim to develop new plant varieties and demonstration and popularization of genetically improved genotypes in the farm lands in collaboration with Industries, farmers cluster groups and Research Institutions. During the current year, seven short listed clones of *Eucalyptus* were multiplied and 6000 plants were transferred to farm fields for establishment of Model Plantation at Karur.

For improving the yield of species, used for bio-energy, a bilateral collaborative project "Yield improvement and adoption of plantation technologies in bioenergy crops for increasing the potential of bioenergy production" was initiated by IFGTB and Kasetsart University, Thailand. Both the Institutes are working on many bioenergy tree species for improving the productivity through genetic improvement programmes. The efforts made by each Institute has been studied through exchange visits in India and Thailand. A study visit was also conducted for a team of scientists from Thailand.

Casuarina

Second generation breeding orchards of *C.equisetifolia* and *C.junghuhniana* were developed using the progeny of the best ranking individuals of first generation orchards located in the States of Andhra Pradesh, Puducherry and Tamil Nadu. Around 20 ha of new orchards were established in different parts of the above mentioned states from the year 2008. These

orchards are periodically assessed for survival, growth, stem form and incidence of pests and diseases. Seeds are being collected from these orchards for supply to users and to establish on-farm genetic gain trials.

The ongoing breeding programme of *Casuarina equisetifolia* and *C. junghuhniana* was taken further from first to second generation. Three community seed orchards established during the previous years have been intensively managed by involving the farming and nursery operator communities. Through pathological screening and field testing, the clones TNIPT 1 and TNIPT 7 showed resistance against the blister bark or stem wilt disease in *Casuarina*. Through systematic selection and multilocation testing, four high yielding clones of *Casuarina* have been released for commercial cultivation. To facilitate registration of these new clones, guidelines for DUS testing in *Casuarina* have been developed and validated with all available clones.

For screening for blister bark disease resistance in *Casuarina equisetifolia*, 250 clones (15 replicates each) were vegetatively propagated and inoculated with the pathogen *Subramanianospora vesiculosa*. The inoculated clones were screened for disease resistance through disease severity score. The clone numbers TNIPT -7 and TNIPT -11 showed 0 symptoms and APSKLM-30 and TNRM -8 showed less symptoms. The clones TNPP -4, TNKP -1, TNIPT -5, TNCS -3, TNIPT 12 were showed severe infection. In all, 36 clones are showing resistance and 55 clones showed moderate resistance.

For improvement of *Casuarina* and *Leucaena* for enhanced pulpwood production from farm forestry plantations, a germination study of the seedlots received from IP-APPM was completed. Attempts were made to multiply 53 CPTs of *Leucaena* for rooting studies. Initiated nurseries for production of seedlings / plantlets of *Casuarina* and *Leucaena* for establishing multilocation trials. Convened three interactive meetings, between the officials of IPMA and IFGTB for the purpose.

Gmelina arborea

Genetic Improvement of *Gmelina arborea* Roxb. through selection and clonal evaluation was carried out.

Quality planting Stock Production of *Gmelina*

Progeny trial of *Gmelina arborea*, Kurumpapatti, Salem

Intensive survey conducted in the natural forest of Siruvani, Anaikatti, Anthiyur, Sathiyamangalam, Dindugal, Kodaikanal, Sirumalai, Theni and Farmers plantation in Pudhukottai. Identified natural population of *Gmelina arborea* in the above set location and selected 50 CPTs based on growth superiority, clear bole and pest and disease resistance. The reproductive traits like flowering phenology, pollen fertility, pollen germination on stigma and pollinator interaction of *Gmelina arborea* have been studied on the selected CPTs.

Forty one CPTs of *Gmelina arborea* from Tamil Nadu, Andhra Pradesh and Kerala were collected and seeds were extracted. Data related to seed parameters, seed weight, gemination percentage, growth parameters of seedlings upto 4 months during the juvenile phase were recorded. Statistical designs were prepared and progeny trials of CPTs with an extent of 1 ha each were establsihed at Gudalur Research Station and Neyveli Research station during the North East monsoon.

Evaluation of *Gmelina* clones were carried out in the experimental site of Naharoni for its best performance. The clones were ranked based on their height, stem straightness, dbh, pruning ability and crown form. On the basis of initial screening for the pest resistance to defoliator, 8 clones were found showing moderately resistant to this defoliator in the field.

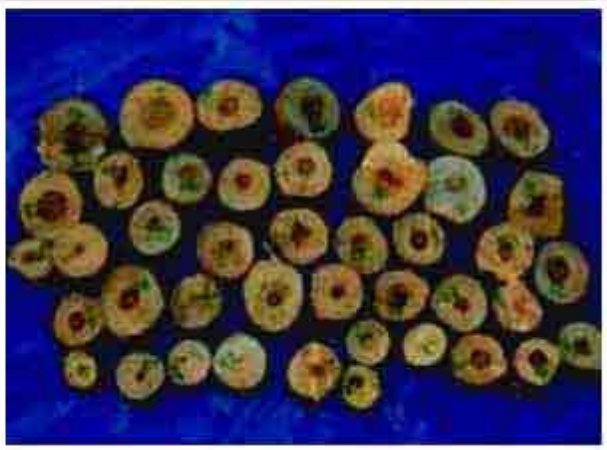
Gmelina mortality in plantation of Madhya Pradesh, Chhattisgarh and its integrated management was investigated. It has been found that sp. of *Hendersonula* and *Phomopsis gmelinae* caused severe damage to the plantation *of Gmelina arborea.*

Acacias

About 63 promising clones of *Acacia auriculiformis* were multiplied and about 12000 rooted plants were produced. Two clonal trials (1.0 ha each) were planted at Chennai (Gudalur) and Neyveli research stations. Two Clone banks of 63 clones have been established and maintained in closed motherbed chamber for propagation through minicuttings at IFGTB.

Significant variation among families was observed for growth and form among 126 families in a progeny trial of *Acacia auriculiformis* at two year age. The first and second year growth data were analysed and ranking of the family was done. The trial was thinned during February 2014 by culling two trees per family in each replication.

Thinning was carried out in 2 year old *A.mangium* progeny trial at Palode



Variation in heartwood formation in 2 year old trees of *A.mangium*

Leucaena leucocephala

Leucaena leucocephala is one of the admirably suited species for paper and pulp manufacture and it expressed superior characters for all the pulp qualities assessed, when compared to other species. IFGTB initiated tree improvement programme on *Leucaena* during July 2013. Various national and international organizations, working on *Leucaena* were contacted to obtain germplasm. Collected 29 seed lots from BAIF, CRIDA, TNAU NAVSARI Agricultural University and seeds imported from University of Hawaii, USA. Raised 3500 seedlings from 29 seed lots at IFGTB Nursery. Established progeny trial at Neyveli field station.

Dalbergia sissoo

- Twenty five numbers of CPTs were identified in Bihar and Jharkhand. Cloning of these CPTs has also been done. Mortality resistant clones developed by FRI Dehradun have been collected and field planted in local conditions at Ranchi. A trial with 12 clones has been established in local conditions of Jharkhand.

- Cloning of *D. sissoo* is standardized for the selected clones and a clonal bank has been established for clonal multiplication and testing purpose in future. Incorporation of more clones from eastern India is in progress.

Dalbergia sissoo roxb. clones for large-scale clonal forestry

Melia composita

Commonly known as Burma Neem, is fairly large, deciduous and fast growing tree. It grows upto a height of ~20 m with straight cylindrical bole of ~ 9 m. Due to its fast growth and multiple uses, it is emerging as a favourite tree for agroforestry plantation in the North-Western states of India. If tested, it may be a good introduction in agro forestry in arid and semiarid tracts, where irrigation is available. Open pollinated seeds of 42 CPTs were germinated in nursery with family identity. It was observed that there exists considerable variation in speed as well as germination percent amongst the selected phenoltypically superior trees.

Different progenies were evaluated for genotype x environmental interactions over different geographical locations in the state of Haryana, Punjab, Uttar Pradesh and Uttarakhand to understand growth performance, stability and adaptability through G x E interactions. Trials were successfully established in the states of Rajasthan, Gujarat, Karnataka, Tamil Nadu, Bihar, Assam and Jharkhand. A series of scientific trials of target species were established to evaluate performance of various germplasm at different geographical locations for comparative performance and G x E interactions. Further selection and characterization of genetically divergent *Melia composita* using index method based on different traits was carried out. The selected trees were marked and seeds were collected and processed and now been sent for establishment of multi-locational trials over the states of India. Genetic evaluation of the most suitable progenies was carried out in various geographical locations to analyze stability and adaptability and screening of suitability of genotypes for arid and semi-arid regions. The progenies / genotypes, which survive and sustain in toughest of the conditions of more than 48°C of temperature and very little rains are expected to play a crucial role in rehabilitation of arid and semi-arid zones.

Progeny trials established at IFB, Hyderabad and at Bangalore, Karnataka were measured periodically in terms of height, DBH, number of leaves and number of branches. The screening of populations has been carried out and new source of plus trees were found for *M. dubia* in Khammam district of Andhra Pradesh, Kollegal of Karnataka and Kothur, Krishnagiri of Tamil Nadu. Similarly, for *M. azedarach* new source was found in Ballampally Forest Division of Adilabad district of A.P. The seeds from plus trees selected by IFGTB were supplied to augment the base of germplasam and accordingly all the collections were raised in Hyderabad and the progeny trials established in Gudalur in Chennai (Tamil Nadu). Experiments were conducted for rooting of stem cuttings of *M. dubia* and

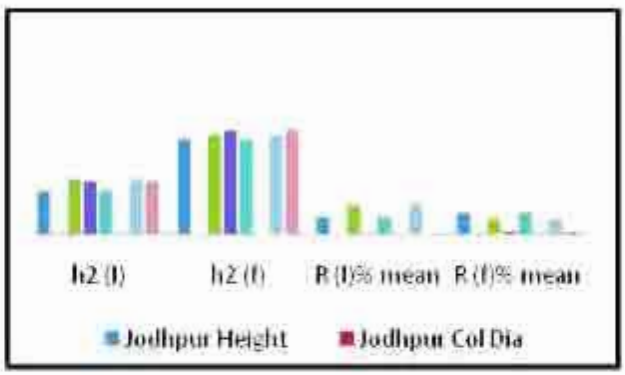
M. azedarach inside the mist chamber as well as outside the mist chamber using shade net by giving different treatments of auxins. The vegetative propagation technique was successful with more than 80 per cent rooting.

In RFRI Jorhat, progeny trials were established at two locations viz. FRC, Mandar and Experimental field Nagari (Ranchi) in Jharkhand and at one location, KVK, Manjhi, Saran in Bihar with 21 progenies collected from FRI, Dehradun. The survey for identification of promising genotypes and provenances has been carried out in North Bengal, Jharkhand and Bihar and seeds have been collected.

To study the genetic variation and investigate inheritance pattern of this species, three progeny trials consisting of 24 families at Jodhpur (Rajasthan), Gandhinagar and Deesa (Gujarat) were established. Growth data were collected from these trials and analysis of variance performed at six month age revealed that both height and collar girth exhibited significant variation amongst the tree tested, except in the case of collar girth at Jodhpur and Gandhinagar. The growth performance and survival (96%) at Jodhpur trial was best followed by Gandhinagar and Deesa.

Progeny trial of *Melia composita* at Jodhpur

Self pruning segregant in Jodhpur trial



Heritability and genetic gain estimated in *Melia composita*

In IWST Bangalore, progeny trial was laid at Agundapalli. Survey of *M. dubia* population in Kollegal, Hunsur, Periyapatana HD Kotte, Ramanagara and Kanakpura was carried out.

Assessment of growth and genetic diversity of *Media dubia* was carried out with funding from Karnataka Forest Department. The project was envisaged with two objectives *viz.* Growth potential of *Melia dubia* and to evaluate the genetic variation in *Melia dubia*. Survey was carried out to identify various plantations in Karnataka and growth observations recorded. From the natural population and plantations, leaf samples were collected and genetic diversity assessed.

Surveys were undertaken in the states of Kerala and Karnataka to identify superior

Germplasm. A Vegetative Multiplication Garden was established in the Model Nursery of IFGTB with the identified material. 42 accessions from FRI and 15 accessions from RFRI were received which were subjected to germination studies. An evaluation trial comprising seedlings, cuttings, tissue culture raised, plantlets were laid out in the experimental design. Identified 10 CPTs of *Melia* in Karnataka in natural growing areas.

Bombax ceiba (Semul)

Evaluation of *Bombax ceiba* for seed sources was carried out in Northern India. Seeds of 14 CPTs were collected and seedlings were raised. Seedlings were maintained for establishing field trial in the next year. Germplasm from Assam was also maintained. Rooting of branch cutting was achieved in juvenile cuttings.

***Azardirachta indica* (Neem)**

Neem progeny trial was established in the year 2002 at Govindpura, Jaipur with seedlings of selected 17 CPTs for high Azadirachtin content. This trial is almost, now, 11 year old and significant variation in flowering and fruiting observed. Overall fruiting and flowering was very poor. Moreover, conversion rate of flowers into fruit was also very poor. It appears that frost has affected the leaf biomass of trees, which resulted in inefficient photosynthesized reserve energy resources required for conversion of flowers into fruit and their growth. Progenies of CPT numbers 4, 7, 11 and 12 were found superior over other remaining CPT's progenies. Seeds collected from 33 plants showed oil content between 40 to 52 % in them.

Sapindus emarginatus

Populations of soapnut in Tamil Nadu were identified in areas, such as, Hogenakkal, Aliyar, Maruthamalai, Pillur, Dhimbham, Thirumurthy hills, Thengumarada, Thalavadi, Mettupalayam, Palani, and Sarkarpathy. Identified 133 CPTs and collected seeds. The number of fruits per metre length of branch was taken as selection criteria. Recorded seedling parameters in the germinated seedlings. Seedlings were transplanted and maintained in nursery. Chemical analysis of saponin by gravimetry was completed for each CPT. Established germplasm bank of Soapnut at Panampally. Average of 13% saponin was identified as benchmark for shortlisting high saponin yielding CPTs. Thirty high saponin yielding accessions were laid out as multilocation trials in three locations namely, Chennai, Salem and Neyveli.

Dalbergia latifolia

Field surveys were conducted in Kalpi, Udaypur and Seoni for selection of superior trees. Twelve trees were selected at different locations in Kalpi, three trees at Seoni and 7 trees at Udaypur. The growth data and GPS locations of the selected trees were recorded.

Sandal and Bamboos

Demonstration of modern nursery for producing quality planting stock of *Santalum album* and bamboo was established with funding from Punjab Forest Department by IWST, Bangalore (Centre for Excellence in Research on Sandalwood). Some of the most outstanding contributions come in the fields from propagation (both micro- and macro-propagation), population assessment, germplasm bank, plantation technology, agro-forestry systems, pest management, chemical profiling, etc. States like Gujarat, Rajasthan, Uttar Pradesh, Maharashtra and others have already adopted the technologies and considerable plantations of the species are coming up in these areas. It is in this regard that the Institute proposed to extend these technologies to the State of Punjab. The idea in the project was to establish a modern nursery of sandalwood and bamboo species, and provide training to the personnel of the Punjab Forest Department. 4000 QPM of sandal raised at IWST transported from IWST, Bangalore was sent to Punjab for Demo plantation, which were established in Bhatola nursery area, Talwara Range, Desuya Forest Division, Mullanpur, Mohali Forest Division, Mathewada, Ludhiana forest Division and Ropar forest Division. Plants

of 4 species *Dendrocalamus asper, Dendrocalamus hamiltonii, Bambusa balcooa, Bambusa nutans (1200)* procured from IHBT, Palampur. Plantations of 0.5ha each were established at Bhatola nursery area, Desuya Forest Division, and 1 ha each in Talwara Range, Desuya Forest Division, Punjab. 35kg of sandalwood seeds collected from IWST germplasm bank were given to Punjab Forest Dept. for establishing modern nursery for quality planting stock of *Santalum album* at Bhatoli, Talwara. Nursery was established and 50,000 sandalwood seedlings raised during 2014.

Distribution, diversity and productivity of *Dendrocalamus stocksii* (Munro) in Western Ghats of Karnataka was studied with findings from Karnataka Forest Department. *D. stocksii* is cultivated in coastal belt of Karnataka. This is considered as an important agroforestry species, ideal for plantations in watershed and coastal regions. This is an extremely manageable species with a great economic and ecological importance, finding large scale utilization in scaffolding, paper and pulp, crafts, construction, making baskets, umbrella handles and poles. The National Bamboo Mission has also prioritized this species for mass scale cultivation in Maharashtra and Karnataka. Genetic diversity is essential to the long term survival of species. Without it, species cannot adapt to environmental changes and are more susceptible to extinction. This study aims at documentation of the extent of distribution of *D. stocksii* in the Western Ghats of Karnataka and will help in approximating the extent of growing stock of this species. The distribution of *Dendrocalamus stocksii* clumps, along the districts of Central Western Ghats in Karnataka, Kerala, Maharashtra and Goa was surveyed. A total of 102 genotypes of *Dendrocalamus stocksii* were evaluated and offsets/ culm cuttings collected and transported first to Dapoli Nursery by road and rail. The coordinates of selected genotypes were plotted using GPS. The edaphoclimatic parameters were also recorded. The morphological and genetic diversity of the species in the region and its physiological adaptations, if any, will help identifying better genotypes for further study.The culm biomass productivity of the clumps distributed in different ecological conditions will be estimated, which will form the baseline for developing management regimes to improve the productivity.

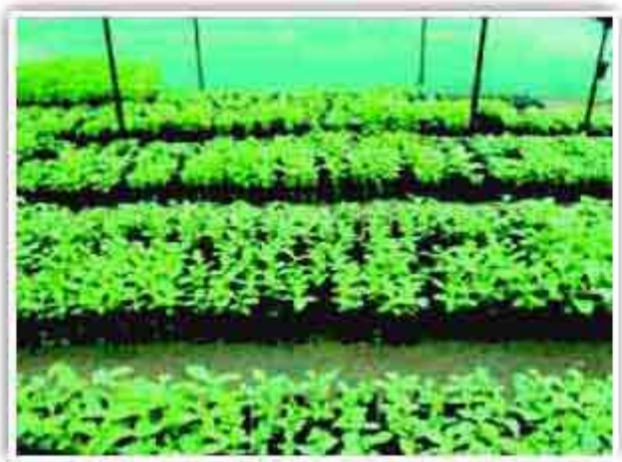
Teak

For developing breeding populations of teak with broad genetic base for long term genetic improvement, about 200 CPTs of teak were selected from SPAs in Topslip, Parambikulam, Nilambur, Kulathupuzha, Konni and seed orchard in Walayar. The trees were selected based on the growth superiority. Seeds were collected from these selected trees and sown in the nursery maintaining the identity of each seedlot. Germination per cent of each lot was recorded and seedling growth data in the nursery recorded.

Teak seedlings in IFGTB Nursery

Teak seed germination in mist chamber

Teak seeds from single tree collection



Teak seedlings in IFGTB Nursery

About 8000 seedlings were raised at IFGTB Nursery. One ha of breeding population of Teak was established at Neyveli field station and is being maintained.

To estimate genetic gain from teak seed orchards, flowering, fruiting and out crossing behaviour was studied in successive years starting from 2009. Comparing the data obtained from the previous five years in an earlier project, the trends in flowering of different clones in different locations were identified. Seeds were collected from ramet and clone-wise and subjected physical, X-radiography and germination studies. Seeds of seed orchards consistently showed poor seed filling and germination across the years and locations compared to seeds of seed production areas. Out crossing studies were also conducted using SSR markers.

Descriptors are now important for registering varieties and clones. Development of descriptors and DUS testing guidelines for indigenous forest tree species was carried out in *Tectona grandis* and *Melia dubia* including establishment of field gene bank.

Molecular assessment of breeding patterns in clonal seed orchards of Teak in Andhra Pradesh was initiated to strengthen the breeding programmes. DNA extraction work using CTAB protocol was completed for all mother plants and 450 progenies. Fifteen microsatellite primer pairs were screened for their amplification efficiency and polymorphism on a batch of test samples. Polymorphism was observed in the banding pattern of nine primer pairs. Genotyping of mother and progenies with the selected primer pairs is under progress.

Evaluated four progeny trials of Teak established with 16, 16, 28 and nine half-sib families at Rajpipla, Shivrajpur, Sajjangarh and Jodhpur, respectively. Individual tree data from these trials were collected. Analysis of variance of these trials revealed that variation due to families was highly significant for height and girth in Rajpipla; girth and clear bole length in Shivrajpur and for both height and girth in Sjjangarh and Jodhpur trials. This indicate scope for family selection.

Under all India Coordinated Projects on Teak with TFRI, Jabalpur as Nodal Institute, selections of plus trees, raising their progeny trials and establishing germplasm bank was initiated as coordinated programme for genetic improvement of Teak. Rukad and Kurai range of Seoni (South) Forest Division was surveyed, seven CPTs marked and data recorded on them along with the 35 comparison trees.

Marking of CPTs of Teak in Seoni (South) Forest Division

Ailanthus

Ailanthus excelsa is an important tree species in Rajasthan and locally known as Ardu. Its timber is used in plywood industries and leaf as green fodder. Demonstration trial of male and female plants was raised of the selected trees using grafting technique developed by the AFRI. Analysis of the growth data collected from the trial after the fifth year revealed significant differences between female and male plants in all parameters recorded on growth (above and below ground), except number of primary roots. Female plants were far superior (above 60%) to male plants in production of leaves (average fresh weight of leaves) and number of branches.

Selection of superior genotypes and developing clonal technology for raising clonal plantation of indigenous species *Ailanthus excelsa* and *Ailanthus triphysa* in Tamilnadu and Kerala was done. Survey done in western zone and Cauvery delta zone, western and southern zone of Tamilnadu. 170 CPT's of *Ailanthus excelsa* and120 CPT's of *Ailathus triphysa* were identified with GPS marking in Kerala and Tamilnadu. The shortlisted CPT's were felled and allowed for coppice production. The coppice shoots performed better than the branch cuttings and gave optimum of 65-70% of rooting. The rooted cuttings are being mass multiplied for the multilocation clonal trial.

Populus deltoides

Nursery stock of 30 clones of *Populus deltoides* was raised in the nursery. Field trials of these clones were established at four sites during 2013-14. The trials established during 2012-13 were also maintained. Cellulose content estimation and wood anatomical studies of 30 clones were completed. Screening of poplar genotypes against *Alternaria alternata* toxin(s) is being done at FRI. Screening of the commercial clones of *P. deltoides* namely, G-48, Udai, WSL-22 and WSL-39 against toxin of *A. alternata* was done. Initially, 15 isolates of *A. alternata* were studied for their relative growth, and dry mycelium and toxin weights. The work is in progress.

Neolamarckia cadamba

For genetic improvement of *Neolamarckia cadamba*, selections in the natural population and existing plantation in different parts of Tamil Nadu, Kerala, A & N Islands and North Eastern State (Assam) was carried out. About 118 CPTs were identified, fruits collected from all the selected CPT's and progenies raised and maintained for out planting in the next monsoon season.

Pterocarpus santalinus

Study of variation in *Pterocarpus santalinus* for growth and heartwood content according to

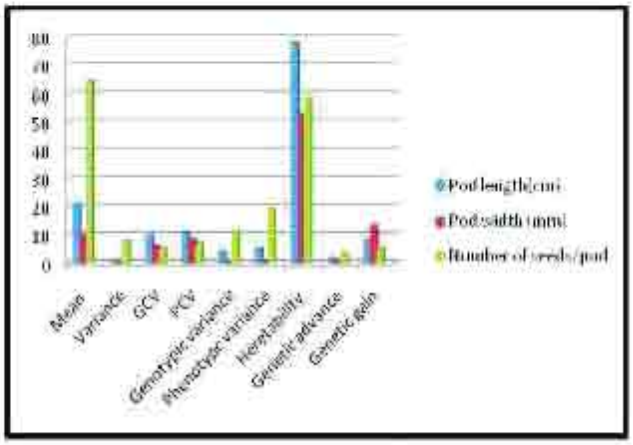
Planting of progeny trial of red sanders at Neyveli during December 2013

Red sanders seedlings ready for planting progeny trial

edaphic and climatic factors in Tamil Nadu was carried out. During current year, 65 CPTs of red sanders were selected from various plantations. Single tree seed collection done from selected CPTs. Germination was done in seed bed after seed treatment and 6000 seedlings were raised in polybags. Morphological characterization of seedlings was done. Two progeny trials were planted at Chennai and Neyveli Research stations during December 2013.

Tecomella undulata

Tecomella undulata is an important timber yielding tree species of arid region. During 2013-14, pods were collected from the selected CPTs across 20 different sources from six districts of



Estimation of genetic parameters of pod characters of *Tecomella undulata*

Seedlings raised with family identity at model nursery

New progeny trial of *Tecomella undulata* at Jodhpur

Raising of seedlings and progeny trial of *Tecomella undulata*, at Jodhpur

Rajasthan (Pali, Jalore,Nagaur, Sikar, Bikaner and Churu). All the pod parameters were moderately heritable ranging from 53 to 78 percent. Seedlings were raised in the nursery and the progeny trial of 36 CPT's established.

Existing (old) progeny trials of *Tecomella undulata* at Beechwal Bikaner and Jodhpur were also evaluated. It was observed that the progeny trial at AFRI Jodhpur performed better as compared to that at Bikaner with 87% of survival at Jodhpur and 58% at Bikaner at the age of 5 years.

5.2 Biotechnology Intervention

Substantial importance was given to the biotechnological approach for the tree improvement and conservation of genetic resources. The biotechnology research achievements are summarised as below;

- Two thousand seed progenies from first and second generation progenies were studied using Image Analyser for seed area, perimeter, width, length and roundness. Significant variation was observed in the orchard progenies. Second generation progenies indicated high mean value of all the parameters studied. One hundred and fifty progenies from ten different trees in the first and second generation orchard seed collections, were raised in the nursery. Both first and second generation progenies were screened completely for five microsatellite markers. Amplified unexpected product sizes of microsatellites were sequenced and were confirmed through BLASTn analysis. The sequences were deposited in NCBI. (KG699501.1, KG699563.1, KG699564.1). The microsatellite allelic data are being analyzed using MLTET software for estimating out-crossing rate in the orchards.

- Production of transgenic teak tolerant to defoliating pests is in progress. Shoot explants from the *in-vitro* germinated seedlings were multiplied in shoot induction medium. An experiment was designed to study the effect of different strengths of TDZ, different auxins (IBA, IAA and NAA) and their interaction on callus formation in different explants obtained from the seedling *viz.*, internode, leaves, roots and hypocotyls. The effect of auxins, TDZ and their interaction on callus formation was found to be statistically non-significant. The type of explant used had significant effect on callus formation. Callus derived from different seedling explants were regularly subcultured and multiplied in fresh callus induction medium for designing further experiments

Effect of different MS strengths and GA3 doses on *in vitro* seed germination in teak after 30 days of inoculation: (a) ½ MS and 0.1% GA3 (b) Full MS and 0.4% GA3

Calhus formation in different explants obtained from the seedlings viz., (a) internode in 0.1 TDZ and 0.1 IBA after 30 days, (b) roots in 1 TDZ and 0.1 IAA after 30 days, (c) leaves in 1 TDZ and 0.1 IBA after 15 days, and (d) hypocotyls in 1 TDZ and 0.1 NAA after 30 days of inoculation.

- Studies on population structure, linkage disequilibrium and marker-trait association mapping of Indian teak.

Germplasm collection, present at NTGB Chandrapur, Maharashtra was selected for pilot/baseline study. Cuttings and Leaf samples from 217 teak trees were collected for DNA isolation. Genomic DNA from 186 trees was isolated and 154 DNA samples and screening of microsatellite primers is under progress. Morphometric data (Height and GBH) were also recorded from 217 trees.

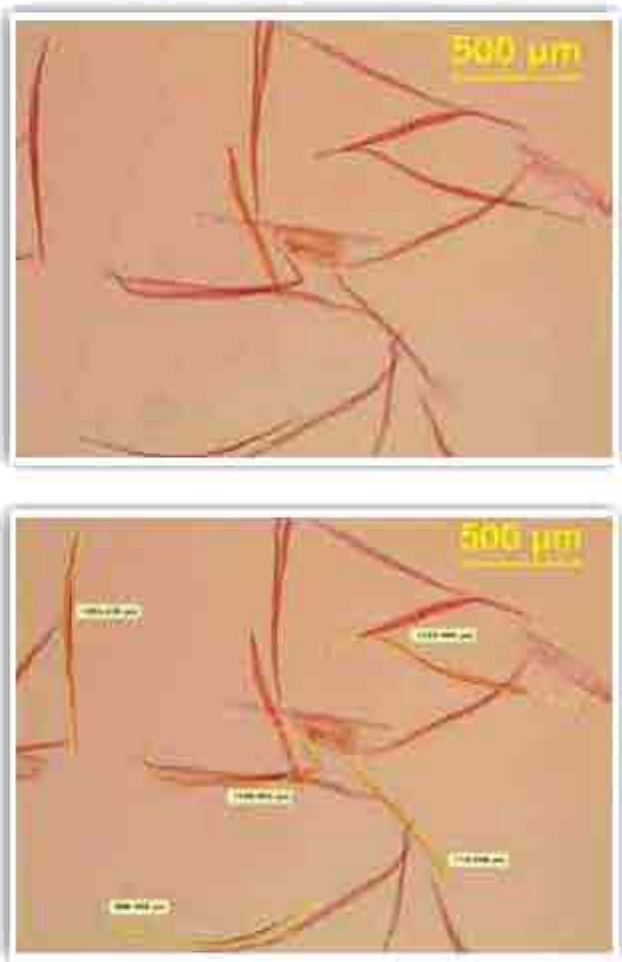
A view of National Teak Germplasm Bank Chandrapur (MS) and sprouting in collected cuttings from NTGB, Chandrapur for DNA extraction

- Development of DNA-marker based technique for *Cedrus deodara* for wood/timber forensics was attempted. Three cpSSR primers reported in *Pinus sylvestris* L. PCP1289, PCP9434, PCP6377, and three Pt15169, Pt26081, Pt30204 from *P. thunbergii* showed positive amplifications as well as variation, specific to the geographical area. The results also showed population specific allelic variations in some SSRs which indicate the possibility and usefulness of the SSR markers in identifying the timber source in case of illicit felling of *C. deodara*.
- Characterization of *Pinus roxburghii* for resin yield and spiral grain formation in wood using association studies and using molecular markers was done. DNA isolation and quantification of all twisted pine sample (144) and normal pine population (20) completed. All the above samples characterized using 10 primers, scoring of gels and data analysis and in progress. 6 populations of twisted pines and DNA bands are being scored for polymorphism in twisted and normal pine samples. ISSR primers are also being screened for low and high resin yielders. Data analysis and interpretation is under progress.
- Population genetic analysis of Himalayan Banj Oak (*Quercus leucotrichophora*) is being carried out. Banj oak is the most common broad leaf tree in the mid-elevational Central Himalaya in India. It is the most preferred tree species in the temperate region, mainly used for fodder, fuel, and small timber. Twenty four populations, each with 30 individual trees covering Himachal Pradesh and Uttarakhand were sampled for DNA marker based study. DNA extraction techniques standardized and genomic DNA isolated from all 24 populations (720 samples). RAPD fingerprinting of 510

samples, representing seventeen populations using, 10 selected primers were completed. Their scoring work has also been completed. For SSR marker analysis, a total of 15 polymorphic microsatellite markers were screened for population genetic analysis work. Initial data analyzed revealed low to moderate level of genetic diversity in populations of Ban Oak in Himalayas.

- Assessment of genetic diversity and structure of *Boswellia serrata* Roxb. Population was done through RAPD and ISSR markers. DNA samples from 12 populations of M.P. were analyzed for their purity index. Results revealed that the quantity of genomic DNA was higher than 200 ug in 1 gm of leaf sample of all the populations. Genomic DNA was also checked qualitatively on 1% agarose throught gel electrophoresis. A considerable variation in fibre length was noted which ranged from minimum 887 um (Mandla and Sheopur) to maximum 1560 um (Rewa).

Flowering in *Jatropha curcas*



Measurement of wood fibre length in 5X magnification using Leica microsystem EC 3 (A) Wood fibres in unmeasured form (B) Measured wood fibres

- Development of gene markers for high seed oil content and dissecting molecular basis of female flower development in *J. curcas* attempted for genetic improvement for high seed yield. This is a new and collaborative project with JUIT Waknaghat (Solan, HP) and was initiated recently.
- Open pollinated progenies of the clonal trial (*Eucalyptus camaldulensis* establisahed in 2003 by IFGTB) tested for genetic gain. Clones available in the trial were shortlisted as parents; samples were collected for DNA extraction. The protocol for obtaining quality DNA was standardized. The DNA samples were checked for amplification. Primer amplification was carried out using 25 primers. Both gel electrophoresis and genetic analyser techniques were standardised to obtain the SSR profiles of the shortlisted parents.
- In the programme of control crossing of *C.torelliana* x *Corymbia citriodora*, germination test was carried out for the *Corymbia* and full sib seeds harvested. A hybrid field trial using vegetatively propagated seedlings of seven combinations was also established in Walayar (Kerala) and silvicultural practices followed after planting. Performance of 12 months old full sib hybrid

trial existing at ITC premises was evaluated jointly with ITC team and field data recorded. Morphological markers (leaves, spines, color of spine, stem and leaves), physiological markers (stomata and its distribution) and molecular markers (DNA) were studied.

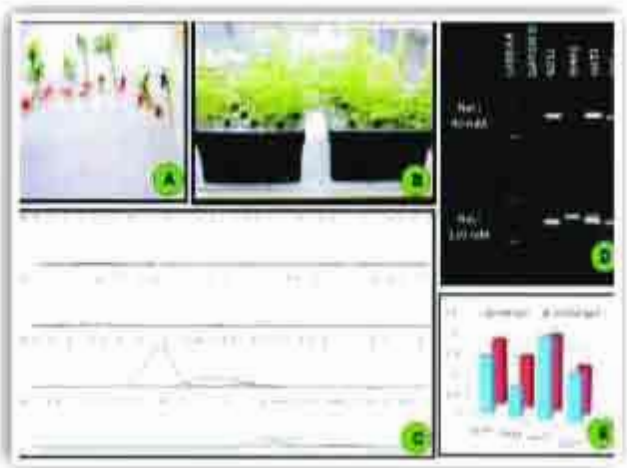
- Under the quantitative trait loci (QTL) mapping programme of eucalypts, genotyping of dihybrids of *E. tereticornis*, *E. camldulensis* and *E. grandis* using 300 SSR markers are in progress. *Eucalyptus* being an obligatory outcrossed species with potential to self polliantion, possibilities of pollen contamination is high. Hence, in this study, *Eucalyptus camaldulensis* x *E. tereticornis* inter-specific hybrids were genotyped, using 25 fluorescent labeled microsatellite markers available in public domain. Multiplex loading of PCR products was performed successfully for most of the microsatellite loci. A subset of six fully informative simple sequence repeats was identified for routine quality control genotyping for these hybrids. Detection of non essential genotypes observed among the hybrid seedlings proved the significance of hybrid purity tests and the false hybrids were removed at the seedling stage. The hybrids with proven hybridity will be used for generation of genetic linkage. Discovery of quantitative trait loci and the individuals with high productivity can enter into mass clonal multiplication.
- A microarray was designed and printed representing 25,908 genes sourced from RNA-Seq and EST datasets involved in wood formation in different eucalypt species. The expression patterns of these transcripts were documented in four distinct genotypes of *E. tereticornis* with low/ high cellulose and lignin content. The data will be used to develop a gene regulatory network (GRN) for xylogenesis in tropical eucalypts. The GRN will be subsequently used to identify major regulatory switches for xylogenesis and wood formation. This will help in identifying major effect genes for candidate gene based association analysis to identify markers tagging wood property traits.
- To study the role of HKT1 gene in *Eucalyptus*, gene silencing construct for EcHKT1 was developed and being used for developing composite transgenic Eucalyptus. The full length coding region of EcHKT1 gene (1653 bp) was isolated from *Eucalyptus camaldulensis* cDNA and is being used in developing the transformation construct for over expression in Tobacco and *Eucalyptus*. Determination of sequence information of insect- genes is crucial for application of transgenic RNAi technology for control of the insects. In this direction, the partial gene sequence information for chitinase gene (596 bp) of *Eucalyptus* insect pest *Leptocybe invasa* and the beta-tubulin gene of the teak insect pest *Hyblaea puera* (560 bp) and Eucalyptus insect pest *Leptocybe invasa* (691 bp) were sequenced and published with accession numbers, KC818286.1, KC818287.1, KC880336.1 at the Gene Bank Database of the National Centre for Biotechnology Information (NCBI), National Library of Medicine and National Institute of Health, USA. dsRNA was synthesized for *L. invasa* chitin synthase and an accessory for delivery of dsRNA molecule into galls in potted *Eucalyptus* plants was developed.
- The antipest lectin *(WsMBP1)* isolated from the salicylic acid treated leaves of *Withania somnifera* was cloned into two plant transformation vectors and the constructs *(pUH-WsMBP1* and *pCambia-WsMBP1)* were transformed into tobacco. The putative transgenics were selected on antibiotic selection medium and transgene integration was confirmed through PCR. The functional validation of the transgene will be conducted subsequently to confirm the antipest property of the encoded gene.

Additionally, a 294 bp antipest cysteine protease inhibitor, cystatin (*WsCYPI*) was cloned from *W. somnifera*. Two gene constructs (*pUH-WsCYPI* and *pCambia-WsCYPI*) were developed for ectopic expression and functional analysis in tobacco. The transformation events have been conducted and putative transgenics have been

selected for confirmation of transgene integration.

The leaf transcriptome data of *W. somnifera* were mined for pathogenesis – related (PR) genes and seventeen genes, representing PR families were identified and their expression pattern post 17 and 36 hours of salicylic acid treatment was documented. The analysis revealed significant up-regulation of all families of PR genes by 36 hours post treatment except *WsPR10*. The relative fold expression of transcripts, ranged from 1 fold to 6,532 fold.

- Study of salt tolerance through gene expression pattern analysis conducted at AFRI. The project aims at analyzing the pattern of expression of four genes (NHX1,SOS1, HKT1 and CLC-c) that are known to function in maintaining ionic balance within the plant, particularly, in regulating the non-toxic levels of sodium chloride, which is the dominant salt in saline soils. A halophyte (salt tolerant plant) – *Lepidium sativum* was used and grown hydroponically at different levels of salinity ranging from 40 to 200 mM NaCl. RT-PCR was performed on transcripts of selected genes. The amplified gene products were separated electrophoretically. Using semi quantitative approach, level of gene expression (up-regulation/down-regulation) has been analyzed. Significant up regulation of NHX1 gene in leaf tissue of *Lepidium sativum* at high concentration (120 mM) of NaCl has been observed as compared to remaining three genes. NHX1(Sodium/ Proton Exchanger) gene in *L. sativum* was found as one of the important gene conferring salt tolerance to the plant.

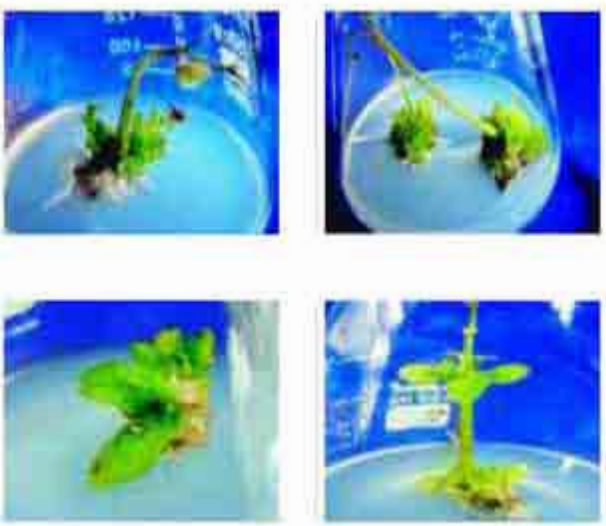


Study of gene expression pattern: A. Seed gumination in *Lepidium sativum* (5 days old); B. *L. sativum* plants growing hydroponically at (7 weeks old); C. Gene sequence data D. Gel images showing four genes expression at two salt concentrations. (*GAPDH* used as positive control) E. The graph showing higher expression levels of NHX1 gene in *L. sativum* at high salinity level.

5.3 Micro and macro propagation

Micro propagation techniques standardized for important forestry species

- Experiments on rooting of cuttings were carried out for *Melia dubia*, Ailanthus excelsa, *Grevillea robusta*, and *Anthocephalus chinensis*.
- Attempts were made to develop micro propagation technique to regenerate/ multiply mahulpatta for getting higher production. Shoot multiplication and elongation of mahul on MS medium supplemented with 1.0 µM TDZ gave encouraging results.



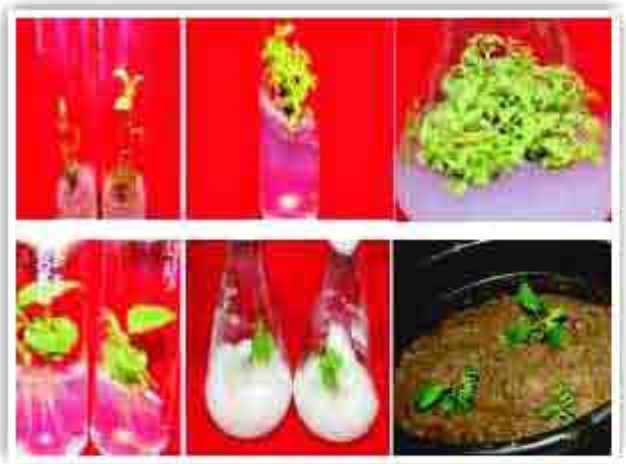
Shoot multiplication and elongation of mahul on MS medium supplemented with 1.0 µM TDZ

Rooting in Mahul cuttings collected from keonchi and treated with 1000ppm IBA and 800ppm thiamine.

- Refinement and standardization of protocols for *in- vitro* propagation and genetic fidelity studies of micro propagated plants of two bamboo species of *Bambusa balcooa* and *Thyrsostachys oliver* carried out. In *Thyrsostachys oliver,* plantable clonal plants are obtained in 5 months period with 7-8 tillers with miniature rhizome. Further multiplication can be done by macro proliferation. In *B. balcooa*, MS liquid medium supplemented with kinetin proved least effective as compared to BAP and TDZ for shoot multiplication.
- Work in progress to refine existing micro-propagation protocols of *Dalbergia latifolia* for production of improved planting stock for genetic improvement of germplasm in central India. Different cytokinins and 2, 4-D treatments were tested for *in -vitro* callusing and organogenesis in immature seeds collected from Kalpi. Seeds collected from selected trees were germinated. Cotyledons of seeds collected from three different genotypes were tried for shoot formation. *In-vitro* shoot cultures are being maintained.

Callus formation in immature seeds and cotyledons of *Dalbergia latifolia*

- *In -vitro* seed Culture has been initiated from green capsules of Vanda coerulea, collected locally in RFRI. Seeds have already started germinating in different media. Different plant parts are also being assessed to induce somatic embryos.
- Efforts were made for the development of macro and micropropagation technology for multiplication of economically important desert plant- *Salvadora persica*. MS medium was found to be the best for *in -vitro* shoot multiplication. Macropropagation through



In- vitro propagation of *Podophyllum hexandrum* Royle through axillary bud

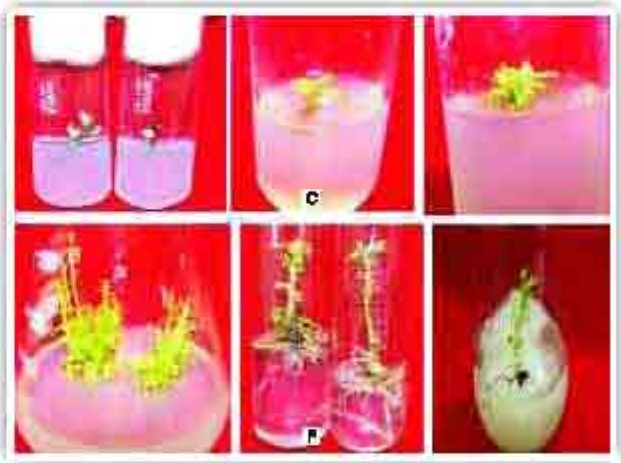
stem cutting from mature plants was carried out using sand as rooting medium in mist chamber. Results revealed that use of various concentration of IBA (500,1000, 2000 4000 ppm) resulted in low rate of rooting from the cuttings.

- Complete tissue culture protocol for *in vitro* multiplication of *Podophyllum hexandrum*, an endangered but high value medicinal plant, through two regeneration pathways namely, organogenesis and axillary bud proliferation was developed.
- Tissue culture technique for clonal propagation and supply of genetically superior trees of Neem, ardu and bamboos was initiated at AFRI, Jodhpur.

Multiple of multiple shoots of *A. nilotica* on MS medium with BAP *(2.0 mg/l)*+ Kn *(2.0 mg/l)*

Shoot initiation in *A. excelsa* MS medium with BAP (2.0 mg/l) + IAA (0.5 mg/l)

- Plantlets of Sea Buckthorn *(Hippophae salicifolia)* have been produced from epicotyle of the in-vitro raised seedlings and nodes of the field grown plants in MS medium. Different plant hormones were tried for shoot induction, multiplication, shoot elongation and rooting. These plantlets are under the process of acclimatization.



A-F: *In -vitro* propagation of *Hippophae salicifolia* through axillary bud

- Under studies on pollarding and propagation in kusum *(Schleichera oleosa)* for lac cultivation collection of stem cuttings & scion of plus trees of Kusum from Jharkhand (Basia, Simdega, Bano, etc) were carried out. Accordingly grafting operation & stem cutting trials were conducted. VMG has been

established. Clonal trial of kusum has been initiated with the plantation of clones of 20 plus trees with three replications. Survivability data were also recorded. Ten year old kusum trees were pollarded at height of 1m & 1.5m. Data are being recorded on number of shoots / branches emerged. Some sapling of kusum were pollarded also. Periodically data are being recorded on number of shoots / branches emerged, collar dia. etc from pollarded trees. Brood lac (25 kg) was collected from Heasardih in July 2013. Inoculation was carried out on pollarded trees of kusum at FRC, Mandar. Total of 336 nets were used (av. 74.4g/net). Around 100 trees/ saplings were inoculated. Removal of phunki was done after two weeks of inoculation.

Quality planting stock production of *Gmelina*

- Studies initiated for standardization of propagation method and germplasm conservation of *Machilus villosa* & *Quercus lineata*. Twentyfive plus trees of each species were selected on the basis of phenotypic characteristics in Darjeeling and Jalpaiguri Districts. On the basis of growth characteristics, 6 plus trees in case of *Q. lineata* and 10 plus trees in case of *M. villosa* were selected.
- Development of micro propagation protocols for production of superior germplasm of *Dalbergia latifolia* Roxb. and *Pterocarpus santalinus* L completed. The project aimed to establish tissue culture lab at IFB, Hyderabad and subsequently, to standardize micro-propagation protocol for *D. Latifolia* and *P. santalinus*. Accordingly, complete protocol for *in -vitro* propagation was standardized for *D. latifolia* and 200 plantlets were raised through the established protocol. Plantlets survived 100 per cent, during acclimatization process and hardened plants were planted out in the field for demonstration. In case of *P. santlinus,* the multiple shoot initiation and multiplication of culture was standardized through explants and callus culture. The experiments on *in- vitro* and *ex -vitro* rooting were carried out for *P. santalinus* and finally *in -vitro* rooting was successful. With this, the tissue culture protocols of both the species have come out successfully.

5.4 Tree Borne Oil seeds (TBOs)

- Selection, improvement and molecular characterization of *Pongamia pinnata* in eastern India was done. The original germplasm was multiplied for plantation at different places along with stockplant management. DNA extraction protocol was standardized using different plant material and 4 methods available in literature. Designing and synthesis of 30 SSR primers. PCR amplification of DNA extracted from all the germplasms were carried out and amplified products checked on electrophoresis. SSR's from related forestry species have also been evaluated in *P. pinnata*.

Fruit & Flower of *Pongamia pinnata (L.)*

A total of 91 high fruit yielding candidate plus trees of *Pongamia pinnata* were selected from different agro-climatic zones of Tamil Nadu, Pondicherry and Kerala. The selected

High pod yield in selected CPT of *P. pinnata* at Hosur (Tamil Nadu)

Vegetative Multiplication Garden (VMG) of *Pongamia pinnata.*

trees were multiplied clonally and a vegetative multiplication garden established. Clones are being multiplied from VMG for establishing multilocation clonal trials. 7 trees showed 103 to 250 kg pod per tree, and the oil percentage in the selected CPTs varied from 15 to 33%. The clones which showed high fruit yield with high oil content will be recommended for large scale planting programme.

Candidate plus trees of *Pongamia pinnata* selected from northern part of the country were screened for phenotypic characters in different states, and progeny trails conducted. Oil content ranged from 27.89 to 41.43 % with an average value of 35.27 %. In fact, 48.42 % genotypes yielded more oil than average (35.27%) and maximum oil content was recorded as 42.17 %. On the basis of higher oil content and high seed germination ability, the genotypes were further narrowed down to forty nine (49) which were established as progeny trials in the different geographical regions of Punjab, Haryana and Uttarakhand to assess their genetic worth.

Seed behaviour and effect of differential drying and temperature on viability of *Mesua ferrea* and *Madhuca insignis* (species of wet evergreen forest of Western Ghats) was studied with fundings from Karnataka Forest Department. Preliminary results revealed that seeds show recalcitrant behaviour on the basis of

Pongamia clones

habitat, seed size, and moisture content at maturity, germination, seed coat ratio and model on probility of recalcitrant. However, the seeds can be dried to moisture content as low as 1.78% with 50% viability.

5.5 Conservation of Forest Genetic Resources

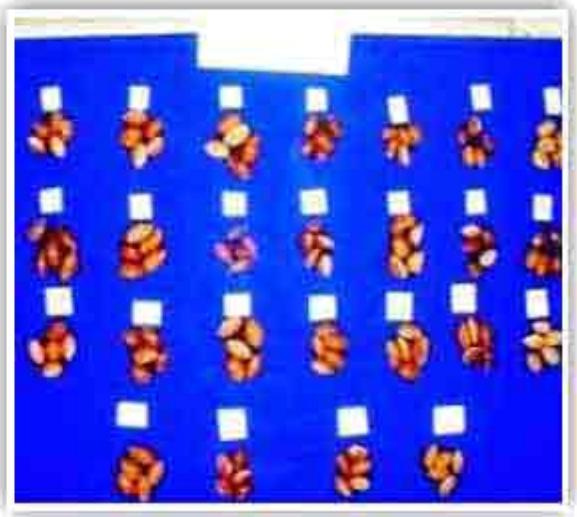
- Forests are the world's most important and most valuable renewable natural resource, evolved and conserved over millions of years in their natural habitat. However, increase in the world's population, together with higher standards of living has resulted in continuous pressure to transfer areas previously under forest to agricultural or other uses. The resulting large scale disappearance of natural forests is leading to an accelerated loss of valuable or potentially valuable germplasm. The objectives of conserving forest genetic resources are to secure the ability of forest tree species to adapt to environmental changes and to maintain the basis for improving production and other benefits of growing trees through future selection and breeding activities. In Western Himalayas, where the tree vegetation is mainly confined to the northern-aspect and the southern slopes are devoid of vegetation. The ever increasing human and cattle population over the years has put lot of pressure on forests of *Pinus roxburghii* (chir pine), *Cedrus deodara* (deodar), *Abies pindrow* (silver fir) and *Picea smithiana* (spruce), *Pterocarpus santalinus etc.* consequently, resulting in decreased density of these forests, though over all forest area may have increased. Hence, FGR are indispensible elements for effective and long term conservation for the betterment of the society, sustainable utilization and conservation.
- Sandalwood is recognized worldwide as one of the most valuable commercial tree species with an estimated market volume of more than $1 billion. Genetic diversity study for prioritization *in- situ* conservation sites for sandal populations in southern India has been initiated. Genetic diversity studies will probably help to unravel this confusion and the results will expectedly help in better management and conservation strategies for this flagship species.
- For conservation of *Garcinia* species in Upper Brahmaputra Valley, Assam, surveys were conducted in Tinkupani and Tipong Reserve Forest, Dihing Patkai rain forest in Tinsukia District, Jokai, Namdang, and Medela Reserve Forest in Dibrugarh district, Sola and Abhoipur reserve forest in Sibsagar district, Gibbon WL Sancturay, Jorhat district and Nambor Reserve Forest in Golaghat district for study of *Garcinia* with respect to its distribution and ecology.

Garcinia kydia in Dihing Patkai Rain forest Assam

Garcinia dulcis in Dihing Patkai rain forest Assam

- A study was conducted with aims at introduction of *Morinda citrifolia* L. (Noni) into NE States as livelihood option for the people of North East India. Collected 750 numbers of tested clones of Noni from CARI, Port Blair for experimental trial in North East. Successfully raised the Noni plants in RFRI campus and further monitoring of growth performance are in progress.
- Collection of germplasm of *Madhuca indica* J. F. Gmel for identification of best sources in

Mahua trees selected in Bhanupratapur and Jagdalpur



Variation in size and shape in fruits and seeds of mahua collected from Bilaspur

Chhattisgarh through phytochemical evaluation was carried out. Survey and selection of trees was carried out at Balod, Bilaspur, Jashpur, Kanker and Jagdalpur. Mahua trees were selected from five girth classes, viz., 61-90 cm, 91-120 cm, 121-150 cm, 151-180 cm and over 181cm. Saponin content is being estimated in seeds.

- For collection and characterization of critically endangered *Litsea glutinosa* germplasm from Madhya Pradesh and Chhattisgarh, visited and carried out survey of Chhindwara (West) Forest & Balaghat (South) Forest division. In Chhindwara (West) Forest Division, Total 31 trees were located and detailed morpho-metric data was recorded along with GPS location in specified format. Out of 31 trees, propagating material from 10 trees was collected and established in the nursery of the division. From Balaghat (South) Forest division, total 26 trees were located and detailed morpho-metric data recorded along with GPS location in specified format. Out of 26 trees, propagating material from 7 trees has been collected and established in the nursery of the division.

Field survey in *Litsea glutinosa* Balaghat Forest Division

- An improved holistic approach was adopted for development of database on fast growing tree species targeting stakeholders in Tamilnadu and Kerala. The information related to fast growing tree species viz., *Acacia auriculiformis, Acacia mangium, Neolamarkcia cadamba, Azadirachta indica, Bambusa bamboos, Bombax ceiba, Calophyllum inophyllum, Casuarina equisetifolia, Eucalyptus camaldulensis, Eucalyptus terticornis, Gmelina arborea, Grewia tiliifolia, Melia dubia, Paraserianthes falcataria and* other species were collected and updated. The database contains information on the important characteristics of the fast growing tree species. The information, such as, genus, family, local and common names, botanical descriptions, taxonomy and nomenclature, habitat, distribution and environmental conditions, important pest and diseases, different products, services, uses, seed characteristics (seed descriptions, weight, dimensions, size, germination, details type, size, percentage), seed collection, handling, processing, agro forestry practices, growth and yield, reproductive biology and breeding system, genetics and tree improvement, ecology, fruiting, flowering, cultivation, propagation, origin, wood (colour, grain, texture, strength, treatability, working properties, durability), planting stock (SSO,CSO, Progeny trial), reference etc were collected and updated.
- Mapping and monitoring of *Casuarina* and *Eucalyptus* Plantations in Tamilnadu using RS and GIS was done. The extent of *Casuarina* and *Eucalyptus* plantations in Ariyalur District of Tamilnadu has been mapped using LISS IV Resourcesat-2/ L-4FMX, geo corrected using Survey of India Topo Sheets. The identification of training pixels and plots were done by using the plantation data collected with the help of GPS from the field survey. Supervised classification was used to classify the image supplemented with visual analysis of the image and recode technique was used to reclassify the misclassified pixel with the

help of Google Earth and field check. Based on the field survey and data collected from TNPL, various land uses, including extent of *Eucalyptus* and *Casuarina* plantations were delineated. The results indicated that the data and processing technique used could offer a reliable approach for mapping Casuarina plants and other plantation crops.

- Forest Research Institute, Dehradun and Institute of Forest Genetics and Tree Breeding, Coimbatore have been designated as the nodal centres for Forest Genetic Resource Management Network (FGRMN) in the country. A FGRMN cell has been constiututed at FRI Dehradun which will be housed in a fullfledged building for operation. A new building for Forest Genetic Resources Management Network (FGRMN) is being established at IFGTB campus to take up the FGRMN activities. These centers will gradually be upgraded under the one time special grant of ICFRE. Exploration, collection, conservation, characterization and documentation are the key activities envisaged under FGRMN. Dr. S. Nagarajan, FGR Chair of Excellence appointed by ICFRE has prepared a document on National Forest Genetic Resources Conservation and Usage Plan in consultations with Forestry Research organizations and State Forest departments and submitted to ICFRE/MoEF for implementation.

Database on Forest Genetic Resources: Genetic Resources in the form of seed orchards, seed production areas, genetic trials, germplasm bank, plus trees etc have been established for important trees species by various stakeholders across the country. A database on candidate plus trees assembled by IFGTB was prepared for *Thespesia populnea, Pongamia pinnata, Neolamarckia cadamba, Ailanthus excelsa and A. triphysa, Calophyllum inophyllum, Sapindus emarginatus, Eucalyptus* and *Tamarindus indicus* and retrieval mechanism also developed. In addition, database has also been developed for seedling seed orchards, clonal seed orchards, seed production areas, clonal trials, progeny trials, clone banks and permanent preservation plots for Teak and *Eucalyptus* maintained by Tamil Nadu and Kerala forest departments.

Under the project, "Exploration, Collection and Evaluation of Forest Genetic Resources and Development of National Gene bank", 23 teak populations in Central and Northern part of Kerala were surveyed and recorded the variation on growth, tree form, branching pattern, reproductive characteristics, pest incidence, topography, soil pattern etc with GPS data. Eleven populations which showed distinct and desirable characteristics were marked for *in-situ* conservation.

Teak population marked for conservation at Nilambur, Kerala

Teak population marked for conservation at Iduki, Kerala

Seed Production Area of Teak at Varagaliar, Topslip (Tamil Nadu)

- Survey was conducted on populations of *C.inophyllum* in Trivandrum, Allepey, Kollam, Kazargod, Nagercoil, Kanya Kumari, Courtrallam, Chidambaram, Aliyar, Chennai, Karur, Annur, Avinashi, Anaikatti, Nagapattinam, Tenkasi, Sengottai, Puducherry, Karaikkal, Havelock, Mayabunder, Diglipur, Wandoor, Chidiyatapu, Rangat and Betapur in total covering Tamil Nadu, Kerala and Andamans and 159 CPTs were identified. The passport data were also collected. Vegetative multiplication through stem cuttings and produced rooted clones of selected CPTs standardized. Conducted germination tests, recorded seedling parameters, raised stock and standardized nursery management practices. Standardized seed processing for oil extraction from *Calophyllum inophyllum* kernels and oil analysis by Soxhlet method. Established Clone bank and Half-sib Progeny trial at Panampally and maintained. Shortlisted 40 high yielding clones having more than 55% oil content.
- Extensive field surveys were undertaken in the Western, North Western, Cauvery Delta Southern, North Eastern and high rainfall zones of Tamil Nadu, Puducherry, Northern and Central regions of Kerala and selected 128 CPTs of *Thespesia populnea*. Cuttings from these trees were collected and kept for rooting in the vegetative propagation complex of IFGTB. Bud sprout could be observed in all the cuttings and the rooting percentage was 60. No pest attack was observed till September 2011. However, 3 clones were affected by Mealy bug, later and, control measures adopted. Established a Clonal Multiplication Area with 82 clones at Panampally Research Station, Kerala.
- Tamarind orchards located at Neyveli, Thoppur, Theni & Mullangaddu have been evaluated for flowering and fruiting. Among different treatments, soil drenching of Cultar @3000 ppm and spraying of 2% KNO, found positive implication on enhancing fruit productivity.
- Studies on variation in reserpine content in some high yielding genotypes of *in-vitro* and seedling raised *Rauvolfia serpentina* revealed that the highest *in- vitro* rooting of 81.67% and maximum number of roots (7) was obtained with GO-MN accession on ½ B5 medium. The hardened plantlets were transferred to the field for trial comprising *in-vitro* and seedling raised plants of five genotypes.

Field trial of five genotypes of *Rauvolfia serpentina*

- Multilocation trials of *Jatropha curcus* were conducted in different agroclimatic zones. Overall, 30 % mortality was observed in MLT after two year of plantation. On the basis of fruits/plant, three accessions are identified viz. IC 468907, IC 468919 and IC 471353.

Trial plot July, 2013, Luxurious growth (above) & fruiting (Right)

Seed variation for germination and seedling growth of *Michelia champaca* was studied and seedling seed orchard established. Survey was conducted in Mizoram, Tripura, Arunachal Pradesh and Assam to identify the natural plantation distribution of *M. champaca* and variation among different population. Huge variation for morphological traits was observed and from the different population phenotypically superior genotypes were selected for establishment of seedling source orchard. Also, identified variation in natural regeneration and further investigation on the subject is under progress.

6. Forestry Education and Policy Research to Meet Emerging Challenges

Indian Council of Forestry Research and Education (ICFRE) is mandated to promote forestry education in Universities by providing financial support to Universities for strengthening the infrastructure such as building, equipments, computer centre, library etc. The Council provides grant-in-aid to different Universities in India and it also undertakes the Human Resource Development Programme and Policy Research Work.

6.1 Improving Formal Forestry Education

ICFRE is providing grant-in-aid for infrastructural development, purchase of scientific equipments, books, creation of mist chambers, purchase of sports items for students, creation of museums etc., purchase of vehicle and transport equipments for tour of students, purchase of computers, teaching manuals, organization of seminar, participation of faculties in the national seminars etc and students educational tours to the universities for promoting forestry education in the country. The Council has invited proposals for grant-in-aid from the Universities and received a total of 19 proposals for the purpose.

6.1.1 FRI University

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

- Two years M.Sc. course in Forestry, Environment Management, Wood Science & Technology and Cellulose & Paper Technology.
- One year Post Graduate Diploma course in Aroma Technology in collaboration with Fragrance & Flavour Development Centre, Kannauj.

Lectures/dissertations/Ph.D guidance given by the different Divisions of FRI.

FRI University conducts online entrance exam for these M.Sc. courses. The syllabus has been revised for all courses during the period of the Report,

1. Two chairs of excellence were engaged in the following disciplines -
   (i) Ecology and Biodiversity
   (ii) Forest Climate Change
2. Following academic activities were undertaken:

- Lectures/ practical's :- 632
- Dissertations supervised:- 27
- Term papers supervised :- 45
- Ph.D awarded :- 64

6.2 Accreditation of Universities

The Council encourages 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 has been completed for 18 Universities and certificates issued. The proposals for accreditation of 03 more Universities have been received which are under consideration for making accreditation with ICFRE.

6.3 Networking Forestry Education with Research and Extension

In view of the issues and challenges before the NTFP sector, a networking project has been envisaged at ICFRE at National level with the help of ICFRE institutions and State Universities, having faculty of forestry to provide an opportunity in the forestry sector for working with universities mutually integrating education and research for the benefit of forest dependent communities. The Status Reports and Detailed Project Reports from 09 universities have also been received which are involved in the Networking Project on NTFP.

6.3.1 Participation in Seminars/Symposia/ Workshops/Trainings

About 250 scientists, officers and officials participated in different seminars/symposia/

Visit by Director, FRI, GCR, FRI and Head, Extension Division during Punjab Summit

Interacting with stakeholders during Punjab Summit

workshops/trainings /meetings organized by various organizations throughout the country on variety of subjects including, IPCC green house gas inventory; ecosystem monitoring; bio-composting/ vermi-composting; agro-forestry and land management; climate change and carbon mitigation; energy and environment; livelihood development programme as a rehabilitation measure; plant taxonomy; forest certification; quality determination of medicinal plants cultivated in agro-forestry; essential oils-isolation, characterization and value addition; agro-forestry and land management for the farmers; value addition of NTFPs; quality assessment of essential oil; insect pests of agro-forestry and their control measure; extension of agro-forestry species; role of poplar-based agro-forestry for economic security; intellectual property management and technology transfer policy for ICFRE; protection of plant varieties and farmers rights (PPV&FRA) Act 2001; genetic transformation for abiotic stress tolerance; seed handling of tree borne oilseeds with special reference to *Calophyllum inophyllum*; forest seed technology; cultivation techniques for *Calophyllum inophyllum*; bio-prospecting of forest resources; application of bio-pesticide in agro-forestry; bio-pesticidal products of Hy-Act, Tree Pal (H) and Tree Rich bio-booster pellets; innovations on biotechnology; Biological Diversity Act, 2002; wood processing; trees for life: accelerating the impacts of agro-forestry; forest policy, law and Acts including, environmental law ; formulating quality standards for bamboo products; REDD and REDD+ benefits in forestry sector under Green India Mission; human resource development; land restoration and biodiversity conservation for sustainable livelihood; cultivation of medicinal plants; biological control of forest insect pests and role of entomopathogenic nematodes; forest insect pest management in nurseries and plantations; insect pests of important medicinal plants and their biological control measures; team building and conflict management; Sal borer and its management; forest certification; bamboo handicraft for the farmers, field functionaries and artisans; drug residues and environmental pollutants; prospects of NWFPs processing and value addition; impact of harvesting practices on bamboo regeneration; disease and pest problems and their management in bamboos ; bamboo cultivation: an opportunity for livelihood needs; augmentation of agar wood in *Aquilaria malaccensis* through fungal technology; science & technology for rural societies; forest & forest management, Forest Conservation Act and policies; environmental problems, threatened medicinal plants; cumulative environment impact assessment of Satluj basin; renewable sources of energy; genetic engineering etc. the details regarding same is mentioned below:

Sl. No.	Hqs./Institutes	No. of trainings	No. of participants	Duration (in days)
1.	ICFRE, Dehradun	2	2	4
2.	FRI, Dehradun	46	55	267
3.	IFGTB, Coimbatore	20	19	38
4.	IWST, Bangalore	14	14	77
5.	TFRI, Jabalpur	43	48	285
6.	AFRI, Jodhpur	10	18	163
7.	IFP, Ranchi	15	19	51
8.	IFB, Hyderabad	5	5	30
9.	HFRI, Shimla	44	53	78
10.	RFRI, Jorhat	13	13	24
	Total	212	246	1017

6.3.2 Visits Abroad

Facilitated 35 cases of foreign visits which were approved from the Government of India with funding from various sources for providing a much needed international exposure to the scientific cadre.

- Dr. Sangeeta Gupta participated as guest speaker on 'Wood culture in India: Past, present & future' at '219th Wood Culture Symposium' Kyoto University, Japan from 18 to 22 February 2013.
- Dr. Sangeeta Gupta participated as guest speaker on 'Indian woods: Historical utilization and future sustainability' at 'World Wood Day Symposium', Dar Es Salaam, Tanzania from 18 to 22 March 2013.
- Dr. T. P. Singh, ADG (BCC), participated in the eleventh session of the Committee for the Review of the Implementation of the Convention of UNCCD from 15 to 19 April 2013 in Bonn, Germany.
- Dr. N. Krishnakumar, Director; Shri T.P. Raghunath, Group Coordinator (Research); Dr. B. Gurudev Singh, Scientist-G and Dr. A. Nicodemous, Scientist-E, IFGTB, Coimbatore visited Australia to attend "Workshop meeting relevant to the implementation of AusAID activity 60794" from 19 to 25 May 2013.
- Shri V.R.S. Rawat, Scientist-E, ICFRE, participated in the UNFCCC thirty-eighth sessions of the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice as well as the second part of the second session of the *ad hoc* Working Group on the Durban Platform for Enhanced Action in Bonn, Germany from 03 to 14 June 2013 as a member of the Government of India delegation.
- Dr. V.P. Tewari, Scientist-G, IWST, Bangalore visited Kenya to attend 5th GAForN International Symposium on 'Sustainable forestry in South-Southeast Asia and sub-sahara Africa: Incentives for close-to-nature-forestry' from 08 to 12 July 2013.
- Dr. P.P. Bhojvaid, Director, FRI, Dehradun visited China to deliver key note address on 'Forest culture in the dialogue on forestry in eco-civilization context', on 20 and 21 July 2013.
- Dr. R. Sundararaj, Scientist-G, IWST, Bangalore visited Australia to attend '6th International Symposium on biology and ecology of gal producing arthropods and related endophytes' from 04 to 08 August 2013
- Dr. N. Krishnakumar, Director, IFGTB, Coimbatore visited China to attend 'Regional Workshop for Asia, Pacific and Oceania' on 20 and 21 August 2013.
- Dr. V.K. Varshney, Scientist-F, FRI, Dehradun visited China to attend '7th International Medical Mushroom Conference from 26 to 29 August 2013.
- Dr. R.K. Borah, Scientist-E and Dr. (Mrs.) Papori Phukan Borpuzari, R.O., R.F.R.I., Jorhat visited Malaysia to attend International Scientific Symposium on 'Agar wood' from 03 to 05 September 2013.
- Dr. Vineet Kumar, Scientist-F, FRI, Dehradun visited Germany to attend 'DAAD alumni special project in the framework of the Tropentag-13' from 08 to 19 September 2013.
- Sh. Saibal Dasgupta, DDG (Extension); Dr. T.P. Singh, ADG (FCC) and Dr. R.S. Rawat, Scientist-C, FCC Division, ICFRE, Dehradun visited Namibia to attend "Next conference of parties (CoP-11) meet of the United Nations Convention to Combat Desertification" from 16 to 27 September 2013.

- Dr. P.P. Bhojvaid, Director; Sh. M.P. Singh, Head, FCCI Division and Mr. Jawaid Ashraf, Scientist, FRI, Dehradun visited China to attend International Symposium on 'Transition to sustainable forest management and rehabilitation' from 21 to 23 October 2013.
- Dr. N.S.K. Harsh, Scientist-G, FRI, Dehradun visited Turkey to attend 3rd International Congress on Fungal Conservation from 11 to 15 November 2013.
- Shri V.R.S. Rawat Scientist-E, ICFRE, participated in the nineteenth session of the Conference of Parties and the 39th Session of SBSTA/SBI meetings of the United Nations Framework Convention on Climate Change (UNFCCC) in Warsaw (Poland) from 11 to 22 November 2013 as a member of the Government of India delegation.
- Dr. Renu Singh, ADG (Education & P.R.), ICFRE, Dehradun visited USA on study tour on 'Forecasting and futures modeling' under the Sustainable Landscape and Adaptation from 02 to 10 December 2013.
- Shri K. Jude Sekar, DG; Shri Saibal Dasgupta, DDG (Extension); Dr. T.P. Singh, ADG (FCC) and Dr. R.S. Rawat, Scientist – C, ICFRE, Dehradun visited Nepal to attend 'International expert group meeting at ICIMOD, Kathmandu, Nepal' on 09 and 10 December 2013.
- Dr. Ombir Singh, Scientist-D, FRI, Dehradun visited Tunisia to attend the 1st Africa International Allelopathy Congress from 06 to 09 February 2014.
- Mr. Jawaid Ashraf, Scientist, FRI, Dehradun, visited Japan to attend seminar on "Transition to sustainable forest management and rehabilitation in Asian countries" on 25 and 26 February 2014.
- Dr. Modhumita Dasgupta, Scientist-E, IFGTB, Coimbatore, visited USA to attend training under ITTO Fellowship from 01 March to 30 April 2014.
- Sh. T.P. Raghunath, GCR; Dr. B. Gurudev Singh, Scientist-G and Dr. V. Sivakumar, Scientist-E, IFGTB, Coimbatore, visited Thailand on study visit, under DST sponsored project from 02 to 09 March 2014.
- Dr. V.P. Tewari, Scientist-G, IWST, Bangalore, visited Indonesia to attend International Workshop on 'Forestry and forest science in an ever more complex global context' from 16 to 22 March 2014.
- Dr. A. Balu, Scientist-G; Dr. A. Karthikeyan, Scientist-D; Dr. M. Hegde, Scientist-D and

Dr. A. Shanthi, Scientist-C IFGTB, Coimbatore, visited Vietnam to attend the IUFRO Acacia-2014 Conference from 18 to 21 March 2014.

6.4 Capacity Building of Scientific and Management Cadre (Trainings Organised)

As part of the HRD initiatives for capacity building of scientific personnel, six training programmes were organized in different organizations of repute in which 85 participants were trained. Induction courses for ICFRE scientists and research officers etc. were organized on regular basis.

Apart from the above, various trainings on subject as vast and varied as conservation of biodiversity and sustainable livelihood in watershed management; climate change and carbon mitigation, climate change, forest ecosystems and biodiversity: vulnerabilities and adaptation strategies; bamboo/ ringal handicrafts

Training workshop on Conservation of Biodiversity and Sustainable Livelihood in Watershed Management

for the farmers/artisans; agro-forestry & land management; development of agro-forestry practises; bamboo processing and product making for artisans and small scale manufactures of Himachal Pradesh; 'hands on' training to artisans for bamboo technology transfer; bamboo mat weaving and making of bamboo handicrafts items; bio-composting/ vermin-composting; ringal, utilization, propagation and conservation; development of green belt ; nursery and plantation technology; improved seed and nursery technology; forestry/silviculture ; afforestation

Training programme on Climate Change and Carbon Mitigation

techniques; role of forestry in disaster management; forest fire mitigation & management; participatory management of forest fire risks in urban areas; forestry as livelihood in climate change adaptation; maintenance of poplar nurseries; essential oils, perfumery & aromatherapy; linking of non timber forest products (NTFP) and agro-forestry produce with markets- constraints, opportunities and threats; tissue culture of important forest trees, bamboos and medicinal plants; nursery & clonal technology ; bio-fertilizer production and application in nursery and field; bio-prospecting-the role of State Forest Department; forest genetic resource management; research methodologies and writing of research papers; 'agarbatti' sticks making ; creation of biological fence with live bamboo; rainwater harvesting and afforestation for the rehabilitation of degraded hills; integrated approach for sustainable development of fragile desert ecosystem; application of technological and research interventions for enhancing forest productivity; conservation, utilization and cultivation of important temperate medicinal plants; etc. were organized by ICFRE Hqs. and its institutes and are as follows:

Hqs./Institute	No. of trainings	Duration (in days)
ICFRE, Dehradun	3	12
FRI, Dehradun	32	151
IFGTB, Coimbatore	12	47
IWST, Bangalore	2	4
TFRI, Jabalpur	12	63
CFRHRD, Chhindwara	13	16
AFRI, Jodhpur	5	12
HFRI, Shimla	8	14
RFRI, Jorhat	15	48
IFP, Ranchi	8	20
IFB, Hyderabad	2	5
Total	112	392

Demonstration and training on bamboo handicrafts and furniture








Glimpses of trainings organized by ICFRE institutes

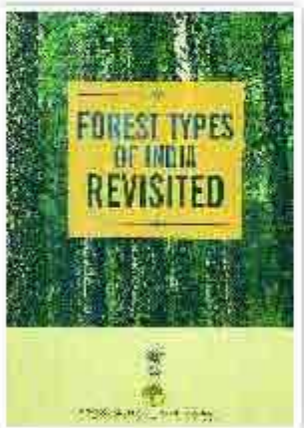
7. Forestry Extension for Taking Research to People

The Council endeavours to transfer simple implementable technologies to the intended target groups, especially the farmers. It also engages in development and dissemination of forestry extension programmes. It coordinates various extension activities of ICFRE institutes and Centres and provides consultancy/technical services in the field of forestry, environment and allied sciences as well as environment impact assessment and other related areas. The Council is committed to disseminate its research outputs to the stakeholders through various schemes, such as, Van Vigyan Kendras, Demo Villages, Networking of VVKs with KVKs, Direct to Consumer Scheme, through organizing and participating in various extension activities and by means of quality publications.

7.1.1 Collection, compilation and publication of forestry reports/ journals

7.1.1 Research publications: Books and newsletters published by ICFRE Hqs. during the year are viz.:

- Annual Report of ICFRE, 2012-13.
- Bi-annuals - ICFRE Newsletter and '*Vaniki Samachar*'.
- Book on 'Forest types of India: Revisited'.
- Proceedings of the workshop on 'Innovations for forest carbon finance in India'.
- Book on 'Soil organic carbon stocks in forests of India'.



- 4 issues of 'ICFRE Climate News' were prepared and uploaded on ICFRE website.
- Publications of SLEM
  - SLEM e-newsletter June 2013 Vol.1, no.5. and December 2013 Vol.6, no.6
  - Proceedings of the one- day seminar on "Drought and water scarcity".
  - Eight flyers were published based on the SLEM best practices.
  - Semiannual report SLEM-TFO project

Cover pages of the publications

A total of 411 research articles were published by ICFRE institutes in scientific journals of national and international repute and in books. The institute-wise details of the same are given below:

S. N.	Name of Institute	Number of research articles published in scientific journals and books/proceedings		
		National Journals	Foreign Journals	Book Chapter/In Proceedings
1	FRI, Dehradun	53	44	19
2	IWST, Bangalore	22	27	21
3	IFGTB, Coimbatore	21	17	61
4	AFRI, Jodhpur	14	14	26
5	TFRI, Jabalpur	18	1	9
6	RFRI, Jorhat	8	13	6
7	HFRI, Shimla	10	-	2
8	IFB, Hyderabad	2	-	3
	Total	148	116	147

Also, a total of 95 research articles were presented in seminars/conferences/ workshops and, 181 abstracts and 25 popular articles were published by ICFRE institutes during the year as per the following details:

S. N.	Name of the Institute	Number of articles presented in seminar/conferences/ workshops along with abstracts & popular articles published		
		Article presented	Abstract published	Popular article
1	IFGTB, Coimbatore	18	54	4
2	FRI, Dehradun	32	7	9
3	IWST, Bangalore	33	6	-
4	RFRI, Jorhat	-	57	4
5	TFRI, Jabalpur	8	28	5
6	AFRI, Jodhpur	-	22	-
7	HFRI, Shimla	4	7	3
	Total	95	181	25

Apart from above, 16 books and 16 booklets, brochures/pamphlets were published by the ICFRE institutes during the year as indicated below:

S. No.	Name of the Institute	Number of books and booklet, brochures/pamphlets published	
		Books	Booklets/brochures/ bulletins/ pamphlets
1	IFGTB, Coimbatore	8	6
2	FRI, Dehradun	4	2
3	IWST, Bangalore	2	1
4	IFP, Ranchi	1	-
5	TFRI, Jabalpur	1	-
6	HFRI, Shimla	-	7
	Total	16	16

National Forest Library and Information Centre

The National Forest Library and Information Centre (NFLIC) is the richest in document collection on forestry and allied sciences in South and Southeast Asia. It has been providing diverse library and information services, viz, reference, referral, lending, reprography, current awareness, inter-library loan, retrieval of information from the machine readable database, etc. to its users, During the year, 27,117 books were loaned to the users for outside reading. Besides, 57,355 documents were consulted in the library.

The document collection of the NFLIC was enriched by the addition of 2,726 books and other documents, out of which 125 books were purchased at a cost of Rs. 1.83 lakh. The NFLIC subscribed 66 Indian and 89 foreign periodical titles. It also received 680 issues of the periodicals as gratis. The NFLIC provided online accessibility to 184 e- journals to the regional institutes of ICFRE. A bibliographical database on forest science was also subscribed for providing access to old as well as latest research articles on forestry to all institutes and centres of ICFRE.

The NFLIC has been selling ICFRE publications through its Book Depot and during the year, 564 books and 12 VCDs were sold to the state forest departments, universities, etc. generating revenue of Rs.163, 836.

7.1.2 Environmental Information System Centre

The Ministry of Environment, Forests and Climate Change, Government of India established Environmental Information System (ENVIS) Centre on Forestry at NFLIC, FRI. The ENVIS Centre enriched the following five databases by the addition of new references: Indian Forestry Abstracts; Participatory Forest Management; *Prosopis juliflora*; Poplars; and Environment and Forests. The Centre published a book titled: '*Eucalyptus* in India' and compiled five issues of *Environment and Forests News Digest*.

7.2 Dissemination of developed technologies

- Demonstration of various developed technologies was made to various stakeholders on World Environment Day, International Day of Forests, Science Day and International Day for Biological-diversity and also in various training programmes by FRI, Dehradun.
- Demonstration of agro-forestry practices, vegetative propagation technologies of important forest tree species was made to the farmers and other stakeholders in Kissan Melas organised at GB Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) by FRI, Dehradun.
- Demonstration of various developed technologies on extraction of essential oil at

pilot scale using hydro distillation as well as steam distillation techniques, quality assessment of essential oil in terms of various physico-chemical properties of essential oil, perfumery & aromatherapy was made to the trainees by FRI, Dehradun.

7.2.1 Van Vigyan Kendras (VVKs) and Demo Villages (DVs)

- FRI, Dehradun till date has established six Van Vigyan Kendras (VVKs) in the States and UTs in its jurisdiction and organised two training programmes under 'Networking of Van Vigyan Kendras and Krishi Vigyan Kendras' at Yamunanagar district. The different technologies developed by FRI on agro-forestry were displayed and lectures delivered in Kissan Mela at KVK, Patiala.
- IFGTB, Coimbatore produced four lakhs quality planting stocks of *Casuarina* and distributed them to the farmers of Villupuram district of Tamil Nadu and Puducherry, affected by the 'Thane' cyclone.
- IFGTB, Coimbatore developed new biopesticidal products (Hy-Act, and Tree PALH) and a growth promoting product (tree rich biobooster) that was commercialized through Prerena shop of IFGTB, Coimbatore, Chinnmaya organisation for rural development, Sri Avinashilingam Kendra at Krishi Vigyan Kendra, Vivekandapuram; KVK of Tamil Nadu & Puducherry, VVK, NGOs and Coimbatore district herbal and tree growers association.
- The Institute organised a workshop on 'Tree cultivation technologies' for transfer of technologies to Krishi Vigyan Kendras (KVKs) of Tamil Nadu and Puducherry in collaboration with Tamil Nadu Agriculture University and Tamil Nadu Forest Department.
- Presentations on practices of *Tectona*, *Casuarina*, *Eucalyptus*, *Melia*, *Ailanthus*, *Gmelina arborea*, *Neolamarckia cadamba* and *Calophyllum inophyllum* and, on the products and techniques developed by IFGTB viz., N-fixer, Hy-Act, tree rich biobooster, tree PAL, windbreak agro-forestry systems, bio-inoculants for native tree species, *Casuarina* ased 'Alley cropping' system, red and sweet tamarind, tree pest management and clonal propagation of *Eucalyptus* and *Casuarina* was made by IFGTB, Coimbatore to various stakeholders.
- IFGTB, Coimbatore established industrial tree based agro-forestry plot in 2 ha and planted 3000 seedlings of *Tectona* and *Gmelina* in 8 farmers' field bunds in Kandiyur, VVK demo village and facilitated the irrigation facility through digging the bore-well.
- IFGTB, Coimbatore organised first interactive meeting of VVK and KVK of Kerala at KVK Thrissur.
- Training programmes were organised by IWST, Bangalore in collaboration with FTATI, Kadogodi at one of its two VVK's, at Kadugodi for frontline staff of the Karnataka Forest Department on aspects of field identification of commercially important timber species, plantation vs. traditional timbers, importance of strength properties of timbers, seasoning and preservation of wood and bamboo, nursery techniques for sandal and bamboo and their insect pests and diseases on 14 and 22 November, 2013; 06 and 13 December, 2013 and 10 January 2014.
- IWST, Bangalore also organised a training programme on 'Sandal based agro-forestry models' for subject matter specialists of KVK's of Karnataka and KVK's of Goa from the 06-08 January 2014 at Bangalore.
- TFRI, Jabalpur has four VVKs, one each in the state of Madhya Pradesh, Chhattisgarh, Maharshtra and Odisha and one Demo village at Moiya Nala in Bijadandi West Mandla Forest Division. Regular training programmes on technologies developed for field staff were conducted at VVKs in which training resource material was also provided to the participants.
- Quality planting stock of *Prosopis cineraria* and *Dalbergia sissoo* was raised at the hi-tech nursery at VVK Bichhwal, Bikaner by AFRI, Jodhpur for demonstration and distribution to farmers for promoting agro-forestry. Besides, a three days training programme on 'Soil and water conservation, silvi-pasture, agro-

forestry, quality seed production and seed storage, production of quality planting stocks, selection of plus tree, cultivation and management of horticulture crops, medicinal plant cultivation, VAM and organic fertilizers' was organised for field staff of Rajasthan Forest Department and farmers of Rajasthan from 28 to 30 January 2014. Thirty four trainees (22 forest officials and 12 farmers) from Jaiselmer, DDP and IGNP Divisions, Barmer, Sirohi, Jalore, Jodhpur and Pali Forest Divisions attended the programme.

- AFRI, Jodhpur in its hi-tech nursery at VVK, Chhipardi Beedi, Rajkot (Gujarat) also raised grafted seedlings of *Emblica officinalis* and *Ziziphus mauritiana* along with superior quality seedlings of *Casuarina equisetifolia*, *Eucalyptus* hybrid for demonstration and distribution to farmers. A three days training programme on 'nursery establishment and management, tree improvement, economic benefits of agro-forestry, improved techniques for agri-horti system for higher production, soil and water conservation and cultivation of medicinal plants in Gujarat' was organised at Gujarat Forest Rangers College, Rajpipla (Gujarat) from 03 to 05 October 2013 attended by forty two participants from Gujarat and Dadra and Nagar Haveli. Hi-tech nursery and demonstration plots at Demo village, Salawas (Jodhpur) were also maintained for raising the quality planting stocks.
- Training programme under Bamboo Technology Support Group on 'Bamboo handicraft' for skill up-gradation of farmers and artisans from the states of Rajasthan and Gujarat was organised by AFRI, Jodhpur from 09 to 13 December 2013.
- Three training programmes on '*Jatropha* cultivation' for farmers and other stake holders were organised by AFRI, Jodhpur on 16 January 2014 at Gajpur, Kumbhalgarh; on 17 January 2014 at Dhilodia Janavat, Rajsamand and on 12 February 2014 at Sundercha, Rajsamand. Farmers were sensitized about cultivating *Jatropha curcas*, its importance, cultivation practices and future prospects.
- RFRI, Jorhat has five Van Vigyan Kendras in Assam, Arunachal Pradesh, Mizoram, Nagaland and Tripura. Different activities like training programmes and exposure visit to various forest based industries viz. agarbatti, furniture etc. and research centre were organised.
- RFRI established a demo village through participatory rural appraisal at Melang Grant, a hamlet of three villages on fringe of Hoollongapar Gibbon Wildlife Sanctuary. Villagers adopted the activities like bee

Bhoot Jolokia nursery and its extension in farmer's fields at Demo village under Areca- Bhoot Jolokia Agroforestry model- RFRI, Jorhat

keeping, vermin-compost production, plantation of *Acacia mangium* in farmer's field and bhoot jolokia (*Capsicum chinense*)-*Areca* nut agro-forestry model. Seedlings of bhoot jolokia were provided to the farmers for the same. The bhoot jolokia – *Areca* nut agro-forestry model shows encouraging results and has been adopted by the farmers for generating extra income.

- Two nurseries of agar (*Aquilaria malaccensis*) have been established in demo village in Gobindpur and Bhogpur village under demo village programme.
- Training programme on networking of KVKs with VVKs was organised at Shimla by HFRI on 30 July 2013.
- Similarly, a training programme on 'Conservation, utilization and cultivation of medicinal plants' was organized by HFRI,

Establishment of nurseries at farmer's field in demo village – RFRI, Jorhat

Shimla at KVK, Saru, Chamba (H.P.) from 25 to 26 November 2013. for frontline staff of Forest Department and farmers.

- Training programme on 'Application of technological and research interventions for enhancing forest productivity' was organized by HFRI, Shimla at Leh, Laddakh (J&K) on 08 July 2013 under the activities of VVK Janipura, Jammu.
- HFRI, Shimla maintained the demonstration nursery and demonstration plantations at Model Village Lanabanka. Quality planting stock of bamboo species (1000 seedlings) were provided to villagers of Lanabanka Panchayat for plantation.

7.2.2 'Direct to consumer' scheme

'Direct to consumer' scheme was launched in July 2011 as a novel extension strategy to bring the technological advancements made through research breakthroughs in ICFRE at the doorsteps of end-users without loss of time with the intention of widening the outreach of research findings, linking livelihoods of people with forestry. Besides, the State Forest Departments, farmers, industries and rural communities are expected to benefit from the scheme. In the first phase, 16 projects were selected and implemented under the scheme for the year 2012-13. During 2013-14, 6 new projects have been initiated and 9 projects were continued from 2012-13. The, total number of on- going projects during 2013-14 were 15.

FRI, Dehradun conducted following activities under 'Direct to consumer scheme':

- Centre for Bamboo Processing and Training was established.
- Cultivation trails of *Ganoderma lucidum* were established in collaboration with NGOs (Baghban and SPECS) at Shyampur and Kandolli villages, respectively.
- Awareness programme on 'Edible and medicinal mushrooms' were organised in four villages of Dehradun (Shuklapur, Ummedpur, Devipur, Pitambarpur) in collaboration with NGO, Baghban on 19 August 2013.
- Conservation activities at the bambusetum, herbarium and botanical garden in FRI were shown to dignitaries, trainees, students and researchers etc. from different organisations.

AFRI, Jodhpur organised the following activities under the scheme:

- A demonstration trial was laid out to control insect pest attack on mehndi (*Lawsonia inermis*) in farmers' field at Nimaz, Pali wherein treatment of monocrotophos (0.05%) + bavistin (0.01%) + suzin (@ 2 ml/ltr,) and pratirodh (a biopesticide) was applied against leaf defoliator (a semilooper, *Achaea janata* - noctuidae) and leaf spot and blight disease (*Alternaria* sp.). In treated plot, no incidence of any pests/disease was recorded.
- A demonstration trial on management of diseases and pest problems in isabgol (*Plantago* sp.) was laid out at Bilawas (Sojat) Pali in farmers' field. The treatment comprising bavistin (1.5%) or ratan (0.2%) + monocrotophos (0.05%) was given against downy mildew disease (*Peronospora alta*) and aphid attack. In treated plot, no incidence of any pests/diseases was seen.
- Two training-cum-workshops on 'Rainwater harvesting and afforestation for the rehabilitation of degraded hills' were organised at Dahod from 19 to 20 September 2013, and at Jodhpur from 23 to 24 January 2014.

Activities taken up by HFRI, Shimla under 'direct to consumer scheme' of Council included:

IPM strategies developed for protection and enhancing productivity in mehndi and isabgol – AFRI, Jodhpur

- Specific skill of farmers for nursery production and cultivation of *Aconitum heterophyllum* (Atish), and *Angelica glauca* (Chora) was developed through training and demonstration programmes and educational exposure visits.
- One day 'Exposure visit-cum-training programme' on practical demonstration of various techniques for raising temperate medicinal plants at Conifer Campus, Shimla and Potter hills, Shimla was organised on 26 December 2013.

IFP, Ranchi had conducted following activities under this scheme:

- Farmers from district Khunti, Jharkhand were periodically trained for scientific lac cultivation by master trainers who in turn, got trained by experts in the institute.
- Quality planting stocks of lac host *Flemingia semialata* were raised at Ranchi and 19100 plants were distributed to 17 farmers and planted in farmer's field at 0.75 x 2.0 m distance.
- Field training-cum-workshop for promoting lac cultivation on *Flemingia semialata* was organised in association with Life Education & Development Support NGO at West Singbhum district on 16 July, 2013. Fifteen farmers of Bandgaon block, West Singbhum district and fifteen farmers of Murhu block of Khunti district participated in it.
- One day training-cum-workshop on 'Non-traditional host *Flemengia* sp. and its possibility in sustainable plantation forestry' for stakeholders was organised at Ranchi on 27 March 2014.

IFGTB, Coimbatore has established 3 ha demonstration plots with superior clones for windbreak agro-forestry system in collaboration with Tamil Nadu State Forest Department under 'direct to consumer scheme' of the Council.

7.2.3 Technologies transferred

- ICFRE is striving to expeditiously disseminate and share research results in an open and accessible manner. At the same time, ICFRE recognizes the importance of protecting its technologies under Indian and other applicable foreign intellectual property laws, and commercializing them in a manner befitting its commitment to public good and welfare. In the process, a comprehensive policy governing the generation and management of intellectual property emanating from ICFRE and its various institutes has been evolved along with Material Transfer Agreement (MTA) and Licence Agreement (LA).
- FRI, Dehradun rendered various technical services to Indian pulp and paper industries and research organisations and tested the physical and optical properties of paper samples received from various Government organisations such as Employment News, Indian Army, NCERT and private industries such as M/s Ayukta Rajya Siksha Kendra, Bhopal, M/s. Distt. Siksha Kendra Betul

(M.P), M/s. Distt. Siksha Kendra Shivpuri, (M.P.), M/s. Distt. Siksha Kendra Sarv Siksha Abhiyan, Khargon (M.P).

- Technology for production of compost from plant biomass was demonstrated and transferred to M/s Anand Organics Krishi Industries, Nagpur (Maharashtra) on 06 December 2013 with the Licence fee of Rs. 1.20 lakhs.
- The Variety Releasing Committee (VRC) of ICFRE approved public release of two clones of *Casuarina junghuhniana*, three clones of *Casuarina equisetifolia* and seven clones of *Eucalyptus camaldulensis* developed by IFGTB, Coimbatore on 08 March 2014.
- A growth promoting product 'Tree rich biobooster' using eco-friendly organic materials for growth improvement of fast growing trees species such as *Casuarina, Gmelina, Ailanthus, Melia, Tectona* and *Eucalyptus* had been developed, introduced and released during the Tree Growers Mela held at IFGTB, Coimbatore in February 2013.
- Technology on wood polymer composite was transferred by IWST, Bangalore to M/s Pointech Pen, Bangalore. The firm had paid the Licence fee of Rs. 10.00 Lakhs to the institute.
- A seminar-cum-workshop on 'Strengthening the network for outreach of research findings developed by ICFRE' was organised by TFRI, Jabalpur at Odisha Forest Ranger's College, Angul from 12 to 13 March 2014, and technologies on processing technique of bael fruits, drum-dryer techniques for NTFPs, development of handmade paper/paper making from *Lantana*, non destructive harvesting techniques of *Terminalia arjuna* bark, agro-techniques of *Asparagus racemosus*, agro-techniques of *Andrographis paniculata*, agro-techniques of *Rauvolfia serpentina* and agro-techniques of *Withania somnifera* were transferred to the stakeholders.
- RFRI, Jorhat transferred technologies on PRA techniques and micro planning, bamboo treatment, vermi-composting, apiculture, patchouli agro-techniques, *Trichoderma* production and field application, mycorrhizal technology, bio-pesticide production and field application, seed handling - grading and sowing techniques, technology on chili based agro-forestry model, technology on air layering of various economically important tree species using *Sphagnum*, technology on low-cost vermin-compost, and technology on raising of agar *(Aquilaria malaccensis)* plantations and cultivation of muskdana (*Abelmoschus moschatus*) to the fields.

7.3 Evolving and coordinating comprehensive Extension Strategies in Forestry Research

7.3.1 Sustainable Land and Ecosystem Management (SLEM) Project

Different activities as detailed below were carried out under the project during the year:

- Training-cum-workshop on 'Climate change adaptations in the Himalayan region' was organised on 03 & 04 October 2014 at the Himalayan Forest Research Institute, Shimla for capacity building of scientists and forest officials.
- Training programme on 'Bamboo based handicraft for farmers and artisans for livelihood enhancement' for frontline staff of M.P. Forest Department was organised at TFRI, Jabalpur from 03 to 07 February 2014.
- Training programme on 'Land restoration and biodiversity conservation for sustainable livelihood in South India' was arranged from 19 to 21 February 2014 at IFGTB, Coimbatore for frontline staff of Tamil Nadu Forest Department.
- Regional consultative workshops on 'Finalization of the impact indicator for issues related to desertification, land degradation and drought' were organised at Hyderabad on 30 August 2013 and at Kolkata on 29 October 2013, respectively. A group of 25 experts working in the areas of desertification, land degradation and drought attended these workshops.
- National consultative workshop for 'Finalization of impact indicators for issues related to desertification, land degradation

Workshops/seminars organized under SLEM Project

and drought' was organised at New Delhi on 28 January 2014. About 40 participants from line Ministries, R&D institutions, SLEM project partners, UN funding agencies and Civil Society Organisations attended the workshop.

- Seminar was organised to commemorate the World Day on Combat Desertification on 17 June 2013 at ICFRE, Dehradun with the theme 'Drought and water scarcity'.It was attended by about 80 participants including senior officers and scientists from ICFRE and FRI.
- The fourth meeting of the National Steering Committee (NSC) of SLEM Project constituted by the Ministry of Environment, Forests and Climate Change to monitor and evaluate the progress of the projects currently operational under the SLEM programme was held at Hyderabad on 04 & 05 April 2013. Fifth meeting of NSC was held at Bhopal on 13 February 2014.
- Under the thematic area on climate change adaptation of SLEM-TFO, Shri Saibal Dasgupta, Deputy Director General (Extension), Dr. T.P. Singh, Project Director, SLEM Project and Dr. R.S. Rawat, Technical Manager, SLEM Project participated in the expert group meeting on Geo spatial information systems for multi-scale forest biomass assessment and monitoring of the Hindu-Kush Himalayan Region at International Centre for Integrated Mountain Development (ICIMOD), Kathmandu (Nepal) from 9 to 10 December 2013.

7.3.2 Seminars/Symposia/Workshops Organised

- Workshop on 'Innovation for forest carbon finance in India' was jointly organised by ICFRE, FRI and Welspun Energy Ltd. on 28 May 2013 at FRI, Dehradun. The workshop aimed to deliberate and achieve a broader and inclusive consensus by inviting leading minds in the field of forest carbon from research institutes, scientists, representatives of industry and state and central government.
- Workshop on 'Uttarakhand 6/16: Analysis, lessons and mitigation strategies' was organised by FRI, Dehradun in collaboration with Central Himalayan Environment Association, GIZ on 19 September 2013 at Dehradun.

- Workshop on 'Report writing' was organised by FRI, Dehradun from 09 to 10 October 2013 at Dehradun.
- Workshop cum Kisan Mela on 'Role of agro-forestry in sustainable timber supply to wood based Industries' was organised by FRI, Dehradun on 13 January, 2014 at G.B. Pant University of Agriculture and Technology, Pantnagar.
- BTSG-ICFRE sponsored seminar on 'Bamboo productivity in forest and non-forest areas' was organised by FRI from 30 to 31 January 2014 at Dehradun. Officers from the State Forest Department, farmers, private bamboo growers, NGOs, officials of the National Bamboo Mission, NABARD and scientists of various research institutions participated in the seminar.
- Workshop on 'Current state of knowledge and way forward post June, 2013 tragedy' was organised by FRI, Dehradun in collaboration with CEDAR and Central Himalayan Environment Association on 26 March, 2014 at Dehradun.
- FRI, Dehradun organised a workshop on 'Application of bio-informatics in forestry' from 27 to 29 March 2014 at Dehradun.
- National workshop on 'Forest seed science - recent advances and challenges in seed research' was organised by FRI from 26 to 27 February 2014 at Dehradun.
- Asia Pacific Workshop on 'Water and forest - beyond traditional forest hydrology' was organised by FRI in collaboration with Asia Pacific Association of Forestry Research Institutions and Korea Forest Research Institute, Republic of Korea from 23 to 25 September 2013 at Dehradun.
- National workshop on '*Eucalyptus* gall wasp - present status and future strategies' was organised by IFGTB, Coimbatore on 10 June 2013 at Coimbatore that was attended by stakeholders involved in large scale *Eucalyptus* planting like paper industries, state forest departments, forest development corporations, farmers and researchers actively working in the gall wasp and its management.
- National workshop on 'Tree seed science and silviculture' was organised by IFGTB from 28 to 29 November 2013 at Coimbatore. Two books on "Forest seed Science and Technology" and "A Compendium of silvicultural technologies" were released to commemorate 25 years of seed and silvicultural research in the institute. The CYCUS software to calculate yield of *Casuarina* plantations and the 19th Newsletter of the Institute were also released. About 120 participants from ICFRE institutes, wood based industries, forest departments, universities, NGOs, students etc. from sixteen states participated in the Workshop wherein fifty papers and 40 posters presentations were made.
- Fifth international *Casuarina* workshop was organized by IFGTB at Mamalapuram (Tamil Nadu) from 03 to 07 February 2014. About 100 participants from nine countries participated in the workshop and deliberated on the research studies on *Casuarina*
- National Seminar on 'Tree biotechnology 2013 – emerging opportunities in forestry and tree science' was organised by IFGTB from 23 to 24 September 2013 at Coimbatore. A website on 'silico gene bank' for adaptation to abiotic stress was launched. About 60 research papers were deliberated and participants from fifty three organisations in the country took part in the seminar proceedings.
- Workshop on 'Recent advances in bio-fuels' was organised by IWST in collaboration with Karnataka State Bio-fuel Development Board and Karnataka State Council for Science and Technology from 22 to 23 November 2014 at Bangalore.
- *International seminar on 'Sandalwood: Current trends and future prospects'* was organised by IWST, Bangalore from 26 to 28 February 2014. Representative from countries like Australia, Fiji, Hawaii, Pacific Islands and Sri Lanka participated in it. The seminar was also attended by people from different parts of the society like researchers, forest officers, industrialists, farmers, plantation owners, entrepreneurs and others.
- A three days national seminar 'Recent Advances in applied statistics and its

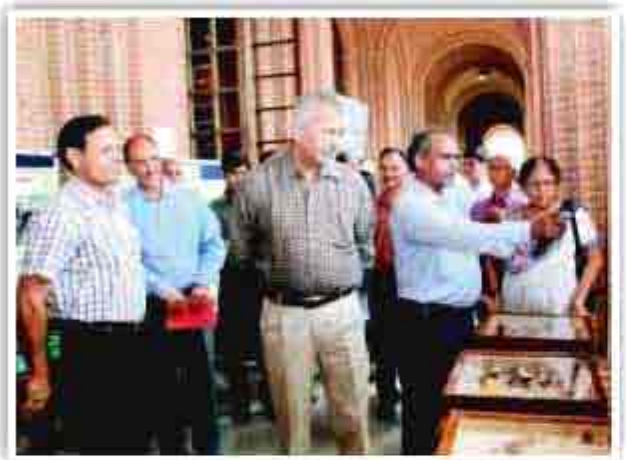
application in forestry' was organised by TFRI at Jabalpur from 15 to 17 April 2013.

- National seminar on 'Recent advances in bamboo research and development in India' was organised by RFRI, Jorhat from 06 to 07 February 2014. About 50 research papers were presented in the seminar.
- The expert group meeting on 'Adaptation to climate change impacts and risks to different forest types of South Asia' was jointly organised by SAARC Forestry Centre, Bhutan and RFRI, Jorhat from 22 to 24 October 2013 with the aim of discussing climate change related critical issues in connection with impact of climate change on forests in their country.
- One day workshop on *'Conservation of rare, endangered and threatened plant species'* was organised by IFP on 29 March 2014 at Ranchi under MoEF &CC funded project titled 'Improvement of the infrastructural facilities in the Botanical Garden as a Lead Garden in Jharkhand for *ex-situ* conservation of rare and endangered plant species'.

Workshop/seminars organised by ICFRE institutes

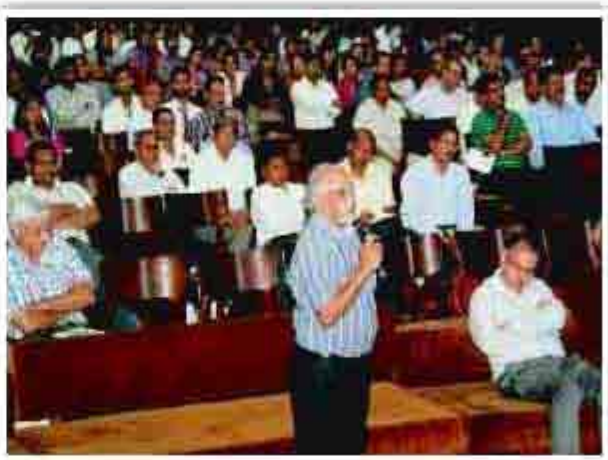
7.3.3 Special Activities (Such as Van Mahotsava, Forestry Day and Other occasions)

- National Technology Day was celebrated on 11 May 2013 with great enthusiasm at FRI, Dehradun. A special exhibition was also held in front of the Information Centre of the institute showcasing recent scientific and technical achievements of the institute in the field of forestry for its use by the society.



Celebration of National Technology Day at FRI, Dehradun

- International Day for Biological Diversity was celebrated on 22 May 2013.
- World Environment Day and FRI Day were celebrated on 5 June 2013. A special exhibition was also displayed in front of the Information Centre of the institute showcasing the recent scientific and technical advancements made by the institute.
- Van Mahotsava was celebrated on 29 July 2013
- Himalayan Day was celebrated on 09 September 2013 and theme of panel discussion was 'Conservation of Himalayan ecosystems and sustainable development in Uttarakhand'. On this occasion, an essay competition on conservation of Himalayan ecosystems and sustainable development in Uttarakhand for students and research scholars of FRI Deemed University and painting competition for student of Kendriya Vidhyalaya of FRI was also held.



Celebration of Himalayan Day by FRI, Dehradun

- International Day for Forests was celebrated on 21 March 2014 and an exhibition was organised at Information Centre of FRI which included posters and models depicting the achievements of FRI.

- The International Day for Biological Diversity was celebrated on 22 May 2013 at IFGTB Coimbatore special lecture on 'Relevance of river basin approach for wise use of wetland ecosystems' was delivered by Dr. E.J. James, Director, Water Institute – A Centre of Excellence, Karunya University, Coimbatore.
- The World Environmental Day was celebrated on 5 June 2013 and plantation of trees was done involving members of the Forest Campus Nature Club.
- The World Bamboo Day was celebrated on 18 September 2013 at IWST, Bangalore. Booklets on three important bamboo species of Karnataka(*Guadua angustifolia, Dendrocalamus stocksii, Dendrocalamus brandisii) were released.* Various species of bamboo (*Dendrocalamus giganteus, D. stocksii, D. brandisii, D. asper, Bambusa balcooa, Thyrsostachys oliveri, Guadua angustifolia, Schizostachyum brachycladum)* were planted in the institute campus on this occasion.
- International Day for Biological Diversity was celebrated on 22 May 2013 at TFRI, Jabalpur
- World Environment Day was celebrated on 5 June 2013.
- National Science Day was celebrated on 28 February 2014 and monthly e-magazine *Van Sangyan* was released on this occasion.
- World Environment Day was celebrated on 5 June, 2013 at AFRI, Jodhpur in collaboration with Jai Narayan Vyas University, Jodhpur. On this occasion, a painting competition for children on 'Our Environment' was organised. Seedlings of trees were planted in the campus of Jai Narayan Vyas University on this occasion.
- World Day to Combat Desertification was celebrated on 17 June 2013 at AFRI, Jodhpur
- Van Mahotasva was organised at demo village, Salawas on 30 July 2013 with the participation of villagers. Multipurpose tree species and medicinal plants were planted at demo village site at Salawas.
- International Day for Biological Diversity was celebrated on 22 May 2013 at HFRI, Shimla Lectures were delivered on forests biodiversity and its conservation, water conservation and biodiversity on this occasion. A drawing competition was also held on water conservation and biodiversity for school children.
- International Day for Biological Diversity was celebrated on 22 May 2013 at Conifer Campus, Panthaghati. About 30 students of Shimla based schools participated in various programmes like quiz competition, painting competition and slogan writing on the theme 'water and biodiversity'.
- Himalayan Day was celebrated in collaboration with WWF at Conifer Campus, Shimla on 09 September 2013 by organising a workshop that was attended by about 80 participants. Here, the problems pertaining to Great Himalayas were visualized and necessary measures and safeguards for conservation of the Himalayas were also suggested. A presentation on 'Towards re-defining & re-assessing the growth measures for sustainable & inclusive growth of Himalayan Ecosystem' was also made on the occasion.
- International Day for Biological Diversity was celebrated on 22 May 2013 at RFRI, Jorhat. About 150 participants took part in this programme including students and teachers of Cheniamguri High School, Sotai (Jorhat), scientists, officers and staff members of RFRI. A presentation on 'Diversity of flora and fauna of Northeast India and their conservation' was made on the occasion.
- World Environment Day was celebrated in collaboration with *Panchawati Prakiti Mancha*, Jorhat at Mahatma Gandhi College, Jorhat (Assam) on 05 June 2013. A large number of school and college students, scientists, officers and supporting staffs of RFRI participated in the celebration. Various events such as quiz, drawing, slogan and essay competition were also organised.
- International Day for Biological Diversity was celebrated on 22 May 2013 with the villagers of Munaga, Chhindwara District at CFHRD, Chhindwara
- World Environment Day was celebrated on 05 June 2013.
- Van Mahotsav was celebrated during first week of July 2013 by planting tree seedlings in the campus of CFRHRD, Chhindwara.
- Wildlife Conservation Week was celebrated by the centre from 2 to 4 October 2013.






Celebration of Van Mahotsava at ICFRE Institutes

7.4 Consultancy Services

With the aim to sustain the high performance of the Council in the area of Environment Management, the Environment Management Division under Directorate of Extension, ICFRE Hqs. is continuously building networking with various ICFRE institutes and reputed R&D and academic institutions across the bio-geographical area for collective scientific services through consultancies. The philosophy at the core of the initiative is to build a platform to

connect the knowledge and wisdom of dedicated real time teamwork for sustaining the scientific service performance. In the process of doing so, the division has contributed in completing the following consultancy service during the year:

1. Final comprehensive environmental impact assessment (EIA) / environmental management plan study report for Bunkha Hydropower reservoir (180MW) project on Wang Chhu River near Buankha village, Chukha Dzongkhags in Bhutan submitted to *National Environment Commission, Royal Government of Bhutan through* Tehri Hydropower Development Corporation. It is a bilateral project between Government of India and Royal Government of Bhutan implemented by Tehri Hydropower Development Corporation.
2. Draft EIA/ environmental management plan report for Surgani Sundla 48 MW on Suli River, a tributary of Ravi River in Chamba District, Himachal Pradesh submitted to Himachal Pradesh Power Corporation Limited (HPPCL).
3. The draft final EIA/ environmental management plan report for Nakthan (520 MW) a run-off-river Hydro-Electric Project (NHEP) on river Tosh Nala and Parbati located in Barshaini Panchayat of District Kullu, Himachal Pradesh under preparation.
4. Draft interim progress report for the cumulative EIA of hydropower projects in Yamuna and Tons River basin submitted to *Uttarakhand Jal Vidyut Nigam Ltd,* and further seasonal data collection for various parameters in progress.
5. Draft interim final progress report for cumulative EIA for river Sutlej and its tributaries submitted to Department of Energy, Himachal Pradesh.
6. Comprehensive final EIA and environmental management plan report for Ankua Iron ore mine (10 MTPA) in Ankua village, Ankua Reserve Forest, Manoharpur Taluka of West Singhabhum district of Jharkhand state submitted to M/s JSW Steel Ltd.
7. The reclamation and rehabilitation plan for individual mine in the mine affected district of Bellary, Chitradurga and Tumkur for Government of Karnataka as per the directions of the Hon'ble Supreme Court of India continued during 2013-14. Plans for 93 mines of category A and B have been completed, of which, during the current financial year, a total of 32 mines of category A &B submitted in line with CEC guidelines to Department of Mines, Government of Karnataka.

FRI, Dehradun provided following consultancy services to the various stakeholders:

- Consultancy for 'Quality assessment of cooling timbers and onsite training' was given to M/s Hindustan Petroleum Corporation Ltd., Visakh Refinery, Visakhapatnam.
- Advisory to APSARA Authority, Cambodia and ASI for conservation of trees at Ta Prohm temple, Cambodia
- Advisory to Bodhgaya Temple Management Committee for maintenance and conservation of Bodhivriksha at Bodhgaya
- Paper samples received from government organisations and private industries, such as, Employment News, Indian Army, NCERT, M/s Ayukta Rajya Siksha Kendra, Bhopal, M/s. Distt. Siksha Kendra Betul (M.P), M/s. Distt. Siksha Kendra Shivpuri, (M.P.), M/s. Distt. Siksha Kendra Sarv Siksha Abhiyan, Khargon (M.P), etc. were tested for physical and optical properties.

Testing and consultancy services, such as, wood identification, determination of moisture content, density and strength properties etc. were rendered by IWST, Bangalore to various organisations (Govt./Non-Govt./PSU/ Private/ individual etc). Total revenue of Rs.5.65 lakhs was generated from testing, training and consultancy services rendered by WPEW division.

HFRI, Shimla undertook a consultancy on "Redrafting of catchment area treatment plan for Shongtong-Karchham hydroelectric project" from HPPCL, Shimla.

7.5 Activities of Rajbhasha

ICFRE Hqs. published Hindi magazine *'Taruchintan'* and a workshop on implementation of Hindi as official language was organised to promote Hindi in official work at ICFRE on 27 June 2013. Training on Hindi software "Saransh" was also organised on 27 June 2013. The aim of the training was to train officials of ICFRE as master trainers for the software.

Rajbhasha activities in ICFRE

ICFRE and its institutes observed '*Hindi Saptah*' during the month of September 2013. During which competitive events, such as, essay writing, drafting, English to Hindi translation, Hindi typing and '*Swarachit Kawaya Path*' were organised.

Training workshop on official language Hindi was organised at ICFRE, Dehradun on 25 February 2014 in which more than 50 participants from ICFRE participated.

IFGTB,Coimbatore prepared a bilingual official language guide containing administrative glossary, noting used in day- to- day office work, usage of technical and scientific terms, and provided to all employees of IFGTB.

7.6 Awards and Honours

- Dr. Dinesh Kumar, FRI, Dehradun received award for the best research paper from CSIR-National Botanical Research Institute for paper titled "Agro-technology of *Jatropha curcas* for diverse environmental conditions in India" published in *Biomass and Bioenergy*. 48: 191-202.
- Dr. Hukum Singh, FRI received DST Young Scientist Award under Start Up Research Scheme of Science and Engineering Research Board (SERB), Department of Science and Technology (DST), Govt of India, New Delhi.
- Dr. Vineet Kumar, FRI was awarded with the prestigious Dr. H. C. Srivastava Young Scientist Award by Association of Carbohydrate Chemists and Technologists, India during the International conference on Challenges in Chemistry and Biology of Carbohydrates organised at Dehradun from 20 to 22January 2014.
- Dr. Vineet Kumar, Shipra Nagar and Dr. Y.C. Tripathi, FRI, Dehradun bagged the *First Best Poster Award* for poster presentation titled 'Do assorted approaches aid in determination of uronic acids? Structural studies on *Tinospora sinensis* polysaccharide' in the *'Science Model and Science Poster Competition'* organised during National Innovation Award Function under NRDC sponsored Innovate India Programme on 27 February 2014 at University of Petroleum and Energy Studies, Dehradun.
- The Casuarina Working Group has nominated Dr. A. Nicodemus, Scientist 'E', IFGTB, Coimbatore as a coordinator of the IUFRO Working Party 02.08.02 Improvement and Culture of Nitrogen-fixing Trees.
- Dr. Modhumita Dasgupta, IFGTB was awarded the International Timber Trade Organisation (ITTO) fellowship for undergoing two months hands-on-training on "Molecular cytogenetics techniques" at Texas A&M University, College Station, Texas, USA.
- Ms. Karpaga Raja Sundari, Scientist - B, IFGTB was awarded first prize in poster session in national seminar on Tree Biotechnology at IFGTB, Coimbatore held from 23 to 24 September 2013.
- Dr. Vipin Parkash, Scientist – D, RFRI, Jorhat received 'Young Achiever Award – 2013' conferred by the Society for the Advancement of Human and Nature , Dr Y S Parmar, University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh.
- Dr. P K Das received 'Brandis Memorial Prize 2011' for published research article in Indian Forester Journal. (Singh, P. K., Das, P. K. and Quli, S. M. S. (2011). Economic Analysis of Agro-forestry model adopted by Tribals of Orissa: India. *Indian Forester.* 137, (5) 535-543).

8. Administration and Information Technology

8.1 Information Technology

Award to ICFRE for "Info System for Decision Making in Forestry":

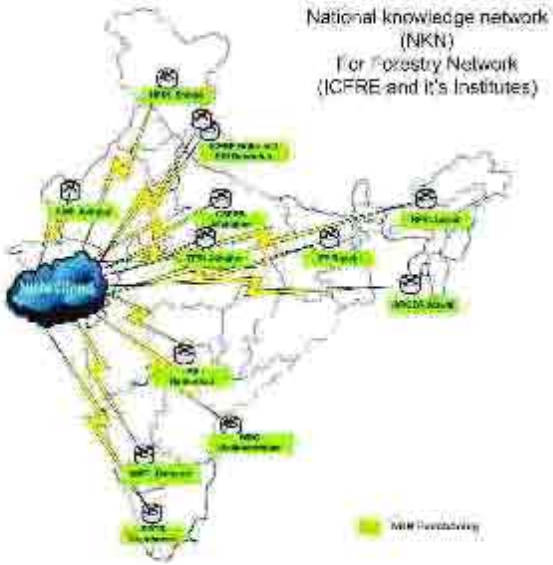
ICFRE had the honour of being conferred by the Karnataka Forest Department, the award for achieving excellence in development and deployment of "Info System for Decision Making in Forestry" on May 10, 2013 at Bangalore during the workshop held from May 10-12, 2013.

ICFRE, Dehradun

Information Technology is a key driver in carrying out research, administrative and other support activity. IT Division ICFRE is using Information Communication Technology, progressively providing the users 24X7 services to their satisfaction. IT Division caters to the Information Communication Technology needs of all institutes under ICFRE and ICFRE HQ. IT Division is keeping pace with the technological advancement of ICT within the allocated budget to the best possible extent.

Transition of ICFRE from BSNL- MPLS VPN to NKN VPN

The major achievement of the year 2013-14 is the transition from Bharat Sanchar Network Limited(BSNL)- Multiple Protocol Label Switching (MPLS), Virtual Private Network (VPN) to National Knowledge Network (NKN) Virtual Private Network (VPN) for ICFRE and its 12 Institutes/Centre. The advantage of migrating to NKN VPN network is the speed, reliability and scalability. The backbone of network connectivity has increased many folds from 2MB, 1MB and 512 KBPS to 100 MBPS scalable network connectivity across all the Institutes and Centres. It also saves around Rs.75 lakhs annually for ICFRE. The different node of NKN VPN for ICFRE started commissioning from 10th January 2013 at ICFRE, Dehra Dun and at the remotest centre at ARCBR, Aizwal by 30th July 2013. The L3 Switch was used to create the VPN on the connected nodes to NKN of ICFRE Institutes/Centre. Finally, with one month of overlap period of these VPN, ICFRE switched to ICFRE NKN VPN on 10th September 2014 with the following architecture:



ICFRE Data Centre:

The ICFRE Server Farm was established in the year 2009-10 and has been functional since then. It provides 24x7x365 services to all the employees of ICFRE and its Institutes. Apart from hosting enterprise wide application, catering to various research and administration needs which are known as Indian Forestry Research Information System (IFRIS), it also caters to services like Messaging Service, Web Service, Database Service, Proxy Service, DNS Service, DHCP Service, FTP Service, Backup Service, Internet Service, MPLS-VPN service,

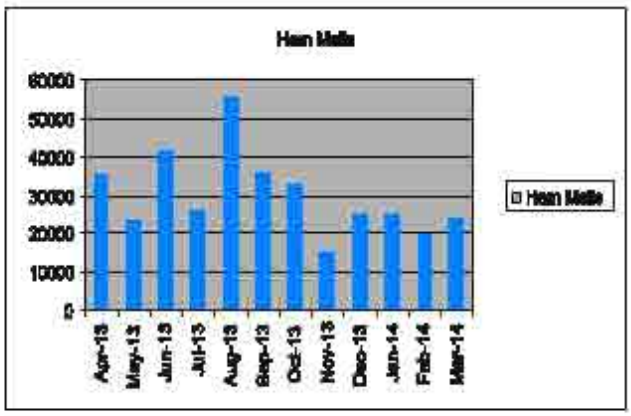
Videoconferencing, Antivirus Service, Helpdesk Service, CAEMS ISS. Around 28 websites on the different aspects of ICFRE and its Institutes have been hosted on ICFRE Web Server. ICFRE Data Centre Building Management System (BMS) is implemented & configured for effective management, monitoring and Integration of various Non-IT equipments like Fire Alarm System, Very Early Smoke Detection Appliance (VESDA) System, Rodent Controller, Water Leakage Detector, Access System, Surveillance System, Public Address (PA) System and Cooling System.

The achievement of the ICFRE Server Farm in terms of availability for 2013-14 was 100 %. The Server Farm was able to sustain 63202 security attacks from 1065 sources and all attacks were failed at the gateway level only during this period due to its robust security infrastructure.

Email IDs created, disabled and deleted data for ICFRE in the year 2013-14 are as below:

New Mail ID created	Disabled Mail IDs	Deleted Mail Ids
91	43	9

Email Transaction data for ICFRE for the year 2013-14 are as given below:



Indian Forestry Research & Information System (IFRIS): IFRIS was conceptualized with the aim to translate some of the present working manual systems into automatic systems; increase /improve access, efficiency, transparency and accountability of services; enhance the responsiveness of ICFRE through workflow automation and knowledge management; enhance the ease of convenience of the users, stakeholders in accessing the information and services provided by the ICFRE. PIMS (Personal Information Management System), PMS (Payroll Management System), FAS (Financial Accounting System), RIMS (Research Information System), EDMS (Electronic Documentation System) etc. are some of modules widely used across institutes since July 2010. PIMS is having 2125 employees' data. 15986 leave transactions took place between 1st April 2013 to 31st March 2014 through PIMS. PMS is being used from more than three years across all institutes. Pay slips and other reports related to salary are being generated through PMS. A total number of 20350 vouchers were generated in FAS between 1st April, 2013 and 31st March 2014. RIMS is having the data of more than 350 projects. EDMS contains more than 7000 documents.

Website Updates:

The ICFRE website is being updated regularly and frequency of updating done from 1st April 2013 to 31st March 2014 is shown below:

Sl.No.	Name of Institute	No. of updating in the ICFRE website
1.	ICFRE, Dehra Dun	366
2.	FRI, Dehra Dun	366
3.	IFGTB, Coimbatore	89
4.	IWST, Bangalore	79
5.	IFP, Ranchi	22
6.	RFRI, Jorhat	46
7.	HFRI, Shimla	69
8.	TFRI, Jabalpur	54
9.	AFRI, Jodhpur	20

Design and Development of Website by ICFRE Institutes: websites of ICFRE and its institutes are being updated and maintained by respective institutes. Apart from this, following new websites were developed and hosted at ICFRE Data Centre.

S. No	Institute	Design and Development of Website
1	ICFRE, Dehradun	• **Asia Pacific Workshop Website:** Developed and maintaining the website of Asia Pacific Workshop i. e. http://apw2013.icfre.org. • **Seminar on Hill Agroforestry System Website:** Developed and maintaining the website of Seminar on Hill Agroforestry System i.e. http://shas2014.icfre.org .
2	IWST, Bangalore	• Designed and developed website for International Sandalwood Seminar on "Sandalwood: Current Trends and Future Prospects" held during February 26-28, 2014 at Bangalore, Visit: http://sandalwood2014.iwst.icfre.gov.in

Databases: Many databases are available and maintained at ICFRE and its institutes like Indian Wood Insects Database, Anatomical Database of Indian Hardwoods, National Forest Insect Collection (NFIC), Forest Soil Information System for India, database of FRI Herbarium, Database on Biodiversity, database of IWST Xylarium, Expert system for Indian woods, NWFP Information System, Research Projects Database etc. These are being updated time to time. A brief summary of databases available at ICFRE and its institutes is as given below:

S. No.	Database	Institute	Detail
1	Wood Anatomy Information System(WAIS)	FRI, Dehradun	A specialized software entitled 'WOOD ANATOMY INFORMATION SYTEM (WAIS) has been developed and all scattered published data stored on it.
2	National Forest Insect Collection (NFIC)	FRI, Dehradun	Information of 17, 000 species belonging to 48,000 localities were entered into the database.
3	Database in Tree Improvement on Mandatory Species	IFGTB, Coimbatore	Tree Improvement information collected from Tamilnadu State Forest Department, Kerala State Forest Department, Annual Reports of Forest departments, ICFRE Statistical Report, DANIDA Plus tree records, Scientists and other sources and entered to Database.
4	Database on Biodiversity	IFGTB, Coimbatore	It is database of 70 threatened plant species with different retrieval, addition, deletion and modification options by using information on botanical name, Family, description, distribution, phenology, uses etc.
5	Database of IWST Xylarium	IWST, Bangalore	Contains the information of IWST Xylarium.
6	Expert system for Indian woods - their microstructure, identification, properties and uses.	FRI, Dehradun	Database of microstructure, identification, physical properties and uses of Indian commercial woods has been generated for commercial woods of India and incorporated on electronic media (CD) for easy retrieval. The same was incorporated in 'WAIS', an expert system developed for storage and retrieval of wood database.
7	NWFP Information system	TFRI, Jabalpur	An interactive database package for keeping records of NWFP species.
8	Indian Wood Insect Database	IWST, Bangalore	Contains the information of Wood and Insects.
9	ICFRE Research Database: Projects since 1990	ICFRE, Dehradun	This database contains all projects of ICFRE since 1990. Lot of search options for the user are available to find the exact information related to projects. It contains detail of 1104 projects.
10	In silico Gene Bank for Adaptation to Abiotic Stresses (IGBAAS)	IFGTB	IGBAAS has a thematically integrated sequence information pertaining to abiotic stress tolerance from different organisms. Presently, the database consists of more than 2500 gene sequences. Furthermore, the database has direct connectivity to BLAST, primer designing software of NCBI and alignment tool (ClustalW), thereby making it a one point resource for bioinformatics analysis for plant researchers working on candidate gene based molecular markers and functional genomics.

Video Conferencing Facilities: Video conferencing services at ICFRE have been started from May 2008 and till date, more than 1000 video conferencing sessions have been successfully completed. Video conferencing services among ICFRE Institutes started through NKN VPN tunnel from 2013. During 2013-14 the process of upgradation of VC equipment and extension to the other centres have been started. The process has been stopped due to the budget constraints. The monitoring and evaluation of the research projects during 2013-14 was carried over by VC only.

IFGTB strengthened the Geomatics lab of the institute with procurement of additional desktops, Laptops, Software – viz ArcGIS Editor, ERDAS Imagine 2014 etc. A new Geographical Information System (GIS) Lab has also been established by HFRI for geo-referencing of forestry related records of Institute on the topographical sheets.

Training /Workshop: Dr. Swapnendu Pattanaik, Scientist- E, Forest Biotechnology, IFB, Hyderabad, Sh Jatender Singh, Scientist D, IT Division, ICFRE Mr. V. Soundara Rajan, Scientist C, IT Cell, IWST, Bangalore and Mr. Nishar Alam, RA-I, IT Cell, RFRI, Jorhat attended the 2nd National Knowledge Network (NKN) Workshop from 17.10.2013 to 19.10.2013 at ISC, Bangalore. The workshop had a technical discussion on "Domain Name Service, Bandwidth Monitoring Service," steps for implementing security.

Development of Web Portal for Forestry Research Extension

The development of the bilingual web application of 160 important plants species of arid and semi arid region database has been completed. The bilingual web pages containing the information about the project, how to use the web application, project team page, contact use page, description of the main parameters like; different type of soils, soil textures, tree shapes, leaf shapes, leaf margins, inflorescence, flower shapes etc. have been organized on the web application. All the searches provided in the web application were also tested thoroughly for their correctness and speed. All the searches were working perfectly. The description for how to use the five type of searches has been provided in the web application. The datasheet of a particular plant species produced by the web application has been designed in a systematic way. The photographs of the plant species can also be enlarged in the datasheet for finer details. The data for 160 plant species of arid and semi arid region including the important tree species, shrubs, herbs, grasses and medicinal plants have been entered in the database through the web application after validation. The relevant photographs of all the species have also been entered in the database. The web application has been hosted on the web server and can be accessed through the internet through the URL

Home page of the web application

Web page describing the leaf shapes

Datasheet for *Commiphora wightii*

List of species through the basic search

Snapshots of the web application for plants database

http://www.seracharidplants.in. Some of the latest snapshots of the web application were as follows:

In addition to the web application, the bilingual dynamic website of the institute developed under this project was updated through-out the year. The status and information of all the new, ongoing and completed projects were updated on the site. The research publications made by the scientists of the institute during the year were updated on their profile on the website. All the other features like institutes directory, bulletin board, image gallery etc. were updated regularly on the webaite.

8.2 Sevottam: Activities relating to the Citizens/Clients Charter

The ICFRE focuses on forestry research and extension through its research institutes situated in different parts of India catering to the research needs of all the regions of the country with its clientele including the Forest and other Departments, the various government organisations as well as non governmental organisations, wood and forest products based industries, farmers, scientists and all those involved in forestry. Its commitment to excel in services it provides, necessitates for the organization to has a standard service delivery system based on transparency, accountability, trust, responsiveness and empathy that meets the expectations of all. The services provided by the Institutes encompass *inter alia* the activities related with identification and analysis of properties of timber/ trees, its conservation, preservation and protection, genetic improvement of important species including improved nursery practices, bio-informatics, market trends, socio-economic studies, NTFP management, plantation and plantation on problematic soils, biodiversity conservation and many others.

It is this zeal to serve conscientiously with a purpose that embodies 'Sevottam' symbolising the Government's intent to move from 'administration' to 'provision of services' in public interest. 'Sevottam' is a standardized Services Delivery Excellence Model whose main features are to identify the services provided by the organization, to set norms for each service, to ensure delivery as per norms, to assess quality of delivery on a continuous basis and to proactively redress public grievances.

8.2.1 Action taken to formulate the Charter

In the modern times, it is the responsibility of every organization to implement a quality management system for public services. This is a part of the Central Government's initiative to improve the quality of public services. Citizen's/Client's Charter is a document, which

represents a systematic effort to focus on the commitment of the organization towards its citizens/ clients in respect of standard of services, information, choice and consultation, non-discrimination and accessibility, grievances redressal, courtesy and value for money. This also includes expectations of the organization from the citizens/ clients for fulfilling the commitment of the organization.

Citizen's Charter is drafted and implemented by all the Institutes of ICFRE with a provision for annual review of the Charter Services provided. The charter has been prepared based on the seven steps mentioned in 'Sevottam'. As ICFRE has already mandated its mission "to generate, preserve, disseminate advanced knowledge, technologies and solutions for addressing 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". The Public Grievance Officer monitors the timely redressal of public grievances. Subsequently, necessary steps if any, for quick disposal of complaints are undertaken. Services are regularly monitored by the Head of the Division/Group Co-coordinator (Research)/Director and also by the officials of ICFRE as per norms. The instruments are standardized with set procedures. Also identified standards are analysed first and under same conditions samples are analysed and compared. Efforts are made to get an unbiased feedback from the clients who have taken our services.

8.2.2 Action taken to implement the Charter

With the aim of implementing the Charter, the ICFRE institutes implement their research endeavors after duly recognizing the users' needs. For instance, AFRI, Jodhpur identifies the research problems of the arid region and then develops the projects based on the problems and disseminates the research results to the users. In order to identify the research problems, stakeholders meetings are organized in the two states viz. Rajasthan and Gujarat falling under the jurisdiction area of the institute. This procedure is followed in all other ICFRE institutes for their respective regions. Officials from SFD's, progressive farmers, scientists and NGO's participate in the stakeholders meeting and express the problems on which the research is required. Based on the research problems given by the stakeholders, in-house discussions are made amongst the scientists of the institute and the research projects are formulated by the scientists after a thorough review of scientific literature.

The projects so developed are sent to the external experts for evaluation and are presented before the Research Advisory Group (RAG) meeting and subsequently presented in the Research Policy Committee (RPC) meeting for approval and funding. The ongoing projects are monitored regularly.

The technologies developed through the projects are extended/demonstrated to the end users with the help of demonstration trails, extension trainings, Van Vigyan Kendras, Demo village, printed material, radio talk, workshops, conferences and publications upload to the website of the institute. Keeping in view the Vision, Mission and Thrust Areas set for the Institute by the *Indian Council of Forestry Research & Education* in consultation with the Institute, the Institute fixes its targets through Annual Action Plan. Annual Action Plan includes the details of research projects to be implemented during the year, information regarding trainings, exposure visits, workshops, seminars and awareness programme to the school children. The information on all above aspects is also included in the Client Charter, which is being implemented in its true spirit

8.2.3 Trainings, workshops, etc. held for proper implementation of Charter

Trainings and workshops for awareness generation and extension activities form an integral part of the endeavors undertaken by the Council being regularly organised in the institutes. The institutes also conducted RAG meetings, stakeholders/ end users' interactive meets, 'melas' and diverse trainings every year.

The training component is covered in detail under Chapter 6 and details about the workshops organised are given under Chapter 7 of the report.

8.2.4 Publicity efforts made on Charter for the Citizen/Clients;

The Citizens' Charter is placed on the website of ICFRE for access by all. Print media is extensively used, besides other media tools, in all the institutes of the Council for propagation of information to the stakeholders. In IWST, Bangalore, publicity material, including pamphlets in Telegu, Kannada, English, Konkani have been distributed in Krishi Melas, during trainings and demonstration programme, VVK etc. Also, technical bulletins/ publications in English, Kannada and Telugu are available to the public on payment basis. At TFRI, Jabalpur, publicity and awareness campaigns on charter for the citizen/clients were made by holding slogans on notice boards and other areas to motivate citizens. General lectures on the awareness were also organized at the institute. At HFRI, Shimla, the staff is being encouraged to implement the Client Charter in its true spirit for the benefit of the stakeholders. All other institutes under ICFRE, too are actively engaged in publicity campaign for awareness generation.

8.2.5 Evaluation of implementation of Charter

Evaluation of the implementation of the Charter is an important process to gauge its effectiveness and is being done at all the institutes. At IWST, Bangalore, the internal evaluation of the implementation of Charter is being done by GCR/Director and ADGs/ DDGs/DG. In due course of time, mechanism for external evaluation of implementation of Charter in the organization will be developed. Similarly, at AFRI, Jodhpur, all the new projects and progress of the ongoing research projects were presented to the internal and external experts of the RAG. At HFRI, Shimla the Client Charter is being monitored at the end of financial year appraising the stakeholders about the extension activities proposed in the Client Charter and encouraging them to attend these trainings for the ultimate benefit of the forests and environment.

8.3 Welfare measures for the SC / ST/ backward / minority communities

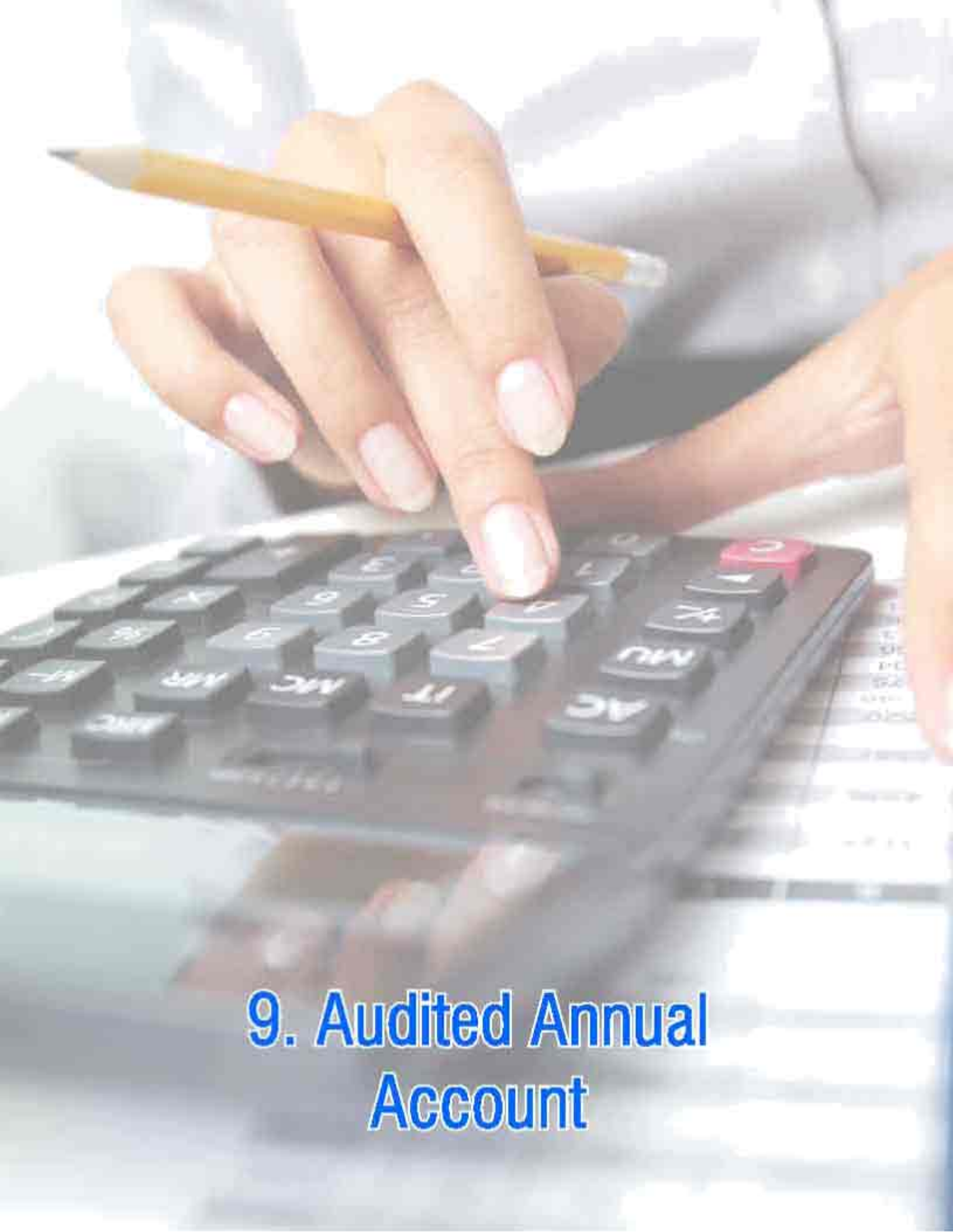
At IFGTB, Coimbatore, Dr. Baba Saheb Ambedkar Birth anniversary was celebrated at IFGTB on 28.04.2014. Chief Guest Prof. D.J. Jayaharan, Centre for Social Analysis, Madurai delivered a lecture on 'Democratization of Indian Society'.

Dr. Baba Sahib Ambodhkar Birth anniversary,2013

IWST, Bangalore has a Grievance and Redressal Cell to attend to all the grievances of IWST employees. The cell is also looking after several welfare measures of SC/ST/OBC employees of the Institute. In this regard, an association of SC/ST employees has been formed which is looking after the overall development

and welfare of the employees. At AFRI, Jodhpur, AFRI SC/ST/OBC Employees Welfare Association was formed on 20th September, 2012 to promote the general interest of SC/ST/OBC employees and to work for their collective betterment, development and upliftment by formulating the BYLAWS and electing the Executive Committee of twelve members. For promotion/recruitment process, roaster has been maintained in AFRI, Jodhpur as per guidelines of the GOI. The roaster is usually checked by the Liaison Officer at the time of considering promotion/recruitment for SC/ST/OBC. The roaster has been signed by the concerned liaison officers. Welfare Association of AFRI organized a programme of Dr. Ambedkar Jayanti on 14th April 2013 to commemorate the birth anniversary of Dr. Babasaheb Bheemrao Ambedkar.

At HFRI, Shimla, the welfare of the communities SC/ ST/ Backward/ Minority Communities is being taken care of on various fronts. Appropriate steps are being taken to accommodate these communities in various training/ extension programmes organized by the Institute from time to time. The directions as conveyed by the Government from time to time in this front are also being followed.



9. Audited Annual Account

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION
DEHRADUN

BALANCE SHEET
2013-14

07th November, 2014

CONTENTS

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

BALANCE SHEET AS AT 31ST MARCH, 2014

(Amount in Rs.)

CORPUS/CAPITAL FUND AND LIABILITIES	SCHEDULE	CURRENT YEAR AS ON 31.03.2014		PREVIOUS YEAR 31.03.2013
		RS.	RS.	RS.
CORPUS/CAPITAL FUND	1		1,456,978,115	1,431,476,721
RESERVES AND SURPLUS	2		-	-
EARMARKED/ENDOWMENT FUNDS :	3			
> One Time Special Grant		254,801,492		-
> Project Unspent Balance		332,789,173		467,762,599
> Corpus Fund Unspent Balance		21,181,104	608,771,769	
SECURED LOANS AND BORROWINGS	4		-	-
UNSECURED LOANS AND BORROWINGS	5		-	-
DEFFERRED CREDIT LIABILITIES	6		-	-
CURRENT LIABILITIES AND PROVISIONS				
(A) CURRENT LIABILITY:	7	60,687,374		
(B) PROVISIONS:		-	60,687,374	79,452,203
TOTAL			2,126,437,258	1,978,692,523

ASSETS		CURRENT YEAR AS ON 31.03.2013		PREVIOUS YEAR 31.03.2012
		RS.	RS.	RS.
FIXED ASSETS	8		1,394,944,452	1,241,132,550
INVESTMENTS-FROM EARMARKED/ENDOWMENT	9			
> F.D.R.(For One Time Special Grant)			80,000,000	80,200,000
> F.D.R.(With Institutes)				-
INVESTMENTS-OTHERS	10			-
> F.D.R.(With Institutes)			-	
CURRENT ASSETS, LOANS, ADVANCES ETC.	11		651,492,805	657,359,973
MISCELLANEOUS EXPENDITURE		-	-	-
> (to the extent not written off or adjusted)				
> (Items under recracilation)				
TOTAL			2,126,437,257	1,978,692,523
SIGNIFICANT ACCOUNTING POLICIES	24			
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25			

Dr. ASHWANI KUMAR (Director General, ICFRE)

Dr. S.P. SINGH , (Dy. Director General, Admin. ICFRE)

SH. VIVEK KHANDEKAR (Asstt. Director General, Admin., ICFRE)

SMT. VIJAY BHASMANA (Under Secretary, Budget, ICFRE)

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR P.K.SINGHAL & CO.
CHARTERED ACCOUNTANTS

(P.K.SINGHAL) Partner
Chartered Accountant
Membership No. 72862
DATED: 7TH NOVEMBER, 2014
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014

INCOME	Schedule	Current Year 31.03.2014	Previous Year 31.03.2013
		RS	RS.
Income from sales/services	12	2,952,092	8,380,296
Grants/Subsidies	13	1,213,737,864	1,205,212,000
Fees/Subscriptions	14	-	9,000
Income from Investments (Income on Invest ./rom earmarked/endow.	15	-	-
Income from Royalty, Publications etc.	16	-	2,106,382
Interest Earned	17	1,196,753.00	17,956,452
Other Income	18	105,679,449.15	50,030,911
Increase/(decrease) in stock of finished goods and works-in-progress	19	-	-
		-	-
Total(A)		**1,323,566,160**	**1,283,695,240.70**

EXPENDITURE	Schedule	Current Year 31.03.2014	Previous Year 31.03.2013
		RS.	RS.
Establishment Expenses	20	1,028,087,221	969,239,966
Other Administrative Expenses etc.	21	319,733,412	349,752,764
Expenditure on Grants, Subsidies etc.	22	758,558	12,148,352
Interest	23	-	-
Depreciation(Net Total at the year end-corresponding to Schedule 8)		8,385,437	109,118,559
TOTAL(B)		1,356,966,627	1,440,259,640
Balance being excess of Income over Expenditure(A-B)		(33,400,467)	(156,564,400)
Transfers to Special Reserve(Specify each)		-	
Transfer to/from General Reserve		-	-
BALANCE BEING DEFICIT CARRIED TO CORPUS FUND		**(33,400,467)**	**(156,564,400)**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

'AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED'

FOR P.K.SINGHAL & CO.,
CHARTERED ACCOUNTANTS

(P.K.SINGHAL) Partner
Chartered Accountant
Membership No. 73852
DATED: 7TH NOVEMBER, 2014
PLACE: DEHRADUN

Dr. ASHWANI KUMAR (Director General, ICFRE)

Dr. S.F.SINGH, (Dy. Director General, Admn., ICFRE)

SH. VIVEK KHANDEKAR, (Asstt. Director General, Admn., ICFRE)

SMT. VIJAY DHASMANA (Under Secretary, Budget, ICFRE)

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE 1-CORPUS/CAPITAL FUND:	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013	
	RS.	RS.	RS.	RS.
Balance as at the beginning of the year		1,431,476,721		1,513,614,732.92
Add: Revenue Received at DDO's		99,592,077.63		64,496,409.46
Add: Contributions towards Corpus/Capital Fund				
Plan Account	37,500,000.00		50,000,000.00	
North East	20,000,000.00	57,500,000.00	22,500,000.00	72,500,000.00
Less: Balance of net income/expenditure transferred		(33,400,466.83)		(156,564,399.64)
LESS: Revenue Receipt paid to D.G. ICFRE by the DDOs		(98,190,216.63)		(62,570,027.46)
BALANCE AS AT THE YEAR-END		1,456,978,113.45		1,431,476,721.28

SCHEDULE 2-RESERVES AND SURPLUS:	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013	
	RS.	RS.	RS.	RS.
1. Capital Reserve:				
As per last Account	-	-	-	-
Addition during the year	-	-	-	-
Less: Deductions during the year	-	-	-	-
2. Revaluation Reserve:	-	-	-	-
As per last Account	-	-	-	-
Addition during the year	-	-	-	-
Less: Deductions during the year	-	-	-	-
3. Special Reserves:	-	-	-	-
As per last Account	-	-	-	-
Addition during the year	-	-	-	-
Less: Deductions during the year	-	-	-	-
4 General Reserve:	-	-	-	-
As per last Account	-	-	-	-
Addition during the year	-	-	-	-
Less: Deductions during the year	-	-	-	-
TOTAL	-	-	-	-

Dr. ASHWANI KUMAR (Director General, ICFRE)

Dr. S.P.SINGH, (Dy. Director General, Admin., ICFRE)

SH. VIVEK KHANDEKAR, (Asstt. Director General, Admin., ICFRE)

SMT. VIJAY DHASMANA (Under Secretary, Budget, ICFRE)

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR P.K.SINGHAL & CO.,
CHARTERED ACCOUNTANTS

(P.K.SINGHAL) Partner
Chartered Accountant
Membership No. 73882
DATED: 7TH NOVEMBER, 2014
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS	FUND -WISE BREAK UP				TOTALS	
	ONE TIME SPECIAL GRANT	PROJECT ACCOUNTS	INTEREST CORPUS FUND	Fund	Current Year 31.03.2014	Previous Year 31.03.2013
	RS.	RS.	RS.	RS.	RS.	RS.
a)Opening balance of the funds	188,732,351	264,819,104	14,211,144		467,762,599	424,842,565
Adjustment of Exp. From Plan (GC) A/c to OTSG A/c under Minor Works						
b)Additions to the Funds:						
i) Donations/grants						
One Time Special Grant (General)		-	-	-	-	33,700,000
One Time Special Grant (Creation of Assets)	161,654,000				161,654,000	58,500,000
ii) Income from investments made on account of funds	-	-	8,711,835	-	8,711,835	8,545,774
iii) Other additions (specify nature)	-	-	-	-	-	-
iv) Project Receipts	-	376,786,691	-	-	376,786,691	341,559,142
TOTAL(a+b)	350,386,351	641,605,795	22,922,979	-	1,014,915,125	867,147,481
C) Utilisation/Expenditure towards objectives of funds					-	-
i) Capital Expenditure					-	-
- Fixed Assets	61,392,160	-	-	-	61,392,160	63,473,071
- Others	-	-	-	-	-	-
Total.....	61,392,160	-	-	-	61,392,160	63,473,071
ii) Revenue Expenditure			-	-	-	-
- Salaries, Wages and allowances etc.	-	-	-	-	-	-
- Rent	-	-	-	-	-	-
- Other Administrative expenses	34,192,699	-	1,741,875	-	35,934,574	47,938,225
- Project Payments	-	308,816,623	-	-	308,816,623	287,953,587
Total	34,192,699	308,816,623	1,741,875	-	344,751,197	335,911,812
					-	
TOTAL(C)	95,584,859	308,816,623	1,741,875	-	406,143,357	399,384,883
NET BALANCE AS AT THE YEAR END(a+b-c)	254,801,492	332,789,173	21,181,104	-	608,771,769	467,762,599

Dr. ASHWANI KUMAR (Director General, ICFRE)

Dr. S.P.SINGH, (Dy. Director General, Admin., ICFRE)

SH. VIVEK KHANDEKAR, (Asstt. Director General, Admin., ICFRE)

SMT. VIJAY DHASMANA (Under Secretary, Budget, ICFRE)

AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED

FOR P.K.SINGHAL & CO.,
CHARTERED ACCOUNTANTS

(P.K.SINGHAL) Partner
Chartered Accountant
Membership No. 73882
DATED: 07.11.2014
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE 4-SECURED LOANS AND BORROWINGS:	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013	
	RS.	RS.	RS.	RS.
1. Central Government	-	-	-	-
2. State Government(Specify)	-	-	-	-
3. Financial Institutions				
a) Term Loans	-	-	-	-
b) Interest accrued and due	-	-	-	-
4. Banks:				
a) Term Loans	-	-	-	-
-Interest accrued and due	-	-	-	-
b) Other Loans(specify)	-	-	-	-
-Interest accrued and due	-	-	-	-
5. Other Institutions and Agencies	-	-	-	-
6. Debentures and Bonds	-	-	-	-
7. Others(specify)	-	-	-	-
TOTAL	-	-	-	-
Note: Amount due within one year				

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

Schedule 5-UNSECURED LOANS AND BORROWINGS	Current Year 31.03.2014 RS.	Previous Year 31.03.2013 RS.
1. Central Government	-	-
2. State Government	-	-
3. Financial Institutions	-	-
4. Banks:	-	-
a) Term Loans	-	-
b)Other Loans (specify)	-	-
5. Other Institutions and Agencies	-	-
6. Debentures and Bonds	-	-
7. Fixed Deposits	-	-
8. Others(specify)	-	-
TOTAL	-	-
Note: Amount due within one year		

SCHEDULE 6-DEFERRED CREDIT LIABILITIES:	Current Year 31.03.2014 RS.	Previous Year 31.03.2013 RS.
a) Acceptances secured by hypothecation of capital equipment and other	-	-
b) Others	-	-
TOTAL	-	-
Note: Amounts due within one year		

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE 7-CURRENT LIABILITIES AND PROVISIONS	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013	
	RS.	RS.	RS.	RS.
A.CURRENT LIABILITIES				
1.Acceptances	-	-	-	-
2.Sundry Creditors:	-	-	-	-
a)For Goods	-	-	-	-
b)Others	-	-	-	-
3.Advances Received	-	-	-	-
4.Interest accrued but not due on:	-	-	-	-
a)Secured Loans/borrowings	-	-	-	-
b)Unsecured Loans/borrowings	-	-	-	-
5.Statutory Liabilities:	-	-	-	-
a)Overdue	-	-	-	-
b)Others	-	-	-	-
6.Other Current Liabilities				
Security & EMD Account	19,113,567.20	19,113,567.20	14,773,801.20	14,773,801.20
Amount Payable to Controller, Pension Cell, ICFRE				
GPF Subscription/ Refund	(199,937.00)		224,521.00	
GSLIS	(14,518.00)		(1,056.00)	
Pension Contribution	(676,942.00)		66,190.00	
New Pension Scheme	1,184,963.00	293,566.00	(24,365.00)	265,290.00
Amount Payable to PAO (F), NEW DELHI				
GPF Subscription/ Refund	358,692.00		358,692.00	
CGEGIS	11,980.00		11,980.00	
Any Other Recovery	128,451.00	499,123.00	128,451.00	499,123.00
Amount Payable to Other Units				
Saving Fund	64,071.00		64,071.00	
Death Claim	44,013.00		44,013.00	
Advance Recovery	511.00		511.00	
Other	1,298,600.00			
CGEIS	1,031.00	1,408,226.00	1,031.00	109,626.00
Amount Payable to Others				
LIC	4,116.00		2,057.00	
T.D.S./Service Tax/ Professionals Tax	(246,943.00)		34,154.00	
Payable to Controller ICFRE	3,394,572.00		1,508,902.00	
Misc. Recoveries	(4,281,126.00)		332,396.00	
Inter Unit Account	(21,981,363.68)	(23,110,744.68)	-	1,877,509.00
Salary Payable Account		62,483,636.00		61,927,854.00
TOTAL(A)		60,687,373.52		79,453,203.20
B.PROVISIONS				
1.For Taxation	-	-	-	-
2.Gratuity	-	-	-	-
3.Superannuation/Pension	-	-	-	-
4.Accumulated Leave Encashment	-	-	-	-
5.Trade Warranties/Claims	-	-	-	-
6.Others(Specify)	-	-	-	-
TOTAL(B)		-	-	-
TOTAL(A+B)		60,687,373.52		79,453,203.20

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Annexure-(IIA)

SCHEDULE 6 -FIXED ASSETS													
	GROSS BLOCK					DEPRECIATION						NET BLOCK	
DESCRIPTION	Cost valuation As at beginning of the year	Addition during the year before 30.09.2013	Addition during the year after 30.09.2013	Deduction during the year	Cost/valuation at the year end	Rate of depreciation	As at the beginning of the year	On Additions during the year before 30.09.2013	On Additions during the year after 30.09.2013	On deductions during the year	Total up to the Year-end	As at the Current year-end	As at the previous year end
	RS	RS.	RS	RS.	RS.	RS.	RS	RS.	RS	Rs.	RS	RS	RS.
A. Fixed Assets:													
1.LAND:													
a)Freehold	10,879,420.00	-	-	-	10,879,420.00	-	-	-	-	-	-	10,879,420.00	10,879,420.00
b)Leasehold	-	-	-	-	-	-	-	-	-	-	-	-	-
2.BUILDINGS:	-	-	-	-	-	-	-	-	-	-	-	-	-
a)On Freehold Land	958,913,057.84	772,000.00	115,800,000.00	-	1,075,485,057.84	0.05	47,808,038.22	38,600.00	2,895,000.00	-	50,741,638.22	1,024,743,419.62	911,105,019.62
b)On Leasehold Land	-	-	-	-	-	-	-	-	-	-	-	-	-
c)Ownership Flats/Premises	-	-	-	-	-	-	-	-	-	-	-	-	-
d)Expenditure on land not belonging to the entity	-	-	-	-	-	-	-	-	-	-	-	-	-
3.PLANT MACHINERY & EQUIPMENT	-	-	-	-	-	-	-	-	-	-	-	-	-
a) Scientific Equipment	194,479,590.66	10,919,562.00	8,210,058.00	-	213,608,190.66	0.15	26,749,235.42	1,637,934.30	615,752.85	-	29,002,922.57	184,605,268.09	167,729,355.24
b) I.T Equipment	20,941,262.84	1,076,717.00	567,050.00	-	22,585,029.84	0.60	11,669,032.10	-	176,115.30	-	11,845,147.40	10,739,882.44	9,272,230.84
4.VEHICLES	11,893,337.11	-	-	-	11,893,337.11	0.15	1,794,000.57	-	-	-	1,794,000.57	10,099,336.54	10,109,336.54
5.FURNITURE,FIXTURES	17,618,741.22	897,215.00	266,053.00	-	18,522,009.22	0.10	1,577,394.70	63,721.50	63,302.65	-	1,704,418.85	16,817,590.37	16,041,346.52
6.OFFICE EQUIPMENT	81,202,920.20	273,536.00	1,519,580.00	-	83,796,036.20	0.15	11,933,853.63	41,050.40	136,468.50	-	12,111,372.53	71,684,663.67	69,747,069.67
7.COMPUTER/PERIPHERALS	-	-	-	-	-	-	-	-	-	-	-	-	-
8.ELECTRIC INSTALLATIONS	2,181,699.95	-	-	-	2,181,699.95	0.15	527,254.99	-	-	-	527,254.99	1,654,444.96	1,654,444.96
9.LIBRARY BOOKS	44,254,693.63	15,597,993.00	5,435,168.00	-	65,287,854.63	0.15	9,754,644.44	2,339,695.00	107,826.60	-	12,202,166.04	53,085,688.59	41,866,089.19
10.TUBEWELLS & W SUPPLY	-	-	-	-	-	-	-	-	-	-	-	-	-
11.OTHER FIXED ASSETS	-	-	-	-	-	-	-	-	-	-	-	-	-
12.TOOLS & EQUIPMENTS	2,387,291.45	-	-	-	2,387,291.45	0.15	308,107.67	-	-	-	308,107.67	2,079,276.78	2,079,276.78
TOTAL OF CURRENT YEAR	1,344,753,015.00	29,076,930.00	133,120,409.00	-	1,506,950,354.00		112,322,561.34	4,120,001.20	4,294,465.60	-	120,737,028.14	1,386,213,325.86	1,232,430,453.66
PREVIOUS YEAR	-	-	-	-	-	-	-	-	-	-	-	-	-
13.CAPITAL WORK-IN-PROGRESS	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	1,344,753,015.00	29,076,930.00	133,120,409.00	-	1,506,950,354.00		112,322,561.34	4,120,001.20	4,294,465.60	-	120,737,028.14	1,386,213,325.86	1,232,430,453.66

(Note to be given as to cost of assets on hire purchase basis included above)

Dr. ASHOK KUMAR, (Director General, ICFRE)

Dr. S.P.SINGH, (Dy. Director General, Admin., ICFRE)

SH. VIVEK KHANDEKAR, (Asst. Director General, Admin., ICFRE)

SMT. VIJAY DHARMANI, (Under Secretary, Budget, ICFRE)

*AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED

FOR P.K.SINGHAL & CO.,
CHARTERED ACCOUNTANTS

P.K. SINGHAL (Partner)
Chartered Accountant
Membership No. 70021
DATED:
PLACE: DEHRADUN

SINGHAL & CO. DELHI Chartered Accountants

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE - 9 INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
1. In Government Securities		
> F.D.R.(For One Time Special Grant)	80,000,000.00	80,000,000.00
> F.D.R.(With Institutes)		
2. Other Approved Securities	-	-
3. Shares	-	-
4. Debentures and Bonds	-	-
5. Subsidiaries and Joint Ventures	-	-
6. Others(to be specified)	-	-
TOTAL	80,000,000.00	80,000,000.00

SCHEDULE 10- INVESTMENTS-OTHERS	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
1. In Government Securities		
> F.D.R.(With Institutes)		-
2. Other approved Securities	-	-
3. Shares	-	-
4. Debentures and Bonds	-	-
5. Subsidiaries and Joint Ventures	-	-
6. Others(to be specified)	-	-
TOTAL	-	-

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE - 11 CURRENT ASSETS,LOANS, ADVANCES ETC.	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013	
	RS.	RS.	RS.	RS.
A.CURRENT ASSETS:				
1.INVENTORIES:				
> Stores and Spares	-	-		
> Loose Tools	-	-		
> Stock in trade	-	-		
> Finished Goods	-	-		
> Work-In- Progress	-	-		
> Raw Materials	-	-		
2.Sundry Debtors:	-	-		
> Debts Outstanding for a period exceeding six months	-	-		
> Others				
4.Cash balances in hand(including cheques/drafts and	432,124	432,124	416,998	416,998
5.Bank Balances:				
a)With Scheduled Banks:				
> On Current Accounts	472,008,961		415,703,759	
> On Deposit Accounts	4,700,000.00	476,708,961	23,392,646	439,096,405
> On Savings Accounts				
b)With non-Scheduled Banks:				
> On Current Accounts	-		-	
> On Deposit Accounts(includes margin money)	-		-	
> On Savings Accounts	-	-	-	-
6.Post Office-Savings Accounts	-	-	-	-
TOTAL (A)		477,141,085	-	439,513,403

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2014

Amount in (Rs)

SCHEDULE 11 - (A) CURRENT ASSETS,LOANS,ADVANCES ETC.(Cont.)	CURRENT YEAR 31.03.2014		PREVIOUS YEAR	31.03.2013
	RS.	RS.	RS.	RS.
B.LOANS,ADVANCES AND OTHER ASSETS				
1. Loans:				
a) Staff Advance				
Forest Advance	1,777,603		2,098,866	
Festival Advance	3,396,601		1,133,146	
Car advance	426,726		448,526	
Scooter Advance	(29,899)		108,583	
Cycle Advance	253,176		253,176	
House Building Advance (HBA)	2,800,943		3,878,395	
TA Advance	1,686,300		905,342	
LTC Advance	956,807		518,177	
TTA Advance	1,108,348		1,088,760	
Medical Advance	666,752	-	723,160	
Pay Advance	797,389		231,830	
Amount Recoverable	149,308			
Computer Advance	510,496		573,834	
Etc. (Please specify)	240,089	14,740,643	62,806	11,824,371
b) Other Entities engaged in activities/ objectives similar to that of the Entity				
c) Other(Specify)				
2. Advances and other amounts recoverable in cash or in kind or for value to be received.				
a) On Capital Account				
CPWD	6,493,685		5,513,185	
CCU -(North East)	113,917,000		76,917,000	
CCU -(Plan Account)	1,914,334		56,914,334	
CCU -(Plan OTSG A/c))	20,200,000		51,000,000	
KVS Account	8,270		8,270	
SCIENTIFIC EQUIPMENTS	151,747	142,683,036	151,747	190,504,536
b) Prepayments	-			
c) Others	-	-		
Amount Recoverable From Controller, Pension Cell, ICFRE				
GPF Advance	6,972,891		1,894,307	
DCRG	12,024,014		4,811,823	
Provisional Pension	815,213		239,600	
GPF Part/Final Payment	4,179,409		4,067,514	
Gratuity	-	23,991,527	-	11,013,244
Amount Recoverable From PAO (P) NEW DELHI				
GPF Advance	(6,170,980)		510,522	
CGEGIS	(242,999)		965,296	
DCRG	(3,351,253)		526,855	
Provisional Pension	282,136		282,136	
GPF Part/Final Payment	322,508	(9,160,588)	322,508	2,607,317
Amount Recoverable From Other Units				
DDOs (Premium for the moth of March)	-		-	
Deputation & Others	-		-	
Service Tax	-		-	
GPF Subscription	13,514	13,514	13,514	13,514
3. Income Accrued:				
a) On Investments from Earmarked/Endowments Funds	-		-	
b) On Investments-Others	-		-	
c) On Loans and Advances	2,083,590		2,083,590	
d) Others (includes income due unrealized - Rs.....)	-	2,083,590	-	2,083,590
4. Claims Receivable				
TOTAL(B)		174,351,720		218,046,572
TOTAL(A+B)		651,492,805		657,559,973

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT

FOR THE YEAR ENDING 31ST MARCH, 2014

SCHEDULE 12 – INCOME FROM SALES/SERVICES	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
1) Income from Sales		
a) Sale of Finished Goods	-	-
b) Sale of Raw Material	-	-
c) Sale of Scraps	-	-
2) Income from Services		
a) Labour and Processing Charges	-	-
b) Professional / Consultancy Services	-	
c) Agency Commission and Brokerage	-	-
d) Maintenance Services(Equipment/ Property)	-	-
e) Others(Specify)	-	-
f) Shairing Cost received from Other Users of KV	2,952,092	8,380,296
TOTAL	2,952,092	8,380,296

SCHEDULE 13 –GRANTS/SUBSIDIES	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
		RS.
(Irrevocable Grants& Subsidies Received)		
1) Central Government		
- To Plan (GC-General)	917,737,864	940,000,000
- To Non Plan (GC-General-KV)	241,000,000	233,730,000
- To North East (GC-General)	55,000,000	31,482,000
2) State Government	-	-
3) Government Agencies	-	-
4) Institutions/Welfare Bodies	-	-
5) International Organisations	-	-
6) Others(Specify)	-	-
TOTAL	1,213,737,864	1,205,212,000

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2014

Amount-(Rs)

SCHEDULE 14 -FEES/SUBSCRIPTION	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
1) Entrance Fee	-	-
2) Annual Fees/Subscription	-	-
3) Seminar/Program Fees	-	
4) Consultancy Fees	-	9,000
5) Others(specify)	-	-
TOTAL	-	9,000
Note - Accounting Policies towards each item are to be disclosed		

SCHEDULE 15-INCOME FROM INVESTMENTS	Investment from Earmarked Fund		Investment -Others	
(Income on Invest .from Earmarked/Endowment funds transferred to Funds)	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.	RS.	RS.
1) Interest				
a) On Govt. Securities	-	-	-	-
b) Other Bonds/Debentures	-	-	-	-
2) Dividends	-	-	-	-
a) On Shares	-	-	-	-
b) On Mutual Fund Securities	-	-	-	-
3) Rents	-	-	-	-
4) Others(Specify)	-	-	-	-
		-	-	-
TOTAL	-	-	-	-
TRANSFERRED TO EARMARKED/ENDOWMENT FUNDS				

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2014

(Amount – Rs.)

SCHEDULE 16 – INCOME FROM ROYALTY, PUBLICATION ETC.	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
1) Income from Royalty	-	-
2) Income from Publications	-	2,106,582
3) Others (specify)		-
4) Revenue Received (House Licence Fees,Guest House,Mandap etc.		-
TOTAL	-	2,106,582

SCHEDULE 17 – INTEREST EARNED ETC.	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
1) On Term Deposits:		
a) With Scheduled Banks	1,196,759	16,873,400
b) With Non-Scheduled Banks	-	-
c) With Institutions	-	-
d) Others	-	-
2) On Saving Accounts:		-
a) With Scheduled Banks	-	-
b) With Non – Scheduled Banks	-	-
c) Post Office Savings Accounts	-	-
d) Others	-	-
3) On Loans:		-
i) Interest accrued during the year		
a) Employees/Staff	-	-
ii) Interest earned during the year	-	
a) Employees/Staff	-	1,083,047
4) Interest on Debtors and Other Receivables	-	-
TOTAL	1,196,759	17,956,432
Note – Tax deducted at source to be indicated		

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2014

(Amount – Rs.)

SCHEDULE 18 – OTHER INCOME /PRIOR PERIOD ITEMS	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013
	RS.	RS.	RS.
1) Profit on Sale/disposal of Assets:			
a) Owned assets		-	-
b) Assets acquired out of grants or received free of cost		-	-
2) Export Incentives realised		-	-
3) Fees for Miscellaneous Services		-	-
4) Miscellaneous Income		105,679,449.13	30,030,960.70
5)Prior Period Income		-	
(i) Account interest income of earlier years		-	-
TOTAL	-	105,679,449.13	30,030,960.70

SCHEDULE 19 – INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013
	RS.	RS.	RS.
a) Closing stock			
- Finished Goods		-	-
- Work-in-progress		-	-
b) Less: Opening Stock			
- Finished Goods		-	-
- Work-in-progress		-	-
NET INCREASE/(DECREASE) (a-b)		-	-

SCHEDULE 20 – ESTABLISHMENT EXPENSES	CURRENT YEAR 31.03.2014		PREVIOUS YEAR 31.03.2013
	RS.	RS.	RS.
a) Salaries and Wages			
NON PLAN (General Component-General)			
By Salaries	210,912,127		196,253,776
By Grant to KV (Salaries)	41,554,847	252,466,974	45,948,000
Plan (General Components-General)			
By Salaries	650,991,397		626,950,289
		650,991,397	199,971,514
b) Allowances and Bonus		-	-
c) Contribution to Provident Fund		-	-
d) Contribution to other Fund (specify)			
Revenue Paid to Pension Cell ICFRE out of Own Revenue		124,628,849	92,235,250
e) Staff Welfare Expenses		-	-
f) Expenses on Employees' Retirement and Terminal Benefits		-	-
g) Other (specify) Staining cost		-	-
h) Salary paid in excess than provision of previous year		-	7,921,177
TOTAL		1,028,087,221	969,279,966

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2014

(Amount – Rs.)

SCHEDULE 21 – OTHER ADMINISTRATIVE EXPENSES ETC.	CURRENT YEAR	31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.	RS.
a) Purchases			
b) Labour and processing expenses			
c) Cartage and Carriage Inwards			
d) Electricity and power		34,220,725.00	32,966,396.00
e) Water Charges		1,744,313.00	2,021,228.00
f) Insurance			
g) Repairs and maintenance			
> Minor Works/Maintenance	34,138,671.00		40,981,116.00
> M & S (Lab Consingencies)	7,077,328.00	41,215,999.00	8,834,100.00
h) Excise Duty	-	-	
i) Rent, Rates and Taxes			
> Rent building / Equipment	591,397.00		536,671.00
> Municipal Tax	395,147.00	1,148,234.00	2,342,403.00
j) Vehicles Running and maintenance			
> Fuel	5,795,166.00		5,648,781.75
> Repair	2,402,270.00		2,466,658.00
> Road Taxes / Insurance	1,282,651.00	10,480,086.00	1,268,415.00
k) Postage, Telephone & Communication Charges			
> Telephone charges	2,594,810.72		2,914,690.00
> Postal / Stamp Charges	1,030,257.00	3,625,067.72	999,207.00
l) Printing and Stationary			
> Printings & Publication	2,365,812.00		2,827,863.00
> Stationary	1,206,435.00	3,572,247.00	2,386,263.00
m) Travelling and Conveyance Expenses			
> T.E. (Technical Staff)	8,524,858.00		11,219,168.00
> T.E. (Non Technical Staff)	4,628,610.00		3,589,427.00
> D.E. (Technical)	-	13,153,468.00	
n) Expenses on Seminar/Workshops			
> Seminar / Conference / HRD	2,161,447.00		5,784,855.00
> Extension - Normal	1,539,113.00		3,015,222.00
> V.V.K. & Desire Villages	1,925,634.00		2,632,142.00
> Direct to Consumer Project	490,262.00		2,015,596.00
> DOE	-		592,327.00
> Field Research Expenses	37,302,661.00	43,652,673.00	32,732,069.00
o) Subscription Expenses			
p) Expenses on fees			
> Fellowship/Scholarship/cash Awards		16,005,259.00	21,136,778.00
q) Auditors Remuneration		99,888.00	95,206.00
r) Hospitality Expenses			
s) Professional Charges		1,498,348.00	2,827,996.00
t) Provisions for Bad and Doubtful Debts/ Advances		-	
u) Irrecoverable Balances Written off		-	
v) Packing Charges			
w) Freight and Forwarding Expenses		-	
x) Distribution Expenses		-	
y) Advertisement and Publicity		1,586,181.00	2,901,675.00
z) Maintenance of Equipments			
> Scientific	1,590,442.00		2,788,798.00
> Office	13,853,064.00		3,082,145.00
> I.T. Equipments / Services	1,021,714.00	16,465,220.00	19,344,009.52
aa) Others (specify)		1,347,680.00	
ab) Contingency Expenditure		73,221,282.38	76,411,664.80
ac) Medicines / X-ray		6,938,600.00	4,762,390.00
ad) Liveries		105,971.00	91,980.00
ae) Newspaper Bill		458,358.00	447,525.00
af) North East Expenditure		50,174,220.50	32,145,950.50
TOTAL		319,735,411.61	349,732,763.57

ANNEXURE OF PLAN NORTH EAST EXPENDITURE

FOR THE YEAR ENDING 31.03.2014

PARTICULARS	AMOUNT
	RS.
By Salaries (Technical Staff)	-
By Salaries (Non Technical Staff)	-
By Salaries (Research KVS)	-
	-
Plan (General Components)	-
By Salaries (Technical Staff)	28,718,037.00
By Salaries (Non Technical Staff)	-
By T.E. (Technical Staff)	812,961.00
By T.E. (Non Technical Staff)	916,238.00
By O.E. (Technical)	-
Maintenance of Vehicle	-
- Fuel	414,963.00
- Repair	508,416.00
- Road Taxes / Insurance	202,058.00
Electricity Charges	1,485,561.00
Telephone charges	70,471.00
Maintenance of Equipments	-
- Scientific	33,731.00
- Office	33,593.00
- I.T. Equipments / Services	154,826.00
Others	1,203,798.00
- Water Charges	-
- Stationery	50,901.00
- Contingency Expenditure	180,116.00
- Legal / Consultancy charges	7,986,310.50
- Municipal Tax	-
- Medicines / X-ray	-
- Liveries	-
- Postal / Stamp Charges	283,470.00
- Advertisement	41,760.00
- Seminar / Conference / HRD	822,673.00
- Newspaper Bill	57,924.00
- Extension -Normal	155,433.00
- V.V.K. & Demo Villages	409,537.00
- Direct to Cunsumers Project	960,757.00
- Rent building / Equipment	16,937.00
Plan (Research)	
By Fellowship/Scholarship/cash Awards	2,183,787.00
Printings & Publication	50,035.00
Field Research Expenses	1,158,222.00
By M & S (Lab Contingencies)	974,592.00
By Minor Works/Maintenance	287,113.00
Conveyance Advances	-
HBA	-
TOTAL:	**50,174,220.50**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2014

(Amount - Rs.)

SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC..	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
a) Grants given to Institutions/Organisations > Grants to Universities b) Subsidies given to Institution/Organisations	758,558	12,148,352
TOTAL	758,558	12,148,352

SCHEDULE 23 - INTEREST.	CURRENT YEAR 31.03.2014	PREVIOUS YEAR 31.03.2013
	RS.	RS.
a) On Fixed Loans	-	-
b) On Other Loans (including Bank Charges)	-	-
c) Other (specify)		
TOTAL	-	-

SCHEDULE 25 SIGNIFICANT ACCOUNTING AND MANAGEMENT POLICIES.

1. **Method of Accounting**:- The financial statements have been prepared as of going concern under historical cost convention. Only salary has been recognized on accrual basis of accounting. The remaining items of the financial statement have been recognized on receipt/cash basis.

2. **Fixed Assets**:-

   (i) The fixed assets are carried at cost of acquisition or book value less accumulated depreciation.

   (ii) Depreciation is being charged in written down value basis and depreciation is routed through Income and Expenditure Account. For assets acquired after 30.09.2013, depreciation has been charged for half year only.

3. **Transaction in Foreign Exchange**:- Transaction in Foreign Currencies are recorded at exchange rates prevailing on the date of transaction.

4. **Employees Retirement Benefits**:- Pension, leave encashment etc. are being accounted on cash basis. Accordingly no provision for the same is being made in the books of Accounts.

DR ASHWANI KUMAR
(Director General, ICFRE)

Dr. S.P. SINGH,
(Dy. Director General [Admin], ICFRE)

Shri VIVEK KHANDEKAR
(Assistant Director General [Admin], ICFRE)

Smt. VIJAY DHASMANA
(Under Secretary [Admin], ICFRE)

FOR P. K. SINGHAL & CO.
CHARTEREDACCOUNTANTS

PARTNER
Membership No.: 073882
Dated: 07.11.2014
Place: Dehradun

SCHEDULE:26 CONTINGENT LIABILITY AND NOTES ON ACCOUNTS:-

1. **Contingent Liabilities**:- No provision for contingent liabilities has been made in the books of accounts.

2. **Taxation**:- ICFRE is registered u/s 12AA of Income Tax Act, 1961 and exempt from Income Tax as per the provision of the act.

3. **Project Balance**:- The opening balance of units, balance outstanding under various projects and inter unit balances are subject to confirmation and reconciliation.

4. **Pension Fund**:- The amount recoverable from controller has been arrived on the basis of data produced by the units after reconciliation of the same with the books of the controller Pension Cell.

5. The advances given to external agencies such as KV is treated as expenditure in the year of advance itself irrespective of non-receipt of utilization certificate. Generally UCs are received in the next financial year.
   (a) Corresponding figures for the previous year have been regrouped/rearranged suitably as far as practicable in the new format of Financial Statement for the Central Autonomous Bodies. Figures have been regrouped/rounded off/adjusted.
   (b) GPG, Pension and GSLIS accounts are annexed at schedule 24.

6. The entries on accrual basis for salary have been incorporated in the financial statements at Head Office Level during Consolidation of Account.

7. The grant is recognized in the books of receipt basis. The grant received by the organization has been accounted for in following manners during the year:-
   (a) The grant under Plan (GC) "General", Non-Plan (GC) "General", "KV" and Plan (North-East) [GC] "General" amounting to total of **Rs.121.37 Crores** is routed through Income and Expenditure Accounts.
   (b) The grant received as contribution towards capital/corpus totaling **Rs.5.75 Crores (Plan & North-East)** is directly transferred to Corpus Account in Balance Sheet.
   (c) The grant received as One Time Special Grant during the year of **Rs.16.16 Crores** has been shown as One Time Special Grant under Earmarked/Endowment fund in the Balance Sheet.
   (d) Interest on Corpus Fund (OTSG) of **Rs.87,11,835/-** has been shown in Schedule 3 with Earmarked and Endowment Fund.

8. Schedule 1 to 26 are annexed to and from an integral part of the balance sheet as at 31.03.2014 and the Income and Expenditure Account for the year ended on that date.

9. A sum of Rs.11.58 Crs has been capitalized during the year out of Advance account CCU on the basis of Utilization Certificate.

DR ASHWANI KUMAR
(Director General, ICFRE)

Dr. S.P. SINGH,
(Dy. Director General [Admin], ICFRE)

Shri VIVEK KHANDEKAR
(Assistant Director General [Admin], ICFRE)

Smt. VIJAY DHASMANA
(Under Secretary [Admin], ICFRE)

FOR P. K. SINGHAL & CO.
CHARTEREDACCOUNTANTS

PARTNER
Membership No.: 073882
Dated: 07.11.2014
Place: Dehradun

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2014

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
OPENING BALANCE AS ON 1.4.2013			**NON PLAN**		
To Cash in Hand			By Salaries (Technical Staff)	125,573,960.00	
Name of Component			By Salaries (Non Technical Staff)	84,322,135.00	
Plant (GC)	396,137.00		By Salaries (Research KVS)	33,450,000.00	244,446,095.00
Plan (Research)	-				
Non-Plan (GC)	-		**Plan (General Components)**		
North East	35,859.00	418,996.00			
			By Salaries (Technical Staff)	454,300,159.00	
			By Salaries (Non Technical Staff)	201,851,466.00	
To Cash at Bank			By T.E. (Technical Staff)	6,524,838.00	
A/c No. & Name of Component			By T.E. (Non Technical Staff)	4,628,610.00	
Plant (GC)	402,133,192.89		By O.E. (Technical)	-	666,505,095.00
Plan (Research)	-		Maintenance of Vehicle		
Non-Plan (GC)	2,609,753.00		- Fuel	5,795,095.00	
Non Plant (KVS)	1,032,715.00		- Repair	2,403,270.00	
North East	2,628,066.50				
To Earnest Money	-	408,403,759.39	- Road Taxes / Insurance	1,982,851.00	
			Electricity Charges	34,220,725.00	
To FDRs			Telephone Charges	2,594,910.72	
A/c No. & Name of Component			Maintenance of Equipments		
Plant (GC)	103,392,646.00		- Scientific	1,593,442.00	
Plan (Research)	-		- Office	15,883,364.00	
LC Account	2,300,000.00				
North East - LC Account	5,000,000.00	110,692,646.00	- I.T. Equipments / Services	7,029,114.00	
			Others	29,895.00	
Grants-in-Aid			- Water Charges	1,744,344.00	
To Plan (Salary)	686,346,000.00				
Less Paid to Centre	-		- Bank Charges	1,147,586.00	
To Plan (General Component)	230,240,500.00		- Stationery	1,926,430.00	
Less Paid to Centre	-		- Contingency Expenditure	73,221,262.39	
To Plan (Creation of Assets)	37,500,000.00		- Audit Fees	89,888.00	
Less Paid to Centre	-		- Legal / Consultancy charges	1,498,348.00	
To Non Plan (General Component)	205,000,000.00		- Municipal Tax	594,147.30	
To Non-Plan (KVS)	36,000,000.00		- Medicines / X-ray	5,928,600.00	
To North East (General Component)	55,000,000.00		- Liveries	76,076.00	
To North East (Creation of Assets)	20,000,000.00	1,268,586,500.00	- Postal / Stamp Charges	1,030,257.00	
			- Advertisement	1,386,181.00	
To Sharing Cost		2,952,092.00	- Seminar / Conference / HRD	2,161,443.00	
To Revenue Receipt From D.D.Os		99,582,077.63	- Newspaper Bill	496,356.00	
To Revenue Earn Payable to DG/ICFRE		105,679,449.15	- Extension - Normal	1,539,113.00	
To Amount Received from DG ICFRE Revenue		-	- V.V.K. & Demo Villages	1,929,634.00	
			- Direct to Consumers Project	499,762.00	
To Corpus Fund Account		-	- Rent building / Equipment	551,387.00	
			- DOE	-	160,324,972.11
To One Time Special Grant (GC)		-	**Plan (Research)**		
To One Time Special Grant (Assets)		161,654,000.00	By Fellowship/Scholarship/cash Awards	15,006,299.00	
			Printings & Publication	2,365,812.00	
			Field Research Expenses	37,502,861.00	
			By M & M (Lab Contingencies)	6,876,328.00	
			By Minor Works/Maintenance	34,128,571.00	
			Conveyance Advances	-	
			HBA	-	
			By Building & Roads	-	
			Others Consumable	199,000.00	96,080,771.00
			Expenditure on OTS Grant (Renovation)		34,192,699.00
			Expenditure on OTS Grant (Assets)		61,392,100.00
To Chair of Excellence (Interest on OTSG)	8,711,835.00	8,711,835.00	Expenditure on Chair of Excellence		1,741,875.00

			By Equipments		
			Building	772,000.00	
			Scientific Equipments	12,237,439.00	
			Office Equipments	2,058,988.00	
			I.T. Equipments/Services	1,573,097.00	
			Tools & Equipment	-	
			Furniture & Fixture	1,763,620.00	
			Books & Journals	15,526,914.00	
			Vehicles	-	35,931,938.00
			By Grants to Universities		758,508.00
			North East Plan		
			Scientific Equipments	6,892,161.00	
			I.T. Equipments/Services	90,570.00	
			Furniture & Fixture	139,348.00	
			Books Journal	3,306,574.00	
			Office Equipment	36,548.00	
			By Building & Roads	-	
			Expenses incurred	50,174,220.50	82,639,621.50
			By Advance Payments		
			CCU -North East	67,000,000.00	
			CCU -North East (Plan Account)	-	
			CCU-DTSG(Creation of Assets)	-	
			CPWD	978,500.00	
			KVS A/c	-	67,978,500.00
			By Advance Payments		
			Scientific Equipments	-	
			Office Equipments	-	
			I.T Equipments	-	
			Furniture & Fixture	-	
			Books & Journals	-	-
To Revenue Receipt Payable to own Revenue Account No.		33,774,881.00	**To Revenue Receipt paid to own Revenue Account No.**		33,889,011.00
			By Revenue Receipt paid to D.G. ICFRE		88,190,216.83
To Securities / EMD			By Revenue Receipt paid to Controller ICFRE		124,628,549.39
Plan (GC)	10,319,857.00		By EMD/Security Refunded		5,980,191.00
Plan (Rec)	-	10,319,857.00			
GRANT TO UNIVERSITY:		2,251,364.00			
To Reimbursement from PAO (F) New Delhi			**By Payments made on Behalf of PAO (F) New Delhi**		
GPF Advance	9,425,464.00		GPF Advance	2,743,962.50	
CGEGIS	1,208,295.00		CGEGIS	-	
DCRG	3,878,108.00		DCRG	-	
Provisional Pension	-		Provisional Pension	-	
GPF Part/Final Payments (Group'D')	-	14,511,867.00	GPF Part/Final Payments (Group'D')	-	2,743,962.50
To Reimbursement from Controller, ICFRE			**By Payments made on Behalf of the Controller, ICFRE**		
GPF Advance	22,989,218.00		GPF Advance	28,067,602.00	
DCRG	29,966,031.00		DCRG	37,178,222.00	
Provisional Pension	-		Provisional Pension	575,613.00	
GPF Part/Final Payments (Group'D')	3,480,061.00		GPF Part/Final Payments (Group'D')	3,591,956.00	
Gratuity	562,205.00	56,997,515.00	Gratuity	562,205.00	69,975,798.00

To Recoveries from Staff on behalf of PAO (F), New Delhi			**By Payment made to PAO (F) on behalf of Staff**		
GPF Subscription	1,850,942.00		GPF Subscription	1,850,942.00	
Refund of GPF Advance	341,058.00		Refund of GPF Advance	341,058.00	
CGEGIS	13,560.00		CGEGIS	13,560.00	
House Building Advance	-		House Building Advance	-	
Interest on House Building Advance	-		Interest on House Building Advance	-	
Car Advance	12,000.00		Car Advance	12,000.00	
Interest of Car Advance	-		Interest of Car Advance	-	
Scooter Advance	-		Scooter Advance	-	
Interest of Scooter Advance	-		Interest of Scooter Advance	-	
Etc. (Please specify)	-	2,018,660.00	Etc. (Please specify)	-	2,018,660.00
To Receipt from Staff on behalf of other Offices			**By Payments made to other offices on Behalf of Staff**		
GPF Subscription / Refund	10,042,574.00		GPF Subscription / Refund	9,472,271.00	
CGEGIS	77,096.00		CGEGIS	77,096.00	
H B A	172,684.00		H B A	216,434.00	
Interest on House Building Advance	160,895.00		Interest on House Building Advance	185,665.00	
Car Advance	3,250.00		Car Advance	3,255.00	
Interest of Car Advance	75,000.00		Interest of Car Advance	75,000.00	
Scooter Advance	24,870.00		Scooter Advance	31,104.00	
Interest of Scooter Advance	1,625,106.00		Interest of Scooter Advance	196,706.00	
Etc. (Please specify)	1,466,346.00	13,646,220.00	Etc. (Please specify)	2,120,694.00	12,347,820.00
To Recoveries from Staff on Behalf of Controller, ICFRE			**By Payments to Controller, ICFRE on Behalf of the Staff**		
GPF Subscription	101,878,824.00		GPF Subscription	102,198,024.00	
Refund of GPF Advance	16,328,365.00		Refund of GPF Advance	16,431,825.00	
GSLIS	1,459,681.00		GSLIS	1,473,143.00	
Pension Contribution	1,053,274.00		Pension Contribution	1,746,406.00	
New Pension Scheme	5,781,510.00		New Pension Scheme	4,846,680.00	
Employer's Share	3,331,057.00	129,760,711.00	Employer's Share	3,054,555.00	129,752,435.00
RECEIPTS	**AMOUNT**	**TOTAL AMOUNT**	**PAYMENTS**	**AMOUNT**	**TOTAL AMOUNT**
To Recoveries of Advances from Staff on Behalf of, ICFRE			**By Advances paid to Staff**		
Forest Advance	51,877,991.00		Forest Advance	51,555,728.00	
Festival Advance	2,650,780.00		Festival Advance	4,914,235.00	
Car advance	33,600.00		Car advance	12,000.00	
Interest Car Advance	-		Interest Car Advance	-	
Scooter Advance	158,426.00		Scooter Advance	19,944.00	
Interest Scooter Advance	-		Interest Scooter Advance	-	
Cycle Advance	-		Cycle Advance	-	
Interest Cycle Advance	-		Interest Cycle Advance	-	
House Building Advance (HBA)	1,186,925.00		House Building Advance (HBA)	109,073.00	
Interest House Building Advance	-		Interest House Building Advance	-	
TA Advance	21,674,408.00		TA Advance	21,855,366.00	
LTC Advance	8,771,417.00		LTC Advance	9,410,047.00	
TTA Advance	1,906,509.00		TTA Advance	1,928,097.00	
Medical Advance	2,591,272.00		Medical Advance	2,534,864.00	
Pay Advance	247,716.00		Pay Advance	813,285.00	
Computer Advance	63,316.00		Computer Advance	-	
			Amount Recoverable	149,306.00	
Etc. (Please specify)	598,624.00	91,763,584.00	Etc. (Please specify)	776,907.00	94,079,854.00

To Recoveries from Staff on behalf of Others			**By Payments made to other Offices on Behalf of Staff**		
By Receipts:			**By Payments:**		
By Recoveries Income Tax (Salary)	52,107,568.00		By Recoveries Income Tax (Salary)	52,049,900.00	
TDS (Contractor/Firms, Service Tax Professional Tax)	5,160,497.00 4,158,235.00		TDS (Contractor/Firms, Service Tax Professional Tax)	5,300,962.00 4,157,535.00	
PPF	936,759.00		PPF	921,755.00	
LIC	3,914,628.00		LIC	3,912,769.00	
EMD / Securities	1,816,500.00		EMD / Securities	3,073,931.00	
Court Attachment	-		Court Attachment	-	
Hindi Translation	-		TDS DEDUCTED ON PROJECT RECEIPTS	640,644.00	
Quarter Rent	233,565.00		Quarter Rent	233,565.00	
Staff Association	55,700.00		Staff Association	55,700.00	
Etc. (Please specify)	7,483,761.00	75,469,913.00	Etc. (Please specify)	7,315,822.00	80,362,473.00
Recovery from Revenue A/c	-		Any other Payment (Sharing Cost)		2,104,847.18
Inter Unit Receipts		97,742,311.32	Inter Unit Reconciliation		119,723,575.00
To Project Receipts / Revenue Receipt		376,786,681.27	**By Project Payments/Revenue**		308,816,622.64
Amount Received by Controller ICFRE			**Amount paid by Controller ICFRE**		
Amount received from PAO (F) on account of GPF transfer		-	By GPF reimbursement to DDO's By GPF Part Final payment By GPF Final payment	- - -	
Amount received from Various DDO'S on account of GPF Subscription		-	Death Claims paid Saving fund paid Amount of premium to LIC for GSLIS Subscription	- - -	
Amount received from Others on account of refund of excess GPF Payments		-	Pensionary benefit paid Reimbursement of DCRG Pension to Various DDO's	- -	
			Amount paid to NSDL on a/c of New Pension Sch ISO Charges	- -	
Closer of New Pension Accounts			Miscellenous Payments(GPF A/c)	-	
Bank & FDR Interest		-			
Amount received on account of Saving Funds under GSLIS		-	**By Closing Balance** Cash-in-hand	432,124.00	
Amount received on account of Death Claim under GSLIS		-	Name of Component Cash at Bank with different institutes/units	- -	
Subscription from various DDOs		-	Plan (GC) / Revenue / Project	446,723,864.31	
Pro-rata Pensionary benefit received from PAO (F)		-	Plan (North East)	1,090,667.00	
Amount received from Various DDO's on account of Pension Contribution		-	Non Plan including share cost Non Plan A/c	- 29,660,625.00	
Amount recovere on account of excess payment of pension by bank		-	Non Plan A/c KVB Name of Component	334,667.00 -	
Amount received from other Departments on account of Pensionary benefits (L3PC)		-	FDR's EMD L.C.Account	84,700,000.00	337,141,065.31
Govt. Securities		-			
FDR interest / DB interest		1,196,753.00			
Misc		-			
GRAND TOTAL:		**3,014,747,884.76**	**GRAND TOTAL:**		**3,014,747,884.76**

... from Previous page.

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"

FOR P.K.SINGHAL & CO.,
CHARTERED ACCOUNTANTS

Dr. ASHWANI KUMAR (Director General, ICFRE)

Chartered Accountant
Membership No. 73882
DATED: - 07.11.2014
PLACE: DEHRADUN

Dr. S.P.SINGH, (Dy. Director General, Admin., ICFRE)

SH. VIVEK KHANDEKAR, (Asstt. Director General, Admin., ICFRE)

SMT. VIJAY DHASMANA (Under Secretary, Budget, ICFRE)

P.K. SINGHAL & CO. DELHI Chartered Accountants

P. K. Singhal & Co.
Chartered Accountants

Maa Ambika Complex
Selaqui, Distt. Dehradun (U.K.)
Pin : 248011
Mob. : 09313088385, 9837354951,
09997631720, Fax: 011-22013772
E-mail : pksinghalca@gmail.com

AUDITOR'S REPORT

To,
The Members,
Indian Council of Forestry Research & Education,
Dehradun.

1. We have audited the attached Balance Sheet of Indian Council of Forestry Research & Educations at 31st March, 2014 and the Income & Expenditure Account with Receipts & Payment Account for the year ended on that date annexed thereto. The accounts of various units/projects of the Institute were consolidated while preparing the Financials Statements. 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.

2. We have conducted our audit in accordance with the auditing 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-statement. An audit includes examining, on a test basis, evidence supporting the accounting and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

3. Further to our comments given above & comments in the annexure referred to above, we report that : -

   (i) We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit, except MOUS' for most of the units for the Funding Agencies and Fixed Assets Register for the Capital Assets acquired out of Grant Received for the Projects, which were not produced before us for our verification.

   (ii) In our opinion proper books of accounts as required by the law have been kept by the Council so far as it appears from our examination of the books.

   (iii) The balance sheet& profit and loss account dealt with by this report are in agreement with the books of account.

P.K. SINGHAL & CO. Delhi

P. K. Singhal & Co.
Chartered Accountants

Mae Ambica Complex
Selaqui, Distt. Dehradun (U.K.)
Pin : 248011
Mob. : 09313085386, 9837354951,
09997631720, Fax: 011-22013772
E-mail : pksinghalca@gmail.com

(iv) In our opinion and to the best of our information and according to the explanations given to us, subject to :-

a. The society is not capitalizing the Fixed Assets purchased from the Fund received for Projects and One Time Special Grant since its inception. During the year 2013-14, the society purchased a total fixed assets of Rs. 7,79,50,629/- out of the Grant received for projects/OTSG. In absence of Fixed Assets register, we are unable to quantify the actual amount of fixed assets purchased out of the Grant received for projects/OTSG since its inception. It is worthwhile to mention here that in absence of Fixed Assets Register the chance of mis-utilisation can't be ruled out. The details of fixed assets purchased during the year are as under :-

S.N.	NATURE OF GRANT	AMOUNT RS.
1	One Time Special Grant	6,13,92,160/-
2	Project Funds	1,65,58,469/-
TOTAL		7,79,50,629/-

b. In absence of respective MOU's with the funding agency we are unable to give any comments about liabilities of Service Tax on the fund received at the units other than Dehradun Units for the Projects.

c. *No Financial & stock records are maintained for capital assets acquired or constructed out of grants received.*

P.K. SINGHAL & CO. Delhi Chartered Accountants

P. K. Singhal & Co.
Chartered Accountants

Maa Ambika Complex
Selaqui, Distt. Dehradun (U.K.)
Pin : 248011
Mob. : 09313086386, 9837254051,
09997611720, Fax: 011-22013772
E-mail : pksinghalca@gmail.com

The said accounts read together with the Significant Accounting &Management Policies and Contingent Liability and Notes on Accounts in Schedule 25 & 26 respectively give the information required by the law in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India :-

i) In the case of the Balance sheet, of the state of affairs of the company as at 31.03.2014; and

ii) In the case of the profit and loss account, of the profit for the year ended on that date.

For P.K. SINGHAL &CO.
Chartered Accountants

P. K. Singhal
(Partner)
M. No. 073882
Firm Reg. No. 05051C

Place: Dehradun

Date: 07/11/2014

BALANCE SHEET OF CONTROLLER,PENSION CELL, OF
(GPF, GSLIS, PENSION SCHEME AND NEW PENSION SCHEME,)
INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
AS ON 31ST MARCH, 2014

SCHEDULE 24

(Amount-Rs.)

CORPUS/CAPITAL FUND AND LIABILITIES	SCHE-DULE	CURRENT YEAR AS ON 31.03.2014		PREVIOUS YEAR AS ON 31.03.2013	
PENSIN CELL FUND ACCOUNT					
GENERAL PROV.FUND A/C	24 -A	549,628,885.38		497,761,806.38	
GSLIS A/C	24 -A	851,866.96		597,708.96	
PENSION A/C	24 -A	1,188,118,975.99		1,147,390,258.64	
NEW PENSION FUND A/C	24 -A	3,410,584.00		2,837,910.00	1,648,587,683.98
ICFRE PHS		8,352,423.00			
			1,750,362,735.33		
TOTAL		1,750,362,735.33	1,750,362,735.33	1,648,587,683.98	1,648,587,683.98
FIXED ASSETS			-		-
CURRENT ASSETS LOANS & ADV.			1,685,689,289.00		
INVESTMENTS-OTHERS					1,603,594,730.18
CASH & BANK BALANCES			64,673,446.33		44,992,953.80
TOTAL		0.00	1,750,362,735.33	-	1,648,587,683.98
SIGNIFICANT ACCOUNTING POLICIES		25			
CONTINGENT LIABILITIES AND NOTES ON		26	-		-

DR. ASHWANI KUMAR (Director General, ICFRE)

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SH. VIVEK KHANDEKAR, (Asstt. Director General, Admin., ICFRE)

SMT. VIJAY DHASMANA (Under Secretary, Budget, ICFRE)

FOR P.K.SINGHAL & CO.,
CHARTERED ACCOUNTANTS

(P.K.SINGHAL)Partner
Chartered Accountant
Membership No. 73882
DATED: 7TH NOVEMBER, 2014
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

DETAILS OF PENSION FUND AS ON 31ST MARCH, 2014

SCHEDULE - 24-'A'

(As Per Annexure 'B')	GPF	GSLIS	PENSION	NEW PENSION	ICFREPHS	TOTAL
Opening	497,761,806.38	597,708.96	1,147,390,258.30	2,837,910.00	0.00	1,648,587,683.73
Add : Excess Of Income Over Expenditure	42,480,523.00	27,740.00	222,972,707.00	138,681.00	10,093,404.00	275,713,055.60
Add : Thdrwns General Fund		0.00	116,990.00	0.00	0.00	116,990.00
Saving Fund under GSLIS		1,268,218.00				1,268,218.00
Death Claim		501,682.00				501,682.00
Received from FAO	685,391.00		4,542,097.00			5,227,488.00
Subscription/contribution	117,723,558.00	1,631,529.00			2,277,400.00	121,632,487.00
New Pension Scheme/LSPC			835,136.00	10,370,583.00		11,205,719.00
Misc. receipts	0.00	169,826.00	0.00	255.00	0.00	170,081.00
TOTAL:	118,409,349.00	3,571,175.00	5,397,233.00	10,370,838.00	2,277,400.00	140,025,795.00
Less :						
Advances to instt.					1,630,000.00	1,630,000.00
Death Claim Paid		394,853.00				394,853.00
Saving Fund		1,162,324.00				1,162,324.00
Subscription to LIC		1,617,739.00				1,617,739.00
GPF Advance Reimbursement	29,980,073.00					29,980,073.00
GPF Part/Final Payment	50,203,536.00					50,203,536.00
GPF Final Payment	28,913,771.00					28,913,771.00
Pensionary Benefit paid			153,467,452.00			153,467,452.00
Paid to NSDL on A/c of NPS Contr.				9,936,830.00		9,936,830.00
DCRG			34,290,761.00			34,290,761.00
ISO Charges/Miscellenous Payments	3,199.00	169,841.00	0.00	13.00	17,577.00	192,632.00
Transfer to revenue			0.00		2,370,804.00	2,370,804.00
TOTAL:	109,022,579.00	3,344,757.00	187,758,213.00	9,936,843.00	4,018,381.00	314,080,773.00
TOTAL:	549,628,685.38	851,866.96	1,186,118,975.99	3,410,564.00	8,352,423.00	1,793,362,735.33

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CHARTERED ACCOUNTANTS

(P.K.SINGHAL)Partner
Chartered Accountant
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PLACE: DEHRADUN

CONTROLLER, PENSION CELL, OF (GPF, GSLIS, PENSION SCHEME AND NEW PENSION SCHEME, ICFRE-PHS,)
INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPT AND PAYEMENT ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2014

SCHEDULE 24

(Amount-Rs.)

CORPUS/CAPITAL FUND AND LIABILITIES	SCHE-DULE	CURRENT YEAR AS ON 31.03.2014		PAYMENT	AMOUNT	TOTAL AMOUNT
		RS.	RS.		RS.	RS.
Opening Balance as on 01.04.2013				GPF reimbursement to DDO's	29,900,073.00	
Cash in hand		-		GPF Part Final payment	50,205,590.00	
Cash at Bank		44,992,934		GPF Fina payment	28,913,771.00	
F.D.R. Account		1,603,594,750	1,648,587,684	Death Claims paid	394,883.00	
Amount recd. From DDG, Admin (Revenue)		114,628,850		Saving fund paid	1,162,324.00	
Amount recd. From PAO(F) on a/c of GPF transf		685,591		Amount of premium to LIC for GSLIS Subscription	1,617,739.00	
amount recd. From various DDO's on a/c of GPF subs		117,725,558.00		Pensionary benefit paid	155,467,452.00	
amount recd. From DDG admin on a/c of PHS contribution & membership		12,277,440.00		Reimbursement of DCRG, Pension to various DDO's	34,290,761.00	
Closer of New Pension account		-		Contribution to NSDL	9,936,830.00	
Bank & FDR interest		148,060,677.00		Miscellenous Payment (GPF A/c)	2,563,436.00	
Amount received on a/c of saving funds under GSLIS		2,899,747.00				
Amount received on a/c of death claim under GSLIS		301,602.00		Advance payment to Institutet for PH	1630000	
Subscription from various DDO's prorata pensionary benefits received from PAO(F)		4,542,097.00		Closing Balance as on 31.03.2014 Cash-in-hand		
amount received from various DDO's on a/c of Pension contribution		3,023,529.00		Name of Component		
amount received from various DDO's on a/c of Pension contribution for NPS		10,370,583.00		Cash at Bank with different Institutes/Units	64,673,446.33	
amount received from other departments on a/c of pensionry benefits (LSPC)		855,136.00		Plan (CF)/Revenue/Project		
Misc. receipts		287,871.181		Name of Component		
			415,855,840.60	FDRS	1,685,689,289	2,064,443,524.33
TOTAL			2,064,443,524.33			2,064,443,524.33

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CHARTERED ACCOUNTANTS

(P.K.SINGHAL)Partner
Chartered Accountant
Membership No. 73882
DATED: 7TH NOVEMBER, 2014
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULE-'F'

PENSION INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2013

INCOME	AMOUNT
GRANT IN AID	
Received through DG(ICAR/MOA)	
Received from Revenue ICFRE	
Interest	
TOTAL.....	
EXPENDITURE	AMOUNT
Expenditure	
Excess Of Income Over Expenditure	
TOTAL.....	

GTI INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2013

INCOME	AMOUNT
Interest & Dividend	
TOTAL.....	
EXPENDITURE	AMOUNT
Excess Of Income Over Expenditure	
TOTAL.....	

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULE-'H'

GSLIS INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2014

INCOME	AMOUNT
Interest	
TOTAL.....	
EXPENDITURE	AMOUNT
Excess Of Income Over Expenditure	
TOTAL.....	

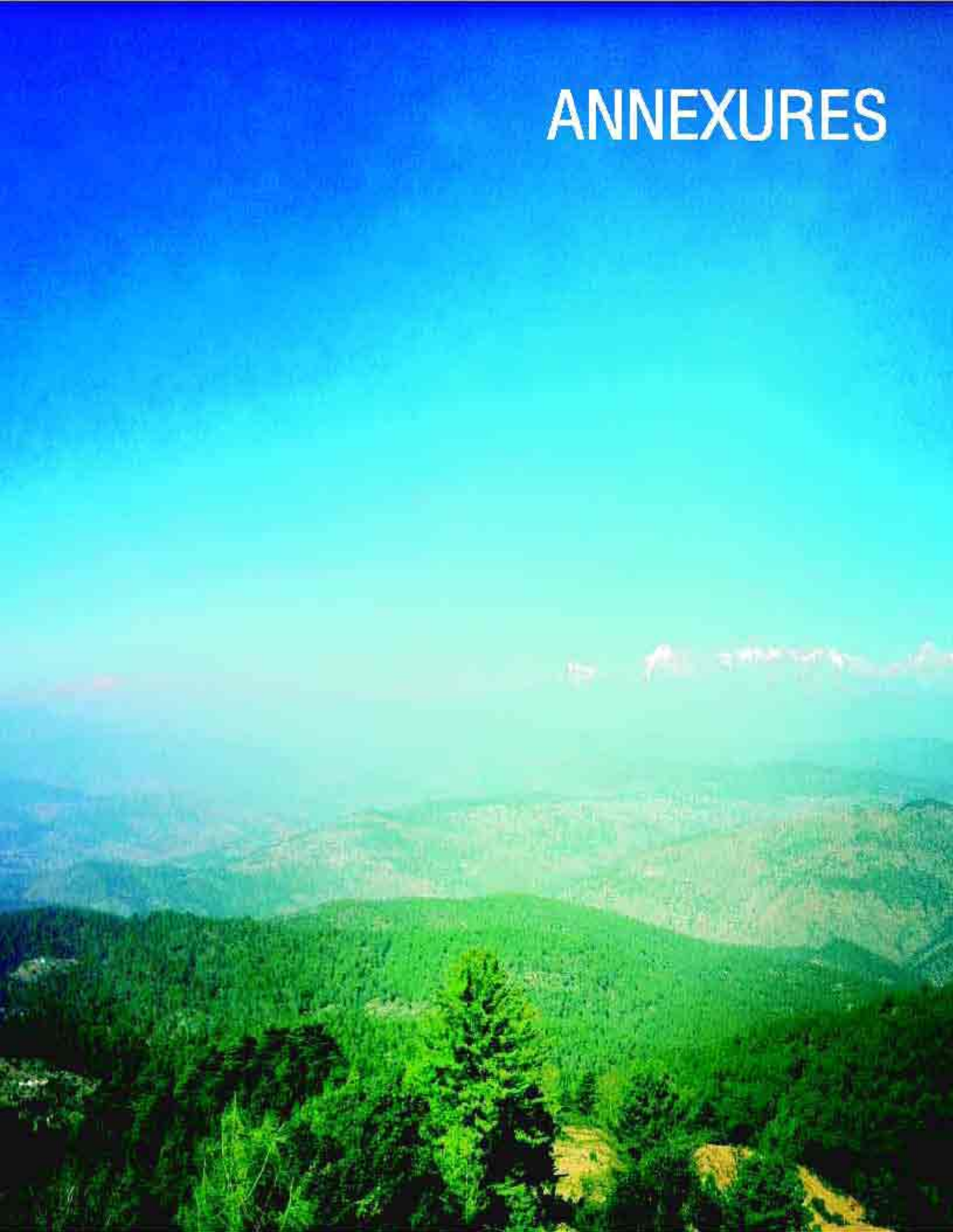
HDM PENSION ACCOUNT INCOME & EXPENDITURE A/C FOR THE YEAR ENDING 31ST MARCH, 2014

INCOME	AMOUNT
Interest	
TOTAL.....	
EXPENDITURE	AMOUNT
Excess Of Income Over Expenditure	
TOTAL.....	

ICFRE(TI) INCOME & EXPENDITURE A/C FOR THE YEAR ENDING 31ST MARCH, 2014

INCOME	AMOUNT
Received from Revenue ICFRE	
Interest	
TOTAL.....	
EXPENDITURE	AMOUNT
Excess Of Income Over Expenditure	
TOTAL.....	

ANNEXURES



Right to Information

A Public Information Officer and Appellate Authority are functioning in Public Authority, ICFRE under the RTI Act 2005. During the year 2013-14, 328 RTI application and 21 RTI Appeals were disposed off. Consolidated Quarterly RTI returns of the Public Authority are regularly uploaded by the ICFRE. A Transparency Officer under the RTI Act functions in ICFRE.

RTI Applications/ Requests	No. of applications received as transfer from other P/As u/s6(3)	Received during the month (including cases transferred to other Public Authority)	Number of cases transferred to other Public Authorities u/s6(3)	Decisions where requests/ Appeals rejected	Decisions where requests/ Appeals accepted
1st Quarter	12	47	06	–	62
2nd Quarter	21	71	05	–	85
3rd Quarter	12	76	02	–	90
4th Quarter	12	79	00	–	91
Total	57	273	13	–	328
			–	–	
RTI First Appeals			–	–	
1st Quarter	N/A	02	–	–	02
2nd Quarter	N/A	02	N/A	–	02
3rd Quarter	N/A	10	N/A	–	10
4th Quarter	N/A	08	N/A	–	07
Total	–	**22**	–	–	**21**

NAME AND ADDRESS 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
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		Dr. A.K. Tripathi, Registrar Deemed University, FRI Phone: 0135-2224439 (O) 0135-2751826 (O) Email: draktripathi@icfre.org	University matters
		Shri Shashikar Samanta, Registrar, FRI Phone: 0135-2224316 (O) 0135-2752670 (O)	Establishment, Administrative & all other matters
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LIST OF ABBREVIATIONS

ADG	-	Assistant Director General
AMS	-	Agro Meteorological Station
AFRI	-	Arid Forest Research Institute
AOXC	-	Antioxidant Capacity
AWTC	-	Advanced Wood Working Training Centre
AWS	-	Automatic Weather Station
BAP	-	Benzlaminopurine
BCC	-	Biodiversity and Climate Change
BCCL	-	Bharat Coking Coal Limited
BSNL	-	Bharat Sanchar Nigam Limited
CAZRI	-	Central Arid Zone Research Institute
CA	-	Citric Acid
CFRHRD	-	Centre for Forestry Research & Human Resource Development
CPT	-	Candidate Plus Trees
CSO	-	Clonal Seed Orchard
CSIR	-	Council of Scientific and Industrial Research
DBT	-	Department of Biotechnology
DNA	-	Deoxyribonucleic Acid
DNS	-	Domain Name System
DST	-	Department of Science and Technology
DV	-	Demo Village
EDMS	-	Electronic Documentation System
EIA	-	Environmental Impact Assessment
EMC	-	Equilibrium Moisture Content
EMBL	-	European Molecular Biology Laboratory
ENVIS	-	Environmental Information System
FAO	-	Food & Agriculture Organization
FAS	-	Financial Accounting System
FCC	-	Forests and Climate Change
FRI	-	Forest Research Institute
FSI	-	Forest Survey of India
FGRMN	-	Forest Genetics Resource Management Network
FG	-	First Generation
FTP	-	File Transfer Protocol
FYM	-	Farmyard Manure
GBP	-	Geosphere Biophere Programme
GIS	-	Geographic Information System
GoI	-	Government of India
GLC	-	Gas Liquid Chromatograph
GPS	-	Global Positioning system
GRN	-	Gene Regulatory Network
GWS	-	Gir Wildlife Sanctuary
HPPCL	-	Himachal Pradesh Power Corporation Limited
HRD	-	Human Resources Development
HFRI	-	Himalayan Forest Research Institute
IAA	-	Indole Acetic Acid

IBA	-	Indole Butyric Acid
ICFRE	-	Indian Council of Forestry Research & Education
ICIMOD	-	International Centre for Integrated Mountain Development
IFP	-	Institute of Forest Productivity
IFB	-	Institute of Forest Biodiversity
IFGTB	-	Institute of Forest Genetics and Tree Breeding
IFRIS	-	Indian Forestry Research Information System
IGNP	-	Indira Gandhi Nahar Pariyojana
IIRS	-	Indian Institute of Remote Sensing
IITJ	-	Indian Institute of Technology, Jodhpur
IPA	-	Isopropenyl Acetate
IT	-	Information Technology
ITTO	-	International Tropical Timber Organization
IUFRO	-	International Union of Forestry Research Organisation
IVI	-	Importance Value Index
IWST	-	Institute of Wood Science and Technology
JFM	-	Joint Forest Management
KMTR	-	Kalakad Mundanthurai Tiger Reserve
KVK	-	Krishi Vigyan Kendra
LAI	-	Leaf Area Index
LVL	-	Laminated Veneer Lumber
MTA	-	Material Transfer Agreement
MoEF&CC	-	Ministry of Environment, Forests and Climate Change
MPLS	-	Multiple Protocol Label Switching
NCBI	-	National Centre for Biotechnology Information
NCP	-	National Carbon Project
NKN	-	National Knowledge Network
NFLIC	-	National Forest Library and Information Centre
NFIC	-	National Forest Insect Collection
NGOs	-	Non Governmental Organization
NSC	-	National Steering Committee
NTFP	-	Non Timber Forest Produce
OBC	-	Other Backward Class
OTC	-	Open Top Chamber
PA	-	Public Address
PGPR	-	Plant Growth Promoting Rhizo bacteria
PHA	-	Polyhydroxy alkanoates
PIMS	-	Personnel Information Management System
PMS	-	Payroll Management System
PSB	-	Phosphate Solubilizing Bacteria
PVC	-	Poly Vinyl Chloride
QTL	-	Quantitative Trait Loci
QPM	-	Quality Planting Material
RAG	-	Research Advisory Group
RAPD	-	Random Amplification of Polymorphic DNA
RET	-	Rare Endangered and Threatened Species
RFRI	-	Rain Forest Research Institute
RIMS	-	Research Management Information System
RPC	-	Research Policy Committee
RSP	-	Rourkela Steel Plant

RVTC	-	Regional Variety Testing Committee
SC	-	Scheduled Castes
SERB	-	Sciene and Engineering Research Board
SIC	-	Soil Inorganic Carbon
ST	-	Scheduled Tribes
SHM	-	Sodium Hypophosphite Monohydrate
SIDBI	-	Small Industries Development Bank of India
SLEM	-	Sustainable Land and Ecosystem Management
SOC	-	Soil Organic Carbon
SPA	-	Seed Protection Area
SQI	-	Soil Quality Index
SSOs	-	Seedling Seed Orchards
SVC	-	Steam Volatile Creosote
TAFCORN	-	Tamilnadu Forest Plantation Corporation
TBO	-	Tree Borne Oil seeds
TCPL	-	Tree Cultivation in Private Lands
TDZ	-	Thidiazuron
TFRI	-	Tropical Forest Research Institute
TLC	-	Thin-layer chromatograph
TNPL	-	Tamilnadu News print Ltd.
TPCs	-	Total Phenolics Contents
TSO	-	Teak Seed Orchard
UNFCCC	-	United Nation Framework Convention on Climate Change
UNCCD	-	United Nation Convention to Combat Desertification
VAM	-	Vesicular Arbuscular Mycorrhiza
VESDA	-	Very Early Smoke Detection Appliance
VCP	-	Vegetation Carbon Pool
VMG	-	Vegetative Multiplication Garden
VPN		- Virtual Private Network
VRC	-	Variety Releasing Committee
VVK	-	Van Vigyan Kendra
WPG	-	Weight percent gain
ZSI	-	Zoological Survey of India

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