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2008 - 2009

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

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Dehradun.

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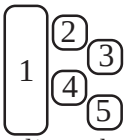

Front cover : **1.** Performance of bamboo plants raised through tissue culture, Dhadiyarghat, Solan Forest Division, H.P. **2.** *Adhatoda zeylanica* **3.** *Punica granatum* **4.** *Rhododendron lepidotum* **5.** *Hippophae tibetana*

Back Cover : View of Kalatop Khajjiar Wildlife Sanctuary, Chamba, H.P.

सत्यमेव जयते

जगदीश किशवान
महानिदेशक एवं
कुलाधिपति व.अ.सं. विश्वविद्यालय
JAGDISH KISHWAN
Director General and
Chancellor, FRI University

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
(आइएसओ 9001:2000 प्रमाणित संस्था)
(पर्यावरण एवं वन मंत्रालय - भारत सरकार की एक स्वायत्त संस्था)
पो.ऑ. न्यू फॉरेस्ट, देहरादून - 248 006
Indian Council of Forestry Research & Education
(An ISO 9001:2000 Certified Organisation)
(An autonomous body of Ministry of Environment and Forests, Government of India)
P.O: New Forest, Dehra Dun – 248 006

FOREWORD

Indian Council of Forestry Research and Education (ICFRE) is the premier forestry research organization of India, taking up research projects for development of a number of technologies for sustainable management of forestry resources of the country, along with the task of dissemination of related knowledge and information to different stakeholders, viz., state forest departments, industries, farmers and people at large. The Council also provides Grant-in-Aid to various State Agricultural/Central Universities for development of infrastructure, students amenities etc. to promote forestry education at Undergraduate and Post-graduate level. With a view to sharing information on its activities that helps in improving its delivery, the Council publishes the Annual Report every year.

The United Nation has proclaimed 22nd May as the International Day for Biological Diversity (IBD) to increase understanding and awareness of biodiversity issues. The Council and its Institutes celebrated 22nd May 2008 as IBD by organizing impressive events to highlight the importance of the Biodiversity and to create understanding and awareness among school children, general public, officers, scientists and staff of the institutes.

The Council has been granted a project by MoEF, GOI, funded by the UNDP-GEF, through Winrock International India titled "Assessment of soil carbon stocks and dynamics in forest soils of India", for the period 1995-2007. The project forms the part of India's Second National Communication (SNC) to UNFCCC.

The ICFRE delegation under my leadership participated in 28th SBSTA/SBI meeting of UNFCCC from 2nd to 13th June 2008 at Bonn, Germany, and in the Fourteenth Conference of the Parties to UNFCCC and Fourth Meeting of the Parties to Kyoto Protocol from 1st to 12th December 2008 at Poznan, Poland, where the delegation was fully involved in the negotiations on SBSTA Agenda item 5 on "Reducing Emissions from Deforestation in Developing Countries (REDD); Approaches to Stimulate Action", and AWG-KP Agenda item 3 (b) on "Land Use, Land Use Change and Forestry" (LULUCF).

The Council has also provided Grant-in-aid to 14 State Agricultural/Deemed/Central Universities to promote forestry education at Undergraduate and Post-graduate levels to the tune of Rs. 502.71 lakh in the year 2008-2009. The Council has also started the process of Accreditation of forestry curriculum of the Universities on the basis of Guidelines issued earlier on the subject by it.

It is a matter of great pleasure in presenting ICFRE Annual Report 2008-2009 which provides an insight into research, education and extension activities of the Council.

Dated : 15th August 2009

(Jagdish Kishwan)
15.08.2009

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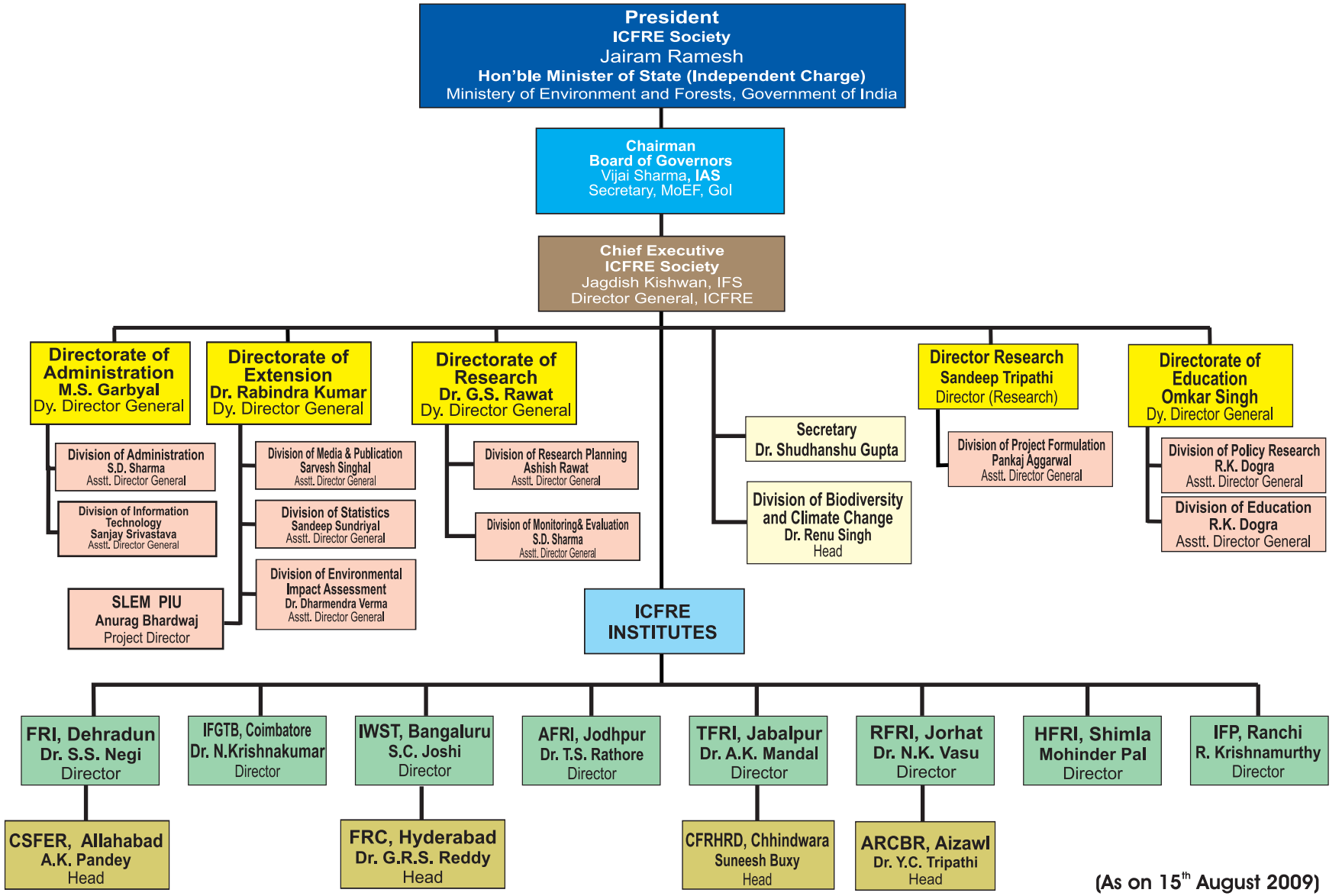
ORGANIZATIONAL STRUCTURE OF ICFRE



(As on 15th August 2009)

Chapter 1

INTRODUCTION

Indian Council of Forestry Research and Education (ICFRE), an apex body in the national forestry research system, has been undertaking the holistic development of forestry research through need based planning, promoting, conducting and coordinating research, education and extension covering all aspects of forestry. The Council deals with the solution based forestry research in tune with the emerging issues in the sector, including global concerns such as climate change, conservation of biological diversity, combating desertification and sustainable management and development of resources. Topical research by the Council enhances public confidence in the ability of forest managers and researchers to successfully handle challenges related to natural resource management.

Objectives of ICFRE

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

Institutes and Centres under the Council

ICFRE has eight Regional Research Institutes and four Advanced Research Centres located in different bio-geographical regions of the country to cater to the forestry research needs of the nation. The Regional Research Institutes are located at Dehradun, Coimbatore, Bangaluru, Jabalpur, Jorhat, Jodhpur, Shimla and Ranchi. The Research Centres are at Allahabad, Chhindwara, Hyderabad and Aizawl.

Research Institutes under the Council are:

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

Advanced Research Centres under the Council are:

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

Salient Achievements/Highlights of Research of ICFRE and its Institutes

ICFRE, Headquarter, Dehradun

- **Participation of ICFRE delegation in the 28th SBSTA/SBI meeting of UNFCCC (United Nations Framework Convention on Climate Change) held in Bonn, Germany from 2nd to 13th June 2008:** The ICFRE delegation, comprising Shri Jagdish Kishwan, DG, ICFRE, Dr. Renu Singh, Head, Biodiversity and Climate Change Division, Mr. V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, and Dr. A. Ramachandran, Director, Centre for Climate Change and Adaptation Research, Anna University Chennai, Tamil Nadu participated in the meeting along with the Government of India Delegation.
- **Participation of DG, ICFRE in Accra Climate Change Talks from 21st to 27th August 2008 at Accra, Ghana:** Shri Jagdish Kishwan, DG, ICFRE attended the Accra Climate Change meeting from 21st to 27th August 2008 and made a presentation on Reducing Emissions from Deforestation and Degradation in Developing (REDD) Countries at Accra, Ghana.
- **Participation of ICFRE delegation in the Fourteenth Conference of the Parties to the UNFCCC and Fourth Meeting of the parties to the Kyoto Protocol held in Poznan, Poland from 1st to 12th December 2008:** The ICFRE delegation, comprising Shri Jagdish Kishwan, DG, ICFRE, Dr. Renu Singh, Head, Biodiversity and Climate Change Division, Mr. V.R.S. Rawat, Scientist- D, Biodiversity and Climate Change Division, and Dr. A. Ramachandran, Director, Centre for Climate Change and Adaptation Research, Anna University Chennai, Tamil Nadu participated in the conference along with the Government of India Delegation.
- **Participation of ICFRE in International Technical Workshop in Brazil:** Dr. Renu Singh, Head, BCC Division, ICFRE attended the international technical workshop on " land area change assessment: the experience of the existing operational system" in Sao Paulo, Brazil from 4th to 6th February 2009.
- **Visit of Shri Jagdish Kishwan, DG, ICFRE to Suriname:** Mr. Jagdish Kishwan, DG, ICFRE was invited by the Ministry of Physical Planning, Land and Forest Management of the Republic of Suriname to participate in the Symposium "REDD Negotiations: the Case of High Forest Cover Low Deforestation Countries" in Paramaribo, Suriname on 13th March 2009 and to make a presentation before the senior officers and negotiators of Suriname.
- **Participation of ICFRE in expert meeting of UNFCCC in Germany:** Mr. V.R.S. Rawat, Scientist-D, ICFRE attended the Expert meeting on methodological issues relating to reference emission levels and reference levels in Bonn, Germany on 23rd and 24th March 2009.
- During X RPC, 89 new projects were discussed by RPC members out of which 81 projects were approved for ICFRE funding amounting to Rs. 810.3 Lakhs.
- Five thousand (5,000) copies of an illustrated Hindi Book "*Bans Ropan evam Upyogita*" were published for the benefit of forest personnel, farmers and field functionaries and distributed free of cost.
- Overall Rs. 502.71 lakhs as Grant-in-aid released to the 14 universities in the year 2008-09.

- Process of accreditation on the pattern of AICTE has been initiated and the Forestry Courses are being accredited. The Forestry Syllabii of Kerala Agricultural University, Trissur (Kerala) has been accredited in the year 2008-09 and several universities have offered for accreditation of their forestry courses which are in process.
- ICFRE in collaboration with State Forest Departments (SFD's) has established 22 VVKs in different states.

INSTITUTES

FRI, Dehradun

- DNA fingerprinting of *Fusarium solani* by specific primers.
- Molecular characterization of resistant germplasm of *Dalbergia sissoo* using 60 primers.
- Artificial culturing of *Cordyceps sinensis* on Jhingora and Mandua grains and analysis of bioactive principles.
- Identification of potential antagonistic species of Trichoderma for the control of medicinal plants.
- DNA sequencing of various pathotypes of *Cylindrocladium quinqueseptatum*.
- Establishment of variability in Drechlera isolates in causing blight in poplars.
- Hill Bamboosetum established at Khirshu, Pauri Garhwal.
- Germplasm Bank of *Dendrocalamus strictus* maintained at Pavilion Ground of FRI, New Forest Campus, Dehradun.
- Establishment of Bamboo Clonal Nursery at FRI, Dehradun.
- Establishment of five Van Vigyan Kendras by Forest Research Institute in the states/UT of Punjab, Haryana, Uttarakhand, UT Chandigarh and NCT Delhi.
- Establishment of one Demo Village by FRI at Shyampur in Dehradun.

IFGTB, Coimbatore

- Standardized suitable culture medium for mass production of different isolates of Ectomycorrhizal fungi (*Laccaria fraterna* and *Pisolithus albus*) under *in-vitro.*
- Serious pest problems in nursery and plantations of fast growing indigenous tree species such as *Ailanthus excelsa, Melia dubia, Gmelina arborea, Thespesia populnea, Bombax* spp. and *Dalbergia sissoo* in Tamil Nadu and Kerala were identified.
- Eucalyptus clones categorized based on the susceptibility for key pests and disease problems.
- Some of the secondary individual compounds identified from tissues of *Aegle marmelos* viz. fruit, unripe fruits and seeds were tested for their bioactivity on teak pest, *Hyblaea puera*. It was observed that a few individual phenol/phenolics expressed their biopesticidal properties.
- Assessment of biopesticidal effect of *A. marmelos* plant extracts and testing the bioactivity in comparison with traditional insecticides, neem derivatives, and development of suitable biopesticidal formulation & phytomedicine are in progress.
- The seed decoater experiment on *Jatropha curcas* seeds proved that removal of seed coat from the kernel upto the level of 80% is essential in order to improve the oil recovery from seeds and to obtain quality oil with desirable physical and chemical characteristics. A prototype 'Seed Decoater' was fabricated to break the whole seed so that shell or seed coat is removed to release the kernel.

IWST, Bangaluru

- Studies carried out on *Simarouba glauca* showed that the timber is dimensionally stable and found suitable for making artifacts, match sticks, tool handles, light packing cases, light furniture and 'BWR' grade plywood.
- Investigations on tree ring analysis of certain species in Western Ghats to monitor climate change and its relevance to wood quality showed local insect attack in 1966 and 1976 in teak based on observations of growth rings and its abnormalities.
- Studies on wood filled thermoplastic composites show that filler morphology, type of coupling agent and processes additive have large influence on the mechanical performance of wood flour filled polypropylene composites. Formulations for producing wood filled composites were developed. To predict the properties of composites, a micromechanics model based on shear lag theory was developed. A fast and reliable method to measure elastic constants using vibration method was also developed.
- Fatty oil content of the seeds of *Baccaurea courtallensis* Muell. Arg. was found to be 22.5%. Ethyl acetate and Methanol extracts of the fruit rind were found to be highly inhibitive to *Fusarium oxysporum* fungi.
- Natural durability of timber of 6 plantation grown species of 5, 10, 15 and 20 years was tested against decay fungi, termites and beetles. By field studies, a package of practice was developed for timber storage in depots. Laboratory and field trials have shown the effectiveness of phosphine fumigation for wood protection.
- One hundred fifty three herbivorous species and 29 species of flower visiting insects were recorded and details of 11 major pollinators of three major species were studied from Karnataka mangroves. Ninty four species of forest lepidoptera were tested and microsporidian parasites were isolated from 29 species.
- One hundred fifty fungal species were isolated from the seeds of selected endemic plants, 40 species were pathogenic and the rest were saprophytic fungi.
- IWID, a database on Indian wood insects is developed including details of about 1000 timber species and 2500 wood inhabiting insects.
- Three important medicinal plants, namely, *Drynaria quercifolia* (L.) J. E. Sm., *Stemona tuberosa* Lour. and *Trichosanthes tricuspidata* Lour. reported for the first time from the tribal areas of North-Eastern Ghats of Andhra Pradesh.
- The fouling organisms, namely, *Siphonaria* cf. *kurracheensis* (Reeve), a new record to India and *Perna indica* Kuriakose and Nair, a new record to East Coast of India were reported from Visakhapatnam harbour.
- Established germplasm bank of 21 bamboo species at Gottipura, Bangaluru.
- Based on the overall biomass and productivity data of 5 years of *Acacia mangium* hybrid under semi-arid condition, line planting was found better than block plantation.
- Among the seeds collected from SPA, SSO, CSOs and unimproved population of teak, seeds from SPA were better in quality in terms of morphological characters and germinations. Seeds from CSO had more emptiness as compared to those from SPAs and unimproved populations.
- Established two agroforestry trials with four industrially important bamboo species in farmers' field. Produced 50,000 plants of sandal and provided to the farmers, NGOs and plantation companies. Established two agroforestry trials of sandal in Karnataka.
- A systematic study on fuel properties and combustion characteristic of *Lantana camara* and *Eupatorium* spp. was carried out and compared with that of a mature tree (20 years old)

of *E.* hybrid and *C. equisetifolia*. The calorific value and other fuel properties of *Lantana camara* were found as good as that of *E.* hybrid and *C. equisetifolia*.

TFRI, Jabalpur

- Dispersion of Suspended Particulate Matter (SPM) from sponge iron factory may render the area near the factory unfertile.
- Complete host record of Indian Braconid species has been prepared.
- Control measures for Xanthomonas leaf curl and stunting in young teak plants has been developed.
- A calendar on nursery techniques of medicinal plants prepared.
- Five hundred sixty three herbal plants used by the traditional healers to cure the various diseases prevailing among the tribal/local communities documented.

RFRI, Jorhat

- Nursery technique for multiplication of *Bambusa pallida* has been standardized.
- Carbon sequestration potential of *Bambusa tulda* and *Dendrocalamus hamiltonii* has been evaluated.
- *Bambusa pallida* has been found to be most resistant bamboo to biodegradation in natural conditions.
- Keys have been developed for identification of infested agar trees.
- Areca nut + Patchouli and agar + Patchouli agroforestry models have been developed. The models have been extended to the farmers' fields in Jorhat and Nagaon districts of Assam.

AFRI, Jodhpur

- Severe infestation of a semilooper, *Achaea janata* (noctuidae) has been noticed on all mehndi (*Lawsonia inermis*) growing areas at Sojat road (Pali).
- Isabgol (*Plantago ovata*) crop was found severely attacked by downy mildew disease (*Peronospora* sp.).
- The major insect pest attacking Isobgol is an aphid species (*Aphis gossypii*).
- Soil treatment (Trichoderma + Vermicompost + Phorate) was found the best amongst other three treatments wherein Mehandi yield was increased from 1.5 to 2.1 kg per metre sq. in treated plots.
- A check list of 20 species of insects, 2 species of mollusk and 5 species of mites of infesting neem in arid areas of Rajasthan has been prepared and compiled. Bioecology of neem weevil, *Myllocerus tenuicornis* has been studied in detail.
- The provenance from Palanpur and Jhansi exhibited the least preference for the larvae of *M. tenuicornis* (0.65 and 0.69 cm sq.) whereas the provenance from Mulag was the most favoured host as the leaf area consumed by larvae was 3.11 cm sq.
- AMF genera like *Glomus, Scutellospora, Sclerocystis* and *Acaulospora* and Seven species of *Glomus* viz., *G. fasciculatum, G. aggregatum, G. mosseae, G. macrocarpum G. intraradices, G. reticulatum,* and *G. constrictum* were isolated and identified.
- The distribution of different VAM species viz., *Glomus aggregatum* (35%); *G. mosseae* (15%); *Glomus fasciculatum* (20%); *G. macrocarpum* (10%); *Glomus* sp. (15%); *Scutellospora* (3%) and *Acaulospora* (2%) were recorded.

- Established performance trial and agri-trial of guggal.
- Established clonal trials and seedling seed orchard of *Jatropha curcas.* Established progeny trial of 30 CPTs of *J. curcas* selected from Rajasthan and Gujarat.
- Developed preliminary seed yield equation for *J. curcas* relating to seed yield with crown diameter.

HFRI, Shimla

- *Arnebia euchroma* (Royle ex Benth.) I.M. Johnston, a critically endangered plant in Himachal Pradesh, has been found in open, drier slopes in Namgia and Hango valley of district Kinnaur, Himachal Pradesh at an elevation ranging from 3700 m to 4200 m above msl. The plant belongs to family Boraginaceae and commonly known as Ratan Jot is used in the treatment of measles, mild constipation, burns, frostbite, dermatitis etc. It inhibits the growth of cancer cells on the chorion membrane.
- The problem of large scale drying of Deodar trees was diagnosed in the Pangna Forest Range of Karsog Forest Division (District Mandi). It was observed that Deodar trees in the two compartments i.e. C-1A (D-19 Shlog) covering area 31.50 hectares and C-1 (D-15 Rakni) covering area 10.49 hectares are drying and dying due to some disease. The symptoms revealed the prevalence of Heterobasidium root rot of Deodar.

IFP, Ranchi

- Traditional medicinal practices commonly used by 22 tribes of Jharkhand were documented under the NMPB funded project. Herbal remedies for common ailments among ethnic communities viz. Arthritis, Diarrhoea, Dysentery, Spermatorrhoea, Bone fracture, Epilepsy, Piles, Asthma, Hyperacidity, Paralysis, Infertility (Male & Female), Otitis, Snake bite and Dog bite, etc. were noted. Herbarium specimens were preserved for plants used by different tribes for treatment of disease symptoms.
- Vegetative propagation techniques were standardized for *Rauvolfia serpentine*, *Gloriosa superb*, *Asparagus racemosus* and *Withania somnifera* in Jharkhand. Growth of four species of medicinal plants was recorded under the shade of trees viz. Teak, Sisham, Khair and Sal.
- Developmental stability of leaves in Neem and Sissoo is demonstrated suggesting that air pollutants and their associated changes in the environment such as increase in temperature and humidity did not induced genotypes to change to their environment. Hence plants have inherent physiological adaptations to overcome evils of environment. Plants do not suffer under optimal water regimes, even under the influence of air pollutants indicating fair resistance to them. However, herbs showed susceptibility to diseases and pests under prolonged exposure to air pollutants.

Chapter 2

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION

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

FORESTRY RESEARCH

1. BIODIVERSITY AND CLIMATE CHANGE (BCC) DIVISION

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

A. Biodiversity

i. The Ninth meeting of the Conference of Parties (COP-9) to the Convention on Biological Diversity (CBD) was held in Bonn, Germany from 19th to 30th May 2008. The COP-9 to the CBD has adopted 37 decisions on various issues such as protected areas, forest biodiversity, invasive alien species, biodiversity and climate change etc. The Ministry of Environment and Forests, Government of India asked ICFRE to provide suggestions on invasive alien species as per the decision IX/4 on invasive alien species of COP-9 to the CBD. Accordingly, the BCC Division prepared a brief note on Forest Invasive Species and submitted to the Ministry of Environment and Forests, Government of India, New Delhi.

ii. The United Nations has proclaimed 22nd May as the International Day for Biological Diversity (IBD) to increase understanding and awareness of biodiversity issues. The IBD on 22nd May 2008 was observed in different regional Institutes of ICFRE. The events organized on this day were attended by children, general public, officers, scientists, and staff of regional Institutes of ICFRE. The BCC Division compiled a detailed report on the celebration of the IBD and submitted to The Ministry of Environment and Forests for its incorporation in the draft National report to the CBD Secretariat.

B. Climate Change

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

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

The BCC Division organized a two days inception meeting of the SNC project activity on 9th and 10th May 2008 at Dehradun under the Chairmanship of Shri Jagdish Kishwan, DG, ICFRE, Dehradun. The inception meeting was attended by the Dean and scientists of

IIRS, and all the nodal officers of regional institutes to finalise the sampling plan and methodological details of the project. A manual providing methodological details along with sampling sites, sampling protocol and sample analysis was also developed for conduct of studies.

ii. **Measurement of forest carbon exchange using eddy covariance and CDM potential studies in India:** The project is a partnership study between the Department of Forest Science and Resources (DISAFRI), University of Tuscia (Italy), Indian Institute of Remote Sensing, Indian Council of Forestry Research and Education, and Uttarakhand Forest Department.

The BCC Division, the nodal point of ICFRE for the project, organized a one day inception meeting of the project on 14th May 2008 under the chairpersonship of Shri Jagdish Kishwan, DG, ICFRE; and discussed about the ongoing activities and progress made so far under the project.

Inception meeting of the SNC Project

C. Other Activities

i. **Participation of ICFRE delegation in the 28th SBSTA/SBI meeting of UNFCCC (United Nations Framework Convention on Climate Change), held in Bonn (Germany) from 2nd to 13th June 2008:** The ICFRE delegation, comprising Shri Jagdish Kishwan, DG, ICFRE, Dr. Renu Singh, Head, Biodiversity and Climate Change Division, Shri V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, and Dr. A. Ramachandran, Director, Centre for Climate Change and Adaptation Research, Anna University Chennai, Tamil Nadu participated in the meeting along with the Government of India Delegation.

Participation of ICFRE delegation in the 28th SBSTA/SBI meeting of UNFCCC

The delegation was fully involved in negotiations in respect of SBSTA Agenda item 5 on Reducing Emissions from Deforestation in Developing (REDD) Countries : Approaches

to stimulate action; AWG–KP Agenda item 3(b) on Land Use, Land Use Change and Forestry (LULUCF); and, SBSTA Agenda item 8(c) Good Practice Guidance for Land Use, Land Use Change and Forestry activities under articles 3.3 and 3.4 of Kyoto Protocol during the Conference.

ii. **Participation of DG, ICFRE in Accra Climate Change Talks from 21st to 27th August 2008, Accra, Ghana:** Shri Jagdish Kishwan, DG, ICFRE attended the Accra Climate Change meeting from 21st to 27th August 2008, and made a presentation on Reducing Emissions from Deforestation and Degradation in Developing (REDD)Countries at Accra, Ghana.

iii. **Participation of ICFRE delegation in the Fourteenth Conference of the Parties to the UNFCCC and Fourth Meeting of the Parties to the Kyoto Protocol held in Poznan, Poland from 1st to 12th December 2008:** The ICFRE delegation, comprising Shri Jagdish Kishwan, DG, ICFRE, Dr. Renu Singh, Head, Biodiversity and Climate Change Division, Shri V.R.S. Rawat, Scientist-D, Biodiversity and Climate Change Division, and Dr. A. Ramachandran, Director, Centre for Climate Change and Adaptation Research, Anna University Chennai, Tamil Nadu participated in the conference along with the Government of India Delegation.

The ICFRE personnel were involved in the negotiations on the following agenda items of the SBSTA and AWG-KP related to forestry during the conference:

1. SBSTA 29 Agenda item 5: Reducing Emissions from Deforestation in Developing Countries (REDD): Approaches to stimulate action,
2. AWG-KP 6 Agenda item 3 (b) Land Use, Land Use Change and Forestry (LULUCF).

India in its statement supported a comprehensive approach on REDD that encompasses all actions by country Parties contributing directly in reducing emissions from deforestation at the global level.

iv. **Participation of ICFRE in International technical workshop in Brazil:** Dr. Renu Singh, Head, BCC Division, ICFRE attended the international technical workshop on "Land Area Change Assessment: The experience of the existing operational system" in Sao Paulo, Brazil from 4th to 6th February 2009. The workshop discussed land cover and land use change detection by using remote sensed data. The objective of the workshop was to introduce developing countries' experts to techniques and scientifically sound practices of detection and tracking of forest land cover changes due to changes in land use (deforestation) and in carbon density (forest degradation including forest fires).

Participation of Dr. Renu Singh, ICFRE and Smt. Rajasree Ray MoEF in International Technical Workshop in Sao Paulo, Brazil

v. **Shri Jagdish Kishwan, DG, ICFRE: Visit to Suriname:** Shri Jagdish Kishwan, DG, ICFRE was invited by the Ministry of Physical Planning, Land and Forest Management of the Republic of Suriname to participate in the Symposium "REDD Negotiations: the Case of High Forest Cover Low Deforestation Countries" in Paramaribo, Suriname on 13th March

2009, and to make a presentation before the senior officers and negotiators of Suriname. The purpose was to sensitize the Suriname officers with the history of the SBSTA agenda item 5-Reducing emissions from deforestation in developing countries: approaches to simulate action (REDD), the ongoing negotiations relating to technical, methodological and policy aspects in SBSTA and AWG-LCA, and the possible strategy for HFLD countries in the ongoing process under the UNFCCC. The presentation was received very well and was followed by an intense question-answer session.

vi. **Participation of ICFRE in Expert Meeting of the UNFCCC in Germany:** Shri V.R.S. Rawat, Scientist D, ICFRE attended the Expert Meeting on methodological issues relating to reference emission levels and reference levels in Bonn, Germany on 23rd and 24th March 2009.

vii. **Climate News Letter:** The BCC Division prepared quarterly Climate News Letters regularly covering latest developments and upcoming events in the field of Climate Change which were placed on the ICFRE website during 2008-09.

D. Training

A one week refresher training course sponsored by the Ministry of Environment and Forests, Government of India, New Delhi for Indian Forest Service Officers on "Climate Change and Relevance to Forestry Sector" was organized by the BCC Division at ICFRE Dehradun from 3rd to 7th November 2008. Twenty five IFS officers of different states participated in the training course. The programme was highly appreciated and rated by the participants.

Participants and organizers of one week refresher training course for IFS Officers

2. RESEARCH PLANNING (RP) DIVISION

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

During the year 2008-09, following achievements have been made by this division :

- **Research Planning (RP) Division** coordinated the Research Advisory Group (RAG) meetings at Institute level on the dates mentioned below:

IFGTB, Coimbatore	-	28-29 August 2008
TFRI, Jabalpur	-	04-05 September 2008
IFP, Ranchi	-	23-24 September 2008
AFRI, Jodhpur	-	29-30 September 2008
IWST, Bangaluru	-	13-14 October 2008
HFRI, Shimla	-	23-24 October 2008
FRI, Dehradun	-	14-15 November 2008
RFRI, Jorhat	-	17-18 November 2008

This year, the Research Advisory Groups were made more broad based by including PCCFs of the states, different strata of scientists, a range of forest officials, diverse stakeholders viz. NGOs, industries, progressive farmers and Universities. From 2008-09 intitiation of seeking comments from peer group was also initiated and accordingly projects were modified to suit requirement of user industry.

- **Research Policy Committee (RPC) Meeting:** The projects approved by RAGs were placed before RPC which was convened from 11th to 13th February 2009 under the chairmanship of Shri Jagdish Kishwan, DG, ICFRE to give the final approval to the new research proposals submitted by eight research institutes under ICFRE.

During X RPC, 89 new projects were discussed by RPC members out of which eighty one projects were approved for ICFRE funding amounting to Rs. 810.3 Lac, two projects were approved for external funding and six projects were not approved. Approval was also given for two All India Coordinated Projects. The abstract of institute-wise sanction of new research project proposals is as under :

Abstract of Sanctions of New Projects in X RPC

Name of the Institute	Number of Projects	Total Amount Sanctioned (Lac)
HFRI, Shimla	2	55.85
IFP, Ranchi	7	84.63
TFRI, Jabalpur	3	32.85
IWST, Bangaluru	17	107.33
RFRI, Jorhat	14	143.536
FRI, Dehradun	23	200.503
IFGTB, Coimbatore	12	146.18
AFRI, Jodhpur	3	39.51
Total	**81**	**810.389**

The All India Coordinated Projects (AICPs) were approved in principle and the chairman desired that the different components of the AICP may be submitted to the donor agencies as

per their requirement and the format. Directors of the institutes were requested to pursue the matter for external funding at their level also in consultation with ICFRE.

Directors' Meet

On 18th September, 2008, III Directors' meet was organized in the Board room of ICFRE hqrs, under the chairmanship of Shri Jagdish Kishwan, DG ICFRE. The Directors' Meet was organized to discuss some of the important issues for which agenda was fixed by different directorates in consultation with the Directors of the Institutes. Some of the issues discussed were bridging the gap between the states and the Institutes in calling PCCF/ State research representatives of the concerned states in RAGs, independent evaluation of research projects, requirement of external funding of research projects and status of All India Coordinated Research Projects.

Bamboo Technical Support Group (BTSG) - Indian Council of Forestry Research and Education (ICFRE), Dehradun:

Bamboo Technical Support Group - ICFRE, Dehradun was constituted by National Bamboo Mission, Govt. of India to provide technical and scientific support for the states of Jammu & Kashmir, Punjab, Haryana, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, Chhattisgarh, Rajasthan and Gujarat. The following tasks were undertaken by BTSG of ICFRE :

Trainings conducted:

(i) Five days Training for the Field Functionaries of Eastern Uttar Pradesh: Conducted by CSFER, Allahabad from 13-17 October 2008.

(ii) Five days Training for the Field Functionaries of Himachal Pradesh: Conducted by HFRI, Shimla from 13-17 October 2008.

(iii) Five days Training for the Field Functionaries of Rajasthan: Organized by AFRI, Jodhpur from 4-8 November 2008.

(iv) Five days Training for the Field Functionaries of Gujarat: Organized by AFRI, Jodhpur from 12-16 November 2008.

(v) Five days Training for the Field Functionaries of Gujarat: Organized by TFRI, Jabalpur from 13-17 October 2008.

Printing of Bamboo Literature:

Five thousand copies of an illustrated Hindi Book "Bans Ropan evam Upyogita" were published for the benefit of forest personnel, farmers and field functionaries. It was distributed free of cost to State Bamboo Missions under BTSG-ICFRE, ICFRE Institutes conducting Trainings, Sister Organizations, SFRIs and NFLIC etc.

Organizing International/National Seminars:

National Seminar on Bamboo "Plantation, Management and Its Utilization" was organized by Arid Forest Research Institute (AFRI), Jodhpur from 17-19 March 2009.

Quinquennial Review:

Quinquennial Review Teams (QRTs) of FRI, Dehradun; RFRI, Jorhat, IFGTB, Coimbatore, and FRC Hyderabad completed their review work and submitted their respective Quinquennial

Review Reports. The quinquennial review report of AFRI was nearing completion at the close of the year under report (2008-09).

3. MONITORING AND EVALUATION (M&E) DIVISION

Monitoring and Evaluation Division under the Directorate of Research deals with the review and evaluation of all the ongoing research projects of ICFRE institutes. It suggests corrective measures for timely completion of the projects and achievements of the objectives with perfection.

During 2008-09, the review/evaluation of 380 (ICFRE funded- 255 and 125 externally aided) ongoing research projects of all ICFRE institutes was done. Apart from the above, independent review of 20 (completed/ongoing) research projects has also been carried out through independent subject matter experts/agencies.

This division of directorate of research also collects information on Annual Action Plan from the Institutes for preparation of consolidated Annual Action Plan for ICFRE.

4. PROJECT FORMULATION (PF) DIVISION

This Division acts as a facilitator between the ICFRE Institutes / Centres and potential donor agencies for the formulation of Research Projects in the identified thrust areas and their submission to various National and International donor agencies funding as per their submission to various National and International donor agencies for funding as per their funding requirements. It also co-ordinates the release of the funds to ICFRE Institutes/Centres and evaluates the project proposals with regard to their suitability in the identified thrust areas.

Externally Funded Projects:

The Division is collaborating with a number of National and International donor agencies for project funding. Presently, 146 projects funded by National donor agencies and 6 projects funded by International donor agencies are being implemented in eight Institutes and three Centres of ICFRE. Besides this, 76 projects and 4 projects are in the pipeline for funding by National and International donor agencies respectively.

Main National donor agencies are Ministry of Environment & Forests (MoEF), Department of Biotechnology (DBT), Department of Science and Technology (DST), National Medicinal Plant Board (NMPB), Council of Scientific and Industrial Research (CSIR) and National Mission of Bamboo Applications (NMBA) etc.

Main International Donor Agencies are Japan International Co-operation Agency (JICA), Swedish International Development Agency (SIDA), International Foundation for Science (IFS), International Tropical Timber Organisation (ITTO), United State Department of Agriculture (USDA) and Department for International Development (DID) etc.

The Division coordinated the formulation of a number of project proposals of ICFRE Institutes as per the guidelines and funding requirements of donor agencies in the identified thrust areas. Suitable proposals were processed for their approval and submission to National / International donor agencies such All India Coordinate Project (AICP) of IFGTB, Coimbatore on Eucalyptus Gall Wasp; All India Coordinate Project (AICP) of FRI, Dehradun on Poplar; All India Co-ordinate Project (AICP) of AFRI, Jodhpur on Jatropha.

Also, a number of MOUs and Agreements for the implementation of collaborative projective projects / programmes of ICFRE Institutes / Centres were scrutinised and processed for the approval of the competent authoritity.

Bihar Project:

The Division Coordinated the execution of comprehensive Bihar Project titled, "Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana in Bihar State" (Phase-I) being implemented by ICFRE with Environment & Forest Department of Bihar State. Activities related to ICFRE Component on Poplar based agroforestry programme on farmer's fields in Vaishali's district of North Bihar were monitored through field visits. Review meetings were organized through Video Conferencing too and that has helped in continuous monitoring of the project.

History of Forests of India-After 1947:

In continuation with the Book titled "The Forests of India" written by E.P. Stebbing in 4 volumes which gives the chronology of forest development in India from 1796 to 1947, it has been decided to document the History of Forests in India for the subsequent period from 1947 to 2005 and the work has been entrusted to ICFRE. After detailed consultations with the experts, the Chapters of this book have been finalized which include Forest Policy, Forest Acts and Laws, Forest Administration, Forest Management, Wildlife Management, Forestry under Five Year Plan, Social Forestry, Participatory Forest Management and Out-turn Revenue etc.

Eleven Chapters have been finalized and the first part of the proposed book "Post-Independence Developments in Indian Forestry", Vol. I is likely to be published very soon.

FORESTRY EDUCATION

5. EDUCATION DIVISION

Financial Support were provided to the Universities imparting forestry education in the country in order to strengthen the infrastructural facilities of the forestry faculties such as Infrastructural Development, purchase of scientific equipments, books/journals, to make mist chambers and similar other teaching/research facilities at teaching manuals, organization of workshop/seminars etc., participation of teachers in workshop/seminar etc and students' educational tours. Overall Rs. 502.71 lakhs as Grant-in-aid released to the 14 universities in the financial year 2008-09 from April 2008 to March 2009 as detailed below:

Sl. No.	Name of University	Amount released (Rs. in Lakhs)
1.	Dr. Y.S.P. University of Horticulture & Forestry, Solan	7.35
2.	Tamil Nadu Agricultural University, Coimbatore	27.50
3.	Kerala Agricultural University, Trissur	3.00
4.	FRI, Deemed Unviersity, Dehradun	172.70
5.	HNB Garhwal University, Srinagar	6.75
6.	Birsa Agriculture University, Ranchi	49.00
7.	Orissa University of Agricultural & Technology, Bhubneshwar	23.00
8.	Dr. BSS Konkan Krishi Vidyapeeth, Dapoli	10.21
9.	Panjab Rao Deshmukh Krishi Vidyapeeth, Akola	2.00
10.	Jawahar Lal Nehru Krishi Vishwavidyalaya, Jabalpur	7.00
11.	University of Agriculture Sciences, Bangaluru	39.70
12.	Maharana Pratap University of Agriculture & Technology, Jhalawar (Rajasthan)	51.50
13.	Allahabad Agricultural Institute Deemed University, Allahabad	38.00
14.	Navsari Agricultural University, Navsari (Gujrat)	65.00
	Total	**502.71 Lakh**

Standardization & Unification of Forestry Syllabus for Under Graduate/Post-graduate Courses:

This directorate has taken up work related to standardization and unification of syllabus of B.Sc/M.Sc (Forestry) courses being run in various state agricultural universities so as to ensure delivery of quality education to safeguard the interests of shed out community in general and forestry sector in particular.

Accreditation of Forestry College/Course Curriculum:

To validate the course curriculum and the forestry colleges/universities imparting the same, process of accreditation on the pattern of AICTE has been initiated and the Forestry Courses are being accredited by this Directorate. The Forestry Syllabii of Kerala Agricultural University, Trissur (Kerala) has been accredited by this directorate in the year 2008-09 and several universities have offered for accreditation of their forestry courses which are in process in this Directorate.

Trainings:

The Directorate of Education, ICFRE also dealt with the cases of deputation of officials/ scientists for up gradation of their knowledge/skills through various courses/training programmes within the country and abroad as follows:

1. Fifty seven Forest Officers/Scientists individually from the Council have been deputed/ permitted to attend/participate in the International seminars, symposia, conference etc. in the foreign countries.
2. One hundred sixty two Forest Officers/Scientists individually from the Council have been deputed/permitted to attend/participate in the National seminars, symposia and conference etc. within the country.

Research Support System:

To provide research support to the scientists of the Council, various JRFs/SRFs/RAs have been appointed through interviews and walk-in-interviews made by the ICFRE and its Institutes for which this Directorate has played key role in constituting/approving the selection committees for selection of JRFs/SRFs/RAs/SRFs/RAs to work in the important projects being run in the ICFRE and its Institutes.

H.R.D Programmes :

This Directorate has also a HRD Cell for imparting training for capacity building of the managerial cadre, scientific cadre and the technical cadre. This Directorate organized 7 training courses on various subjects. One hundred fourty two officers/scientists of the Council have been trained in the year 2008-09 to build up their knowledge/skills.

6. POLICY RESEARCH (PR) DIVISION

1. The Directorate of Education is mandated to conduct "Policy Research" works in the arena of forestry. The work is being continued on the following subjects:
   - Scientific basis to assess the proportion of forest and tree cover in the country.
   - Analyze the linkages of forestry to national priority of poverty alleviation, thus, bringing policy prescriptions in tune with the goals/objectives of National Development Perspective.

- Formulation of policy and legislative measures on certification mechanism for regulation and marketing of quality seeds/planting stock for tree improvement to give an impetus to plantation activities at regional/national levels.
- Desk review for identification of inconsistencies in policies of related sectors with National Forestry Policy 1988 and suggestions for addressing the inconsistencies.

2. To carry out the Policy Research Studies, the consultancies were awarded to the following consultants:
   - Academy of Forest & Environment Sciences, Dehradun.
   - TNS-India Pvt. Ltd., New Delhi.
   - Shri Piare Lal and other, Phagwara (Punjab).
3. The Consultancy "Need for Institutional and Regulatory Mechanism for Certification of Planting Stock / Material of Forest Seeds and Vegetative Origin" provided to Consultants Shri Piare Lal and others, Phagwara (Punjab) has successfully been completed in 2008-09.

Disaster Management:

ICFRE proposes to hold consultancies, workshops, training and awareness campaign so that role of forest ecosystem in maintaining natures balance and, thus, ameliorating impacts of such hazardous events could be fully understood at all levels. The Council and its Institutes shall also be networked with Institutes/Organizations at National/International levels so as to be essential part of consultancies aimed at planning measures at regional/national levels.

FORESTRY EXTENSION

7. MEDIA AND PUBLICATION (M&P) DIVISION

Media and Publication Division, Directorate of Extension looks into the extension activities and strategies being adopted by the Institutes of ICFRE for the dissemination of research findings in forestry sector. This division maintains the monthly account of various R&D activities of ICFRE Institutes and keeps MoEF apprised of them. The division publishes the Quarterly Newsletter of ICFRE (that brings out the latest and significant achievements made by the ICFRE Institutes) and the ICFRE Brochure. The reports of ICFRE and its Institutes are collected, compiled, edited and published as the Annual Report of ICFRE, which is tabled in Parliament.

Work on establishment of Van Vigyan Kendras (VVKs) in collaboration with SFDs and selections of Demo Villages for adoption by ICFRE Institutes have progressed considerably. Twenty two VVKs have been established in different states. Eight Demo Villages have been established in different eco-climatic zones of the country.

National Workshop on "Extension Strategies in Forestry Research"

Directorate of Extension, ICFRE Dehradun conducted a two-day National Workshop on "Extension Strategies in Forestry Research" on 15 and 16 January 2009 at Dehradun to evolve Extension Strategies in Forestry Research for the Council. The workshop was inaugurated by the Chief Guest Shri Jagdish Kishwan, Director General, ICFRE, Dehradun. Padma Bhushan Shri Chandi Prasad Bhatt, the celebrated Environmentalist graced the occasion as Guest of Honour.

Inauguration of National Workshop on "Extension Strategies in Forestry Research"

Dr. Rabindra Kumar, Deputy Director General (Extension), ICFRE welcomed the Chief Guest, Guest of Honour and participants from all over the country. The Chief Guest, Shri Jagdish Kishwan in his key note address informed that the Council has succeeded in establishment of 22 Van Vigyan Kendras in different states of the country with active cooperation of the State Forest Departments.

Pleanary session in progress

Padma Bhushan Shri Chandi Prasad Bhatt shared his experiences with the August gathering. He emphasized that while prioritizing the research needs, it is essential to consider the priorities of women folk. He expressed his happiness on the establishment of Van Vigyan Kendras.

8. STATISTICS DIVISION

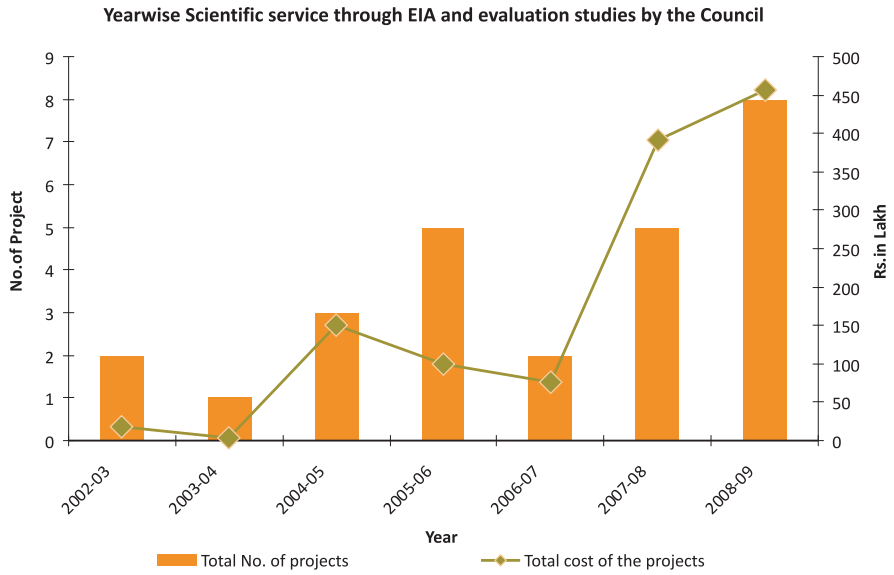
The following works were carried out by the Division of Statistics in 2008-09:

- ICFRE-ITTO projects was extended up to July 2009.Under this project, five capacity building programmes were taken up at five Institutes of ICFRE, i.e. AFRI, Jodhpur; TFRI, Jabalpur; IFGTB, Coimbatore; FRI, Dehradun and IFP, Ranchi. The new formats and manual were explained to the Nodal Officers (Statistics) of ICFRE Institutes.
- Four issues of Timber/Bamboo Trade Bulletin were compiled and published.
- The 2005 issue of Forestry Statistics of India was compiled, validated and scrutinized. The final copy was prepared for approval and publishing.

ITTO workshop in progress

9. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) DIVISION

Environmental Impact Assessment Division under the Directorate of Extension has been providing scientific services to leading project proponents such as Jindal South-West Group of Companies (JSWGC), Singareni Collieries Company Ltd. (SCCL), Tehri Hydro Development Corporation Ltd. (THDCL), New Delhi Municipal Council (NDMC), Himachal Pradesh Power Corporation Ltd. (HPPCL), National Thermal Power Corporation (NTPC), Chandigarh Administration, National Medicinal Plants Board (NMPB), Ministry of Health & Family Welfare, Government of India, Chhattisgarh State Electricity Board (CSEB), Raipur, Reliance India Limited (RIL), National Hydropower Corporation (NHC), Andhra Pradesh Tourism Development Corporation (APTDC), Andhra Pradesh Mineral Development Corporation Ltd. (APMDCL), National Afforestation Eco-development Board (NAEB), MoEF and ESSR Global Limited. The Division acts as a pool of expertise of in house scientists of ICFRE Institutes in partnership with subject experts nationwide from other Institutions for evolving the best practice to achieve the environmental protection for sustainable management of various ecosystems facing development interventions.



The following studies have been undertaken by the Environmental Impact Assessment Division during the year 2008-09:

1. Preparation of EIA and EMP report for integrated Kashang Hydroelectric Project (243 MW), Himachal Pradesh awarded by Himachal Pradesh State Electricity Board, Shimla.

2. Preparation of EIA and EMP report for Kuther Hydroelectric Project (KHEP) (260 MW) Chamba, district Himachal Pradesh awarded by JSW Energy Ltd. Mumbai.

3. Evaluation of Catchment Area Treatment (CAT) Plan of Loharinag Pala Hydro Electric Project (4 x 150 MW) to be constructed by National Thermal Power Corporation (NTPC) in Uttarkashi district, Uttarakhand awarded by MoEF, Government of India.

4. Preparation of detailed Catchment Area Treatment Plan (CATP) and sub plan for implementing Bodhgaht Hydroelectric Project awarded by Chhattisgarh State Electricity Board (CSEB) Raipur.

5. Rapid EIA and EMP with one season data for DPR updation of Sankosh multipurpose project in Bhutan for reservoir portion (4060 MW) and in India, for canal portion awarded by Tehri Hydro Development Corporation Ltd. (THDC), Rishikesh.

6. Rapid EIA and EMP with one season data for DPR updation of Jadhganaga (50MW) and Karmoli (140MW) project awarded by Tehri Hydro Development Corporation Ltd. (THDC), Rishikesh.

7. Biodiversity assessment report for the 2000 MW Pit Head Thermal Power Station at Jharkhand awarded by ESSAR Power Limited, Jharkhand.

8. Rapid EIA and EMP with one season data for DPR updating of Bunaka Hydro Electric Project (180MW), Bhutan awarded by Tehri Hydro Development Corporation Ltd. (THDC), Rishikesh.

Phoenix rupicola - A rare plant recorded from the submergence area

Sankosh river - Proposed dame site

DIRECTORATE OF ADMINISTRATION

10. INFORMATION TECHNOLOGY (IT) DIVISION

The Information Technology Division, Directorate of Administration, ICFRE caters to all the Information Technology needs of the users at ICFRE and its Institutes / Centres. Being a part of e-Governance activities at ICFRE, the IT Division has taken a lead in e-Governance initiatives through some major projects which have been implemented or are under implementation.

E-GOVERNANCE

The name ICFRE has, now, become synonymous to e-Governance by virtue of Futuristic Information and Communication Technology initiatives undertaken in the field of forestry research and various field of management through planning of comprehensive enterprise level software solution namely Indian Forestry Research Information System (IFRIS).

Indian Forestry Research Information System (IFRIS)

IFRIS aims to transform the present manual working environment into an automated system, Enhance responsiveness through workflow automation and knowledge management, real time information management of research projects, monitoring of ICFRE engagements with external stakeholders, convenience of users, stakeholders in accessing the information and services. Taking into account the IFRIS success, many national agencies are using it as a road map for induction of e-Governance programme and are approaching ICFRE to generate in-house talent pool.

IFRIS broadly comprises of two main parts viz.;

- Indian Forestry Research Management Information System (IFRMIS) and
- Indian Forestry Research Administration Information System (IFRAIS)

They Cover all the key research and non-research service areas at the enterprise level viz.; ICFRE and its Regional Institutes and centres.

The development of IFRIS was planned in three stages viz.:

Stage I : Conceptualization (June 2006 to January 2007) wherein a detailed study on services to be delivered, IT infrastructure requirements, Process Re-engineering of the services, and Functional Architecture was conducted.

Stage II : Project Development (March 2007 to August 2007) wherein M/s Wipro, Gurgaon was appointed as Project Development Consultant. The potential improvement areas were identified and Analysis Report "As-Is" Report and the "To-Be" processes for ICFRE was prepared with detailed functional and Technical Architecture. The Request for Proposal (RFP) for engagement of system developer was also finalized and finally the

Stage III : Software Development and Implementation (January 2008 to March 2009) under which the software has been developed and is under implementation.

The Project Institutional Framework has played an effective role wherein four ICFRE Apex Committee Meeting and around 50 other Institute Apex and Technical Committee Meetings were conducted to highlight the expectations and concerns of the stake holders. The Change Management has brought about four intensive trainings of e-Champions (the change agents) and gradual exposure to the new IFRIS application at Dehradun, Bangaluru, Shimla and a Pre-Go-Live training at Jorhat and also through lectures by external dignitaries. During these trainings, the officials from the local institutes were also involved to give them a look and feel of the newly developed application.

Apart from the e-Champions training, several rounds of training at Institute level and also the User Acceptance Training have been done to increase the acceptability of the application.

It has been planned that the IFRIS shall be put to use in an incremental way with four basic modules in the first phase viz.; Research Information System, Personal Information Management System, Payroll Management System and Financial Accounting System, which are almost ready and shall be rolled out as per schedule and the next phase of roll-out has been planned in the month of August 2009.

ICFRE Server Farm (Data Centre)

To host the upcoming IFRIS application, the process of establishment of ICFRE Server Farm has been initiated through a tendering process and the facility is likely to be in place by July 2009. Apart from hosting the envisaged IFRIS Application, the ICFRE Server Farm shall be hosting other allied services with state of art technologies like Mail and Messaging etc.

Multi-Protocol Level Switching – Virtual Private Network

With the induction of MPLS-VPN, the ICFRE hqrs. has enabled dedicated links with its regional Institutes and Centres spread all across the nations in various geographical locations viz.; Jodhpur, Jabalpur, Jorhat, Coimbatore, Bangaluru, Ranchi, Shimla, Hyderabad, Chhindwara, and Allahabad with ICFRE hqrs at Dehradun. This arrangement facilitates the secured transmission and sharing of information within ICFRE. To utilize this facility, the IT Division has hosted a Intranet portal wherein the users can host the circulars, orders requiring wide circulation. This effort has increased the reach of the users and also reduced the use of paper for such activities. A FTP server has been established and is being utilized for transaction and sharing of voluminous research and administration data within the ICFRE Institutes.

Video Conferencing

Further, to harvest this network connectivity (MPLS-VPN), the Video Conferencing (VC) facility has been established which is proving to be a boon for e-Governance development at ICFRE and Institutes. Around 100 VC sessions ranging from one-on-one to a gathering of around 100 people have been taken care and materialized during this span of one year. These had the participation of researchers and administrators to interact in real-time irrespective of the geographical distances and take active participation in trainings and workshops conducted across Institutes of ICFRE since May 2008.

A major value addition through the ICT was done during Research Policy Committee meeting held form 11 to 13 February 2009, wherein the greater participation and involvement of Scientists from ICFRE Institutes viz.; Shimla, Jabalpur, Jorhat, Jodhpur, Coimbatore, Bangaluru and Ranchi was ensured through Video Conferencing, which was earlier restricted to RAG at Institute Level only. This has improved the quality of research proposals and enabled them to understand the requirement of the stake holders.

Apart form the e-Governance Activities, the Information Technology Division, Directorate

of Administration, ICFRE caters to all the Information Technology needs of the users at ICFRE and its Institutes / Centres. The other major activities of the Division are broadly classified in the following:

- LAN-WAN Support
- Procurement and Maintenance of Hardwares
- New Proposals
- Trainings
- Providing IT Support for the technical presentations in the Video Conference, Meetings, Conferences, Seminars, Workshops etc.

LAN - WAN - Support

- Regular Maintenance / Monitoring of MPLS VPN viz.; 11 MPLS Leased Line and 2 Mbps 1:1 Internet bandwidth.
- Regular Maintenance and reporting of e-mail, Internet etc. for around 1100 users across ICFRE hqtrs and its institutes.
- Updation of the existing website of ICFRE (www.icfre.gov.in) a CMS based website.
- Regular Maintenance of Proxy Server / Web Server for providing uninterrupted service to its users of ICFRE hqtrs and ICFRE's institutes.
- Regular Maintenance and reporting of Network Antivirus facility at the ICFRE hqtrs and FRI campus through a centralised AV Server.

Procurement and Maintenance of Hardware

The IT Division undertakes the Maintenance of computer and peripheral hardware installed at ICFRE hqtrs and FRI. The Hardwares have been categorized and inventorised accordingly for its proper maintenance and coordination with the vendors.

The IT Division is also managing AMC for Photocopiers, of ICFRE hqtrs through different vendors looking after their own brand of machines broadly, Xerox, HCL and Ricoh.

Rate Contract of Consumable items and Printers cartridges is also processed and operated for provisioning of consumables to the users of ICFRE hqtrs through different vendors.

Initiatives

- The upgradation of old hardware (Desktops, Printers and Laptops) are being taken up on priority basis.
- The ICFRE Institutewise maintenance of Local Area Network is being consolidated for Maintenance and Facility Management Service through a third party vendor.
- A ICFRE wide single central antivirus has been created and an centralized Antivirus have been installed across Institutes of ICFRE.

Training

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

Providing I.T. Support

- Division provides technical support in conducting Video Conferencing among ICFRE

institutes. IT Division provided support to ICFRE hqtrs and FRI with regards to the IT and Visual Arrangements in all the Meetings, Conferences, Seminars and Workshops etc. organized at ICFRE hqtrs and FRI in the year 2007-08.

PUBLICATIONS

Jagdish Kishwan and Anita Srivastava (2008): "Role of Forest in Disaster Mitigation" Paper presented in 1st World Congress on Disaster Management (WCDM) - 2008, held in NAC Hyderabad from 21st to 24th October 2008.

Jagdish Kishwan and V.R.S. Rawat (2008): "Forest Conservation–based, Climate change – mitigation approach for India". International Forestry Review, Vol. 10(2): 269-280.

Renu Singh and Anita Srivastava (2008): "Key Management Issues of Forest Invasive Species in India". Paper presented during International Workshop on Role of Taxonomy in Biodiversity Management and Human Welfare held in 1st to 3rd December 2008, at FRI, Dehradun.

Renu Singh and V.R.S. Rawat (2008): "Proceedings of International workshop" –Development methodology for assessment of enhancement of forest carbon stocks due to conservation, sustainable management of forest and increase in forest cover on 7th and 8th March 2008 at New Delhi, organised by ICFRE, Dehradun.

Renu Singh and V.R.S. Rawat (2008): "Proceedings of National workshop - Forestry project for climate change mitigation in India: Stakeholders dialogue and capacity building," on 21st and 22nd February, New Delhi, organized by ICFRE, Dehradun.

Anita Srivastava, Om Kumar and Renu Singh (2009): "Impact of Climate Change on Plant Biodiversity". Bull. Env. Sci. Vol. XXVIII, pp. 137-142.

Poster Presentation:

Anita Srivastava and Om Kumar (2008): "Important Floral Species in Mandal Chopta Forests, for Human Welfare," poster displayed during International Workshop on Role of Taxonomy in Biodiversity Management and Human Welfare, 1st to 3rd December 2008, FRI, Dehradun.

Chapter 3

FOREST RESEARCH INSTITUTE DEHRADUN

Forest Research Institute (ISO 9001:2000), having history of over a century (established in 1906) of forestry research, is an ideal institution for learning forestry. Forest Research Institute (FRI) enjoys the reputation of leading Institute at global level in the field of Forestry Sciences. Under the umbrella of Indian Council of Forestry Research and Education, FRI is mainly focussing its activities in Uttarakhand, Uttar Pradesh, Haryana, Punjab, Chandigarh and Delhi. Researches on every aspect of forests like Silviculture, Ecology, Pathology, Entomology, Chemistry, Non-wood Forest Product, Genetics and Tree Breeding and Forest Soil and Land Reclamation is being conducted through projects of regional, national and international importance in the Institute. The Institute has excellent laboratory facilities and sophisticated and modern equipments to support its research. National Forest Library Information Centre of the Institute is the biggest forest library of the country having around two lakhs books and subscribes to 114 foreign and 110 Indian periodicals of forestry and related subjects. Forest Research Institute, Dehradun has also been conferred the status of 'University' by the Ministry of Human Resource Development, Government of India, New Delhi vide Notification No. F.9.25/89 U-3 dated 6th December 1991. Keeping in view the present scenario of advancement in the field of science, Institute has added two more Divisions i.e. Climate Change and Forest Influence Division and Bioinformatics Centre and GIS Cell.

An abstract of projects run by the Institute is as follows:

		No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
FRI, Dehradun	Plan Projects	21	45	25
	Externally Aided Projects	18	27	01
CSFER, Allahabad	Plan Projects	Nil	05	Nil
	Externally Aided Projects	Nil	01	Nil
	Total	**39**	**78**	**26**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement PHASE II [FRI-203/G&TP-9/April 2006 - March 09]

Findings: Provenance-cum-progeny trials evaluated on the basis of various morpho-metric traits after data recording and its analysis. North Queensland Provenances were identified as good performers (particularly Laura river and Petford provenance). Forty seven promising

phenotypes representing different sources and families of *Eucalyptus tereticornis* were identified and marked based on index selection, their coppicing and rooting ability was ascertained. Twenty four new clones developed and established in VMG at FRI. A clonal trial with 13 clones established at Manakpur (Haryana). Insect and disease incidence was recorded. Intra species hybridization was carried out between the best sources.

Project 2: Impact of ban on green felling on the plant diversity of selected sites in Uttarakhand [FRI-357/Bot-52/2006-09]

Findings: Vegetative analysis of unallotted seeding and final felling sites of Chirpine and Deodar forest of Chakrata and Nainital division were carried out. Regeneration was observed in seeding and final felling sites in both the species. Regeneration of Chirpine was observed in some compartments of northern aspect in Chakrata. However, in Nainital and Almora, regeneration was observed in both aspects. In case of deodar, regeneration was observed in some compartments of southern aspect. Check list of ground vegetation was made. No significant difference in plant diversity in unallotted seeding and final felling sites was observed.

Project 3: Preparation of Weight and Volume Tables for Agroforestry Tree Species [FRI-389/RSM-17/April 2007-March 09]

Findings: Weight and volume tables for *Melia composite*, Poplar and *Ailanthus excelsa* tree species have been prepared for use of tree growers based on the data from state of Punjab.

Project 4: Development & multiplication of superior bioactive clones of *Stevia rebaudiana* [FRI-320/NWFP-19/2005-09]

Findings : Fifty three accessions of *Stevia rebaudiana* have been collected from Uttarakhand, Delhi, Himachal Pradesh, Haryana, UP, and J&K States and introduced under field conditions for assessing their performance. Of these, 22 accessions have been analyzed for their biomass productivity and active constituent's viz., stevioside and rebaudioside percentage using HPLC technique. Breeding of accessions resulted in identification of eight high stevioside and 3 high rebaudioside rich selections which have been multiplied vegetatively.

Project 5: Bio-ecology and nutritional behaviour of polyphagous insect pests with special reference to *Spilarctia obliqua* [FRI-304/FED-21/April 2005-July 08]

Findings : Studies were conducted on the biology and nutritional preference of *S. obliqua* on Paulownia, Poplar, Teak, Toon and Brassica.

- Paulownia was found to be preferred host followed by *Brassica compestris, Populas deltoides, Tectona grandis* and *Toona ciliata*.
- Total sugar was found to be maximum (88.54 mg/gdw) in *P. fortunei* followed by 55.61mg/gdw in *Brassica compestris*, 33.00mg/gdw in *P. deltoides*, 31.87 mg/gdw in *Tectona grandis* and lowest 23.53mg/gdw in *Toona ciliata.*
- Starch contents were also found maximum i.e. 79.76mg/gdw in *Paulownia fortunei* followed by *B. compestris* (43.10mg/gdw), *P. deltoides* (29.27mg/gdw), *T. grandis* (28.69mg/gdw) and *T. ciliata* (21.12mg/gdw).
- Protein content was found to be maximum (18.10mg/gdw) in *Paulownia fortunei* followed by *Brassica compestris* (16.25mg/gdw), *Populus deltoides* (16.19mg/gdw), *Tectona grandis* (15.05mg/gdw) and *Toona ciliata* (14.12mg/gdw).

- Chlorophyll contents were found maximum, (1.14mg/gfw) in *P. deltoides,* (1.02mg/gfw) in *P. fortunei,* 0.73mg/gfw in *T. ciliata,* (0.71mg/gfw) in *B. compestris* and (0.36mg/gfw) in *T. grandis.*

Project 6: Endangered and rare entomogenous fungus *Cordyceps sinensis*, identification of its insect hosts and food plants of insect hosts in the Bugyals of Uttarakhand [FRI-347/FED-22/April 2008-March 09]

Findings : *Cordyceps sinensis* infested larvae were collected from Bedini Bugyal, Ghoralathani, Kuramtoli, Kewala Vinayak, Bhaguwabasa and Auli Bugyals, Badrinath Forest Division.

The life cycle of the insect is completed in two years. Larval period is prolonged and lasts for 18 to 21 months and the pupal period lasts for 2-3 months. The insect is tentativly identified as *Thitarodes nepalensis* (Lepidoptera: Hepialodae).

Project 7: Studies on the Termite diversity of Northern India with special reference to species composition in relation to different tree species [FRI-275/FED-19/October 2004 - March 09]

Findings : The project has been completed and altogether 73 species belonging to 24 genera and 5 families have been recorded from Northern India, which includes 7 new species and many new distributional records: Delhi - 11 species with 6 genera belonging 3 families; includes 7 new records, Haryana - 21 species with 11 genera belonging 3 families, which includes 9 new records; Himachal Pradesh - 20 species with 8 genera belonging 5 families, which includes 10 new records, Punjab - 28 species with 11 genera belonging 2 families, which includes 14 new records Uttar Pradesh - 17 species with 8 genera belonging 2 families; includes 13 new records and 1 new species, Uttarakhand - 52 species with 14 genera belonging 5 families; includes 31 new records and 3 new species and Uttar Pradesh - 17 species with 8 genera belonging to 2 families; includes 13 new records and 1 new species. Diagrams of all the 73 species were prepared with the help of the *Camera lucida*. Keys for the identification of families, genera and species have been provided. All the 7 new species have been described and illustrated with line diagrams.

Project 8: Control of Shisham leaf miner *Leucoptera sphenograpta* using systemic insecticides [FRI-349/FED-24/April 2006-March 09]

Findings : Experiment was laid out at Nahi Forest Block, Thano Forest Range for control of shisham leaf miner (*Leucoptera sphenograpta*) as per statistical design. Three different concentrations of Monocrotophos and Rogor were used for laying out the experiment. The concentrations used were 0.01%, 0.02% and 0.04% of both the insecticides having five replications. Post treatment observations on infestation of *Leucoptera sphenograpta* was taken and it was found that 0.04% of Monocrotophos has given maximum protection.

Project 9: Production and value addition by chemical derivatization of alpha cellulose of *Lantana camara* for its useful applications [FRI-345/Chem-17/2006-09]

Findings : Alpha cellulose isolated from stems of *Lantana camara* was subsequently modified to prepare industrially important cellulose derivatives as Cyano Ethyl Cellulose (CEC), Hydroxy Propyl Cellulose (HPC), Cellulose Sulphate (CS). Preparation of Methyl Cellulose (MS) by using methyl chloride (in gaseous phase) is in progress. All the variables for preparing the cellulose derivatives such as concentration of the reactants, solid liquor ration, time and temperature were optimized for maximum DS and solubility. The optimized product was evaluated with IR, SEM, TGA/DTA and WAXDs studies.

Project 10: Analytic Studies in Woody Cell Wall Architecture [IWST/WSP/62/2006-09]

Findings: Role of microtubules in orientation of microfibril was analyzed. Orientation of microfibril with the help of cyto-skeletal microtubules is not a universal phenomenon. Due to liquid crystalline nature of cellulose, self assembly of cellulosic microfibrils is possible which help in proper orientation of microfibrils. Role of geometrical constituent in cell wall was analyzed as a mechanism of cellulosic microfibril orientation in woody cell wall. It seems that no single model is capable of explaining the entire range of observations.

Project 11: Studies on the effect of design parameters and different adhesives on the performance of finger joints in commercial timbers [Code:FRI-376/FPD(WWF)-62/2007-09]

Findings:

Mango: Urea Formaldehyde adhesive always performs better than PVA in static bending and compression. The role of design parameters is not very explicit always. However, if one has to make a choice between the two cutters used, it is the cutter with design parameters L = 21 mm, P = 7 mm, T = 1.4 mm and S = 0.1 that gives better strength values.

Eucalyptus: Fingers profiled with first cutter and jointed using Urea Formaldehyde adhesive always perform better in static bending and compression. The role of the design parameters is quite clear unlike in the case of mango. The maximum crushing stress under compression parallel is lesser in jointed sections of Eucalyptus unlike in the case of mango.

Project 12: Drying studies on timbers useful for Handicraft [Code: FRI-378/FPD(WS)-64/2007-09]

Findings: The chemical seasoning study done on mango and kikar wood showed that bulking treatment was very effective in controlling the surface cracks in both the wood species. This technique will help wood handicraft artisans in value addition of their products.

Project 13: Studies on shrinkage, swelling behavior of edge bonded solid wood boards [Code: FRI-379/FPD(WS)-65/2007-09]

Findings: Studies were conducted on edge bonded boards of Shisham, Teak, Poplar and Pine. Fevicol and UF jointed boards showed similar trends of swelling irrespective of the thickness in the four species studied. Minimum swelling was observed with boards made from tangentially sawn material. Maximum swelling was observed with boards made from radially sawn material.

Project 14: Eco-friendly preservative and fire retardants combinations for protection of structural bamboos for low cost houses [FRI-350/FPD(WP)-60/May 2006-March 09]

Finding: Six combinations of fire retardant chemicals and preservatives at 15% conc. were tested for flame penetration, surface spread & rate of burning. Data of Flame Penetration Test was analyzed through SPSS: Species are arranged in the decreasing order of Performance: *Dendrocalamus strictus* > *Bambusa tulda* > *Bambusa arundinacea.*

Whereas, Composition performance on cumulative basis are as follows:

Arranged in decreasing order of performance: Comp.4 > Comp. 2 > Comp 1> Comp.5 > Comp.3> Comp.6

	Composition	Ratio
1.	Ammonium Sulphate: Ammonium Phosphate: ZiBOC	5:5:5
2.	Ammonium Sulphate: ZiBOC	10:5
3.	Ammonium Phosphate: ZiBOC	10:5
4.	Magnesium Phosphate: Magnesium Pyrophosphate: ZiBOC	5:5:5
5.	Magnesium Phosphate: ZiBOC	10:5
6.	Magnesium Pyrophosphate: ZiBOC	10:5

A demonstration hut of Bamboo treated with Fire retardant compositions was constructed.

Project 15: Studies on performance of plantation grown species in cooling towers [FRI/351/FPD(WP)-61/2006-09]

Findings: Samples of *P. radiata, A. excelsa, P. roxburghii* and *T. ciliata* treated with 4% of CCA, CCB and ZiBOC were installed in cooling tower. Study shows that treated samples have shown upto 8 fold protection over the control samples.

Project 16: Assessing biodiversity through maintenance of Preservation Plots of Uttarakhand [FRI-393/Silva-36l/2007-09]

Findings: Studies were carried out on forest composition, and enumeration in selected preservation plots situated in three forest types i.e. tropical, sub-tropical and temperate. Data was recorded on elite trees situated in the preservation plots of Uttarakhand. Thirty Preservation Plots of Uttarakhand were surveyed and data on their present status were also collected. The Project Completion report has been submitted.

Project 17: Enhancing the longevity of acorns of *Quercus dilatata* and *Quercus leucotrichophora* [FRI-354/Silva-33/2006-09]

Findings: The acorns of *Q. leucotrichophora* exhibited much better storability than the acorns of *Q. dilatata.* The acorns stored well in hydrated (non-desiccated) condition. Lowest Safe Moisture Content (LSMC) for acorns of banoak (*Q. leucotrichophora*) was 30% whereas acorns of moru oak (*Q. dilatata*) did not tolerate desiccation due to their maturity during rainy season.

Sub zero (-5^{0}C) temperature proved to be fatal for the acorns. 5^{0}C temperature was found to be suitable for the storage of seeds of Ban Oak as they retained above 60% viability even after 610 days in storage.

Polythene bag and steel box proved to be equally good containers for the storage of acorns as seeds stored in them retained viability for longest duration.

Project 18: Evaluation of Seed Orchards of *Dalbergia sissoo* for Seed Quality [Project No. FRI-355/Silva-32/2006-09]

Findings: Clonal Seed Orchard (CSO) and Seedling Seed Orchard (SSO) of *Dalbergia sissoo* Roxb. situated at Hissar, Yamunanagar and Hoshiarpur were evaluated for seed quality and genetic divergence at the age of about 10 years. The seeds of various clones/progenies exhibited significant variability in seed size, seed weight including pod parameters. The germination percent of fresh seeds from orchards is around 100% whereas it was 90% from general population. The storing capacity of seeds collected from orchards is more as compared to the seed collected from general plantations. The estimates of variability with regard to genetic parameters for seed traits in this study depicted wide range of variation. Moderate heritability and genetic gain was observed in seedling height and collar diameter at nursery level for about one year old seedlings raised from seeds of CSO and SSO's.

Project 19: Multilocation trials of promising clones of *Gmelina arborea* [FRI-326/Silva-30/ April 2005-July 08]

Findings : Assemblage of 27 promising clones of *G. arborea* were collected from RFRI, Jorhat in March 2006, Total no. of cuttings sprouted in 2006 were recorded to be 63 % and total no. of cuttings rooted in the same year were 0.66%. Maximum value of sprouting were recorded 95% in RFRI 054 and minimum value were recorded in RFRI 053 i.e. 25%. Assemblage of 20 promising clones of *G. arborea* were collected from RFRI, Jorhat in March 2007. Total no. of cuttings sprouted in 2007 were recorded to be 73% and total no. of cutting rooted in the same year were 1.3%. Maximum value of sprouting were recorded 89% in RFRI 106 and minimum value were recorded in RFRI 004 i.e. 45%. Assemblage of 20 promising clones of *G. arborea* were collected from RFRI, Jorhat in March 2008. Total no. of cutting sprouted in 2008 were recorded to be 75.7% and total no. of cutting rooted in the same year were 1.1%. Maximum value of sprouting were recorded 95% in RFRI 037 and minimum value were recorded in RFRI 003 and 017 i.e 45%. It was observed that all three year sprouting was above 60 % but rooting was only around 1 %. After two months of planting of cuttings in polybags /field, no good rooting percentage could take place under best possible conditions also. This result of *Gmelina* rooting proves that Gmelina RFRI clones were hard to root under Dehradun conditions. Field trial of cuttings and seedlings of Gmelina at Majari compartment no 1 of Timli range (at Kalsi forest division) was laid, total 140 seedlings were planted along with 5 survived promising clones plants of RFRI (RFRI-079, RFRI-106, RFRI-004, RFRI-027 and RFRI-007) and F.R.I Tree 1,2,3,4 and also Tree 1,2,3,4 of Barkot range (Hardwar). Of each 5 plants were planted in field.

Project 20: Studies on seasonal distribution of weeds in forest nursery and eco-friendly methods of their control [FRI-392/Silva-35/2007-09]

Findings: Carried out experiments to study effect of leachates on vegetative propagules of weeds, on seeds of weed, on plants of test species vis-a-vis hand weeding and to study effect of dry leaves in combination with hand weeding on weed control.

Project 21: Effect of Pine & Oak forests on agricultural crops [FRI-327/SF-10/October 2005-September 08]

Findings: Survey of selected sites in Uttarakhand has been made to know the status of Chirpine and Oak. Soil profile of area falling under oak forest has been studied. Data on agriculture crops are being recorded and analyzed. Study on vegetation has been done in Oak and Chirpine forests in project area.

EXTERNALLY AIDED PROJECTS

Project 1: Collection and dissemination of market information on commercially important plants of Uttarakhand [FRI-282/RSM-16/External/2005 - March 09]

Findings: The original project period expired on 31st March 2008. However, the funding agency i.e. National Medicinal Plants Board of Govt. of India granted extension upto 31st March 2009. The field project activities are, thus completed.

Project 2: Preparation of working Plan of Dadra and Nagar Haveli Forest Division [FRI-328/RSM-20/External/2005-08]

Findings: Draft Final Report submitted to Dadra and Nagar Haveli Forest Department for acceptance.

Project 3: Delhi Development Report, Forest, Tree Crop Management, Greening of Delhi

Findings: Chapter on Forest, Tree Crop Management, and Greening of Delhi had been written and re-submitted to the funding agency after incorporating the necessary enhancement requested by funding agency.

Project 4: Demand & Supply of medicinal plant sand produce grown / found in Haryana [FRI-291/NWFP-18/External/2005-09]

Findings: District wise data pertaining to cultivation, collection and demand and supply position of 11 selected medicinal plants in the state of Haryana revealed that currently there are 56 functional herbal units in the state and 66 active traders dealing in medicinal plants trade. The study estimated a demand of 690 MT/annum of these species by various herbal units, of which 379 MT is being met from within state by the local traders. Over 500 acres of land area is under cultivation of various medicinal plants.

Project 5: Researches on natural decay resistance of juvenile timbers like poplars (DST sponsored) [FRI-283/Path-18/External/2005-June 08]

Findings: The information regarding the natural decay resistance of poplar clones has for the first time been brought out in India. It is a misconception that poplar wood is not durable. However, the present study reveals otherwise. There is definite variation among the clones/ source material for decay resistance; even within same clone of different locations. Poplar blocks are more susceptible to the attack of the white rot test fungus *Pycnoporus sanguineus* than the brown rot test fungus *Gloeophyllum striatum*. Brown rot fungi are more confined to higher altitude regions and from the findings of the present study, it can be suggested that poplar (*Populus deltoides*) wood can be safely used for construction and furniture making at high altitudes.

Unlike most traditional timber species, heartwood of poplar is more susceptible to decay fungi than sapwood. This quality can be used while peelings are made for plywood manufacture. Leaving a central core of inner-wood would give a decay resistant material.

Decay resistance varies within a tree from base to top, maximum resistance observed at 2.5 m height, above and below it decreased considerably. Resistance was more at the base than at the top of the tree. This quality can be used for selecting logs one metre above and below 2.5 m from the base for selecting material for manufacturing decay resistant plywood and panels.

Clone G-48 from Pind Khakli, Hoshiyarpur and S7C15 from WIMCO, Rudrapur are highly resistant clones against decay. These materials can be used selecting logs one metre above and below 2.5 metre from the base for making decay resistant plywood as well as for construction and furniture making.

Project 6: Income generation for women in rural areas of Uttarakhand through vermicomposting of organic solid waste into manure [FRI-281/Eco-16/External/2005-09]

Findings: Four pit vermicomposting unit/ demonstration unit was constructed in FRI campus. On campus and off campus trainings were organized for the women folk of Shivpuri, Kotada, Aamwala, Kandoli, Phoolsani, Bhagwanpur, Rajawala and Telpura villages. Two vermimelas were organized. Total 775 women folk were given on campus and off-campus training and 23 vermicomposting units were constructed on the lands of the beneficiaries of phoolsani village. Earthworms were cultured in FRI and vermicompost distributed to the rural women.

Project 7: Impact of tourism on Environment of Roopland and Pindari of Nanda Devi Biosphere Reserve of Uttarakhand [FRI-280/Eco-15/External/2004-December 08]

Findings: Tourist trend of both the areas, vegetation survey / analysis along the trek routes, soil samples collection and analysis for their physico-chemical characteristics along the trek route and control sites, collection of information for socio-economic studies of both the areas like village wise human population, caste composition, literacy rate, livestock population, people's participation in tourism etc. have been done. For participation of stakeholders in tourism, environmental awareness among the local people, meetings were held at Khati, Vachham, Wan, Lohajung and Mundoli etc. villages of both the study sites.

Project 8: Studies on population status and berberine content in different provenances of *Berberis aristata* DC in H.P. and standardization of its propagation techniques (Funded by DBT) [FRI-329/Chem-15/External/August 2005 - July 08]

Findings: Chemical method for estimation of berberine in the roots of *Berberis aristata* was standardized. Forty three samples of roots of different provenances of Himachal Pradesh received from HFRI, Shimla were analyzed for berberine using the standardized method. Maximum berberine concentration was found to be in Kharapathar (1.25%), Kinnaur and Shimla (2.50% each) provenances.

Project 9: Deployment of the promising F_1 hybrids of *Eucalyptus citriodora* and *Eucalyptus torelliana* for establishment of vegetative multiplication garden and their field trials [FRI-338/G&TP-17/External/2006-09]

Findings: Natural (spontaneous) hybrids of *E. torelliana* and *E. citriodora* have been picked up based on established morphological genetic makers. To evaluate the growth performance, the hybrids along with the parents and proper control have been established in field trials at 10 locations in the state of Punjab, Haryana, Uttarakhand and Uttar Pradesh. Some of the hybrids between *E. citriodora* and *E. torelliana* displayed superior growth at the age of one and half year. Hybridization has released a new spectrum of variation for making useful selections from these two species. The resistance of hybrids to *Cylindrocladium quinqueseptatum* inherited from *E. torelliana* parent may be helpful for planting the hybrids on sites where *E. citriodora* is prone to the fungus. Some of the genotypes of F_2 generation of FRI- 4, *E. citriodora* and *E. torelliana* parents also showed good growth. Preliminary studies carried out on oil contents of F_1 hybrids of *E. citriodora* and *E. torelliana* have revealed variation in yield and odour. The vegetative multiplication garden of selected genotypes has been established at FRI to get rejuvenated shoots for conducting experiments on rooting of cuttings.

Project 10: DNA fingerprinting of Shisham (*Dalbergia sissoo*) clones planted in Punjab [FRI-364/G&TP-21/External/April 2006 - July 08]

Findings: Sixty seven clones of Shisham (*Dalbergia sissoo*) obtained from Punjab Forest Department were characterized and fingerprinted using RAPD-DNA markers. Twenty two most divergent and distant clones were identified and recommended to Punjab Forest Department for using those clones in their plantation and improvement programs. The level of genetic diversity existing between clones has been estimated and the closely related clones were listed. DNA fingerprints of 67 clones developed and provided to Punjab Forest Department.

Project 11: Development of Live Red Data Book [FRI-277/Bot-42/External/2006-09]

Findings: Rare and threatened species (*Buchanania lanceolata, G. travancorica, Calophyllum calaba, G. wightii, Coscinium fenestratum, Humboltia vahliana, Cyathea nilgirensis, Myristica*

malabarica, Cyrtostachys renda, Poeciloneuron indica, Diospyros buxifolia, Syzygium mundagam, Garcinia, Diospyros buxifolia, Myristica malabarica, Calophyllum calaba, Garcinia wightii, Garcinia travancorica, Humboltia vahliana and *Buchanania lanceolata*) collected from different parts of India and species were reintroduced in the Botanical Garden.

Project 12: Expert system for Indian woods - their microstructure, identification, properties and uses [FRI-277/Bot-42/External/2005-08]

Findings: Final Draft report' and "Users Manual" submitted. Suggestions received on the same are being incorporated.

Project 13: Wood Anatomy of important commercial timbers of Assam with notes on their properties and uses [FRI-292/Bot-43/External/April 2006 - March 09]

Findings: Described wood anatomy, properties and end uses of 52 timber species from Assam state. The important findings of the project are given below:

1. The card and dichotomous key will ensure the correct identity of the woods of selected tree species of Assam state for utilization point of view and for further researches. It was prepared on the basis of 178 wood anatomical and physical features.
2. Cluster analysis was also done to see the affinity of different species on the basis of the 178 wood anatomical and physical features plus 4 characters of form and commercial importance. Dendrogram showed that species belonged to same genera and genera to same family grouped together while genera of different families grouped separately. For example, members of Magnoliaceae and Dilliniaceae grouped together. In the same way species belongs to Elaeocarpaceae grouped in the same cluster. It showed that physical and wood anatomical features had also significance in taxonomy and phylogeny.
3. Dichotomous key was prepared for the genus Elaeocarpus and Dillenia at species level.

Project 14: Development of micropropagation protocol for clonal multiplication and germplasm conservation of *Swertia chirata* Buch.-Ham. A medicinally important herb [FRI-333/Bot-47-External/2005-08]

Findings: *In-vitro* shoots of *Swertia chirata* were multiplied on large scale. Ten to fifteen fold multiplication was obtained on MS medium supplemented with 1.0mg/l BAP + 0.5mg/l IAA+ 50mg/l Ads. *In-vitro* rooting was standardized. Ninty two percent rooting was obtained on ½ strength MS medium supplemented with 1.0mg/l IBA.

Rooted plantlets were hardened and acclimatized under control conditions, thereafter, transferred to soil and pots. A complete tissue culture protocol has been developed.

Project 15: Study on the impact of riverbed material collection on Silviculture, ecology and environment in Uttarakhand Himalayas (Funded by UFDC) [FRI-407/Silva-38/ External/August 2006-08]

Findings: Field studies were initiated in 7 rivers viz. Yamuna and Amlawa of Chakrata Forest Division, Gaula, Dabka, Nandaur and Nihal of Haldwani Forest Division and Kosi of Ramnagar Forest Division of Uttarakhand. Data were collected with respect to the impact of material extraction on ecological successions, accumulation of debris, change of river course, soils, volumes of ditches and gradient of catchments as well as lower courses. The following recommendations were made as per findings of study:

- Treatment of upper catchments to reduce debris transported downstream.
- The extraction of riverbed materials in the centre portion of the river is essential to control bank erosion during the influence of flood in rainy season. It is necessary to follow strict rules of extraction by leaving at least 25 m control wide strips on both the sides of the river. The soil on both the sides of the strips should be replenished and controlled by making spurs and dykes at suitable interval (50 m). It will not only bind the soil but also make favourable condition for regeneration and aggregation of species. The spurs will prevent debris accumulation in the adjoining forests.
- The monitoring of extraction area is necessary to prevent formation of deep ditches and removal of soil. Quantity of debris /annum should be calculated from extraction sites by random selection of ditches per hectare. Monitoring involves measurement of chemical, physical, and biological parameters to evaluate the magnitude of change that occurs following remedial and restoration activities and to estimate the rate of recovery of an ecosystem. The patch should be regulated where heavy extraction is done. This work is required to be done in Gaula and Yamuna rivers where extraction is not being regulated. This may cause damage to the ecology of the river and loss of property and life.
- The extraction of materials should not be started from the river mouth in case of perennial rivers. It may cut the river to other direction as in the case of Asan and Timli areas where river course has been changed and back flow is noticed at some places. It creates loss of water in the river and also loss to aquatic fauna.
- The extraction helps in deepening of central river channel, the water in rainy season flows in this channel without making bank erosion. The deepening of central channel enhances succession of the bank resulting regeneration of desired species. Nihal river is an example where debris have been accumulated in the centre of the river as a result the flood water enters in the nearby agricultural fields and also causes loss of property and lives. Regeneration and succession is badly affected due to heavy debris accumulation. The accumulation of debris is not only harm to forest regeneration.
- The extraction of riverbed materials should be incorporated in the Working Plans of respective divisions as the river mining work is carried out in forest areas of the divisions.

Debris accumulation in untrained rivers-damage to forest vegetation

Project 16: Development of Silvicultural practices for promoting cultivation of *Taxus baccata*, *Rhododendron arboreum* and *Phyllanthus amarus* [FRI-294/Silva-25/External/2005-09]

Findings: It was observed that germination of freshly harvested seeds in *Phyllanthus amarus* was slower than that of older seeds. Seeds from the first capsules to dehisce after harvest (dark green seeds) had higher percentage germination than those from capsules dehiscing later (light tan seeds). Experiment was carried out on the Effect of Nitrogen and Phosphorus doses on the Biomass production of *Phyllanthus amarus* plants in nursery stages. The results showed

that N30P50 had highest the plant height, number of branches, collar diameter, root length, fresh and dry weight of shoot. Further increase in level caused general decrease in plant growth rate. *Phyllanthus amarus* seeds were broadcasted for germination at three different degraded sites in Uttarakhand (Raipur, FRI and Premnagar). It was observed that 5 cm x 5 cm spacing gave highest biomass percentage in *P. amarus.* Experiment was conducted on rooting of branch cuttings of *Taxus baccata* and *Rhododendron arboretum* at Chakrata nursery. It was concluded that best results were recorded in 10,000 ppm IBA in both species (*Taxus baccata* and *R. arboretum*). Morphological observation of flower study of *Taxus baccata* was conducted. Grafting and air layering in Rhododendron were also performed.

Project 17: Development of Technological package for the production and quality evaluation of seeds of important medicinal plant species under National Medicinal Plant Board [FRI-285/Silva-22/External/December 2004 - December 08]

Findings: Seeds of 100 species of medicinal plants were collected from Ranikhet (Almora), Rishikesh, Mandal (Gopeshwar), Munsiyari (Pithoragarh) and Ramnagar in Uttarakhand. Seeds were extracted, cleaned and upgraded with the help of dodder sieve and gravity separator. The viability of seeds was evaluated by direct germination test and indirectly through TTZ test. Seed morpho-logical parameters such as seed length, width, shape, colour, 1000 seed weight, number of seeds in a single fruit and number of seeds in 1 kg were recorded. Seeds were pretreated with different growth promoters such as GA_3 0.1%, KNO_3 0.2%, H_2O_2 0.1% and subjected to germination test monthly.

Two Information Booklets on Medicinal Plants

Some of the important medicinal species on which studies were conducted are *Abroma augusta, Arus precatorius, Aegle marmelos, Andrographis paniculta, Artemisia vulgaris, Asparagus racemosus, Berberis asiatica, Bergenia ligulata, Catharanthus roseus, Celastrus paniculatus, Coleus barbatus, Costus speciosus, Cymbopogon martini, Gloriosa superba, Hippophae salicifolia, Lepidium sativum, Myrica nagi, Ocimum gratissimum, Peganum harmala, Plantago ovata, Potentilla fulgens, Saussurea lappa, Solanum nigrum* and *Woodfordia frutocosa* etc. The research findings has been compiled in the form of two booklets on medicinal plants seeds.

Project 18: Raising of Demonstration Plantations for Augmenting Fuelwood and Fodder Resources and Promoting Income Generation in two villages of Uttarakhand (Funded by Uttarakhand Council of Science and Technology) [FRI-343/Silva-31/2006-08]

Status: Under this project, model plantations of fuel, fodder and income generating species were established in two villages in Uttarakhand. Socio-economic survey showed greater requirement of fuel and fodder species in village Jadi, Chakrata whereas income generating species were in greater demand in village Hadam Dandasli, Dist. Tehri Garhwal. Mulbery, Walnut, Chullu, Kathal, Aonla and Carissa etc. were planted as cash generating species. In future, villagers will get fuel, fruits and fodder from this plantations and these sites will promote income generation in the villages. The plantations are now being maintained by the villagers.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Genetic Improvement of *Asparagus racemosus* to enhance root production and saponin content [FRI-340/G&TP-19/2006-09]

Status: Total saponin was estimated in all the twenty sources deployed in the field. The flowering was observed in the month of October 2008 in the field trial. Certain seed sources have exhibited precocious flowering at the age of one year. The variation in seed size and shape has been studied in all seed sources of *A. racemosus* bearing fruits. Data recorded on seeds collected from monocarpellary, bi-carpellary and tri-carpellary ovaries. Leaves variation has been observed in same sources with regards to appearance of green leaves after dryness. Variation in saponin content was also recorded in plants of different phenological appearance of the same sources.

Project 2: Establishment of breeding arboretum of Eucalyptus and production of interspecies hybrids [FRI-319/G&TP-15/2005-10]

Status: Two species of Eucalyptus i.e. *E. pellita* and *E. urophylla* flowered synchronously and are inter-crossable as the reciprocal crosses attempted between two species have yielded fruits with seeds. The open pollinated seeds from *E. pellita* have been collected and progenies have been raised. Controlled hybridization attempted for production of tri-hybrids between *E. urograndis* (di-hybrid) and *E. pellita.* Phenological observation recorded regarding flowering and fruiting in all the species of Eucalyptus established in the trial.

Project 3: Impact of biotic factors on forest biodiversity with particular reference to specific threatened sites and species of Uttar Pradesh, Uttarakhand and Delhi [FRI-359/Bot-54/2007-10]

Status: Site selection and phytosociological analysis in north, central and south Delhi ridge forest has been completed .Candidate plus trees of important species were selected from Delhi ridge forest for germplasm collection and *ex-situ* conservation. Threat value assessment of species like *Sophora mollis, Dendrocalamus strictus* and *Leonotis nepetifolia* etc. has been completed. Inventorization of threatened sites of Bhagirathi valley, ecotone of Betula-Cedrus, threatened *Erythrina arborescens* and *Berberis asiatica* were studied. Threatened sites of Keshav Prayag, Laxmi Van and Auli were studied for threat value assessment.

Project 4: Revision of Indian Woods – their identification, properties and uses, Vol. II [FRI-360/Bot-55/April 2007 - March 11]

Status: Microstructure studies of the family Linaceae, Zygophyllaceae and Meliaceae completed as per the feature list given by International Association of Wood Anatomists, 1989.

Project 5: Planting stock improvement: Inter and intraclonal variations in relation to shoot production, rooting and subsequent growth in Vegetative multiplication garden of *Dalbergia sissoo* [FRI-358/Bot-53/2007-10]

Status: Marked interclonal and intraclonal variations in shoot no., days of shoot emergence and shoot length. Maximum shoot number (26) were produced in clone 66 and 6 while maximum shoot length of 68 cm observed in clone no. 49. Significant differences were observed in rooting percent which was maximum (90%) in 4 years old hedges in clone no. 41 while in aggregate, 73% rooting was observed in 4 years old hedges. There were inter and intraclonal

variations in sucker production which was maximum of 3 in clone no. 9. Five months growth data revealed maximum of 23.8 cm length in Cl. 41 and collar diameter of 5.65 mm in Cl. 88 in 4 years old hedges. Overall treatment effect of three different ages of VMG, the best response in shoot production was observed in 9 years old hedges while rooting and subsequent growth was best in 5 years old hedges while 14 years old depicted decline in rooting percent as well as subsequent growth of propagules.

Project 6: Field evaluation of different clones of *Dalbergia sissoo* growing in Clonal Seed Orchard at Lachhiwala, Dehradun for their growth and physiological parameters [FRI-357/Bot-52/2007-10]

Status: The best clone regarding height and clearbole was Cl. no. 123 belonging to Nepal followed by Cl. 202, 198 and 235 belonging to Gonda. Chlorophyll Fluorescence parameter FV/Fm was also maximum in clone no. 123 belonging to Nepal followed by clones 202, 196, 194 and 235, all belonging to Gonda. All the clones belonging to Rajasthan have poor growth but pod formation was observed in all the clones. Most of the clones of Rajasthan shed their leaves earlier. No pod formation in 66, 19, 80, 35, 123, 67, 194, 84 and 85.

Project 7: Molecular analysis of high resin yielding genotypes of *Pinus roxburghii* [1.15/FRI/384/G&TP-20/2007-10]

Status: RAPD analysis carried out for 93 high and low resin yielding genotypes of *P. roxburghii* from Uttarakhand and Himachal Pradesh. A total of fifty RAPD primers were initially used in the present study, of which 18 primers were selected based upon their reproducibility and polymorphic nature for screening of germplasm.

Project 8: Recommendation of Land use model for degraded forests of Nainital of Uttarakhand [FRI-383/FSLR-25/2007-10]

Status: Adoption of proper land use model for degraded sites may not only increase the productivity but also decrease the soil degradation. Therefore, need to identify existing constraints and suggest proper land use model for forest area of Uttarakhand is imperative. Surveyed the new area at Khurpatal, Naina, Rajgarh, Laldhunga, Herakhan, Lohakhan, Patloghat, Bhimtal, Bhowali and Neelghat etc. and soil profiles were exposed and their morphological properties were recorded. Soil samples from all genetic horizons were collected and brought to the laboratory. Soil samples so far collected are analysed for their physico-chemical properties.

Project 9: Relative effect of geology, vegetation and climate on soil formation of Uttarakhand [FRI-381/FSLR-23/2007-12]

Status: Uttarakhand forests of North-Western Himalaya is a confluence of all the rock formations resulting in different soil and vegetation types on different climatic zones. The importance of geology in forestry research is of great significance in evaluating the soil fertility status and in managing the soil for greater production. As such, the study regarding this project is being carried out in Uttarakhand State. The area was surveyed and the soil and rocks samples were collected from Dehradun, Nainital, Tehri Garhwal, Pauri Garhwal, Chamoli, Rudraprayag, Udham Singh Nagar, Pithoragarh and Champawat districts of Uttarakhand under different natural forests of *Quercus leucotrichophora, Pinus roxburghii, Cedrus deodara, Picea smithana, Abies pindrow* and *Shorea robusta* and miscellaneous forests with different geological formations. Geology of the area was studied. Soil and rock samples so far collected are being analysed for physical and chemical attributes.

Project 10: Soil organic carbon inventory of Uttarakhand [FRI-382/FSLR-24/2007-12]

Status: In this project, Soil Organic Carbon pool is being estimated under different land uses viz. Forests (Silver fir and Spruce, Deodar, Chir, Oak, Sal, Kail and Miscellaneous), Plantations (Shisham, Teak, Chir, Poplar and Eucalyptus), Horticulture (Mango, Letchi, Guava, and Apple), Agroforestry (Poplar + Wheat) and Grasslands of Uttarakhand. Surveyed the various areas and selected the sites. This year, soil samples were collected from different land uses in Dehradun, Tehri Garhwal, Pauri Garhwal, Chamoli, Rudraprayag, Nainital, Udham Singh Nagar, Champawat and Pithoragarh districts of Uttarakhand. Total 1155 samples were collected from different land uses in the above mentioned districts and all the samples were analysed for soil organic carbon, bulk density and coarse fragment.

Project 11: Econometric analysis of potential and constraints for farm forestry development in Eastern UP [FRI-356/Stat-2/April 2006 - March 10]

Status: Field data collection and its entry in the computer is completed.

Project 12: Development of Organic Cultivation protocols for enhancing productivity of selected medicinal and aromatic plants in Uttarakhand [FRI-359/NWFP-23/2006-09]

Status: Organic cultivation protocol for 3 medicinal plants such as *Asparagus racemosus*, *Rauvolfia serpentina* and *Ocimum sanctum* is being finalized using different combinations of FYM, and vermicomposts. A hands on training on cultivation and value addition of medicinal plants was conducted. Optimization of farm input cost, effective soil moisture conservation, soil nutrient replenishment and weed control using mulch were suggested.

Asparagus racemosus

Ocimum sanctum

Rauvolfia serpentina

Project 13: Studies on nursery diseases of important medicinal plants of Uttarakhand [FRI-352/NWFP-22/2006-09]

Status: Nursery diseases of Medicinal and Aromatic plants in the state of Uttarakhand have been studied. Diseases attacking over 70 medicinal and aromatic plants have been identified. Pictorial report with nursery management requirements are being suggested for reducing disease incidences and increasing productivity of medicinal and aromatic plants.

Disease on *Coleus barbatus*

Nursery Disease of *Digitalis purpurea*

Infection on *Gymnema sylvestris*

Project 14: Extent and evaluation of die back of Shisham (*Dalbergia sissoo*) and identification of disease resistance sources [FRI-385/Path-22/2007-10]

Status: Combined tours were undertaken in Rishikesh, Lacchiwala Range, Mejia, Durgapur (West Bengal) and Mattewala Range, Ludhiana. The disease severity and incidence were estimated and pathogen was collected. Soil samples and ecological parameters were also taken for future study. Molecular characterization of *Fusarium solani* by RAPD-PCR was done and resistant/susceptible germplasm of *Dalbergia sissoo* were DNA fingerprinted.

Project 15: Mortality of Kikar (*Acacia nilotica*) in Punjab and Haryana and its management [FRI-386/Path-23/2007-10]

Status: Areas in Punjab viz. Ludhiana, Amritsar, Firozpur, Bhatinda and Hoshiarpur were visited for disease incidence. Evaluation of mortality in Kikar with special reference to Ganoderma root rot and heart rot caused by *Phellinus badius* were estimated. Soil samples were collected.

Project 16: Screening and hybridizing Indian isolates of *Cordyceps sinensis* for enhanced production of bioactive principles [FRI-387/Path-24/2007-10]

Status: Thirty isolates of *Cordyceps sinensis* were brought into pure culture. Cultural characterization of these isolates was done. Growth of *Cordyceps sinensis* on different nutrient media was studied. The isolates were grown in Jhingora as per the protocol developed. Seven isolates were powdered in liquid nitrogen after a growth of 6 months and were analyzed for their bioactive principles by HPTLC. Some of the bioactive principles have been found to be in a higher quantity in the cultivated *Cordyceps sinensis* in comparison to the wild. Cordycepin was detected in these cultures, however, ergosterol was found in only one culture.

Vegetative growth of *C. sinensis* on Mandua (Left) and Jhingora (Right)

Project 17: Molecular variability in *Cylindrocladium quinqueseptatum* causing leaf and seedling blight in Eucalyptus [FRI-388/Path-25/2007-10]

Status: Seventy three isolates of *Cylindrocladium quinqueseptatum* from Uttarakhand, Punjab, Haryana and Uttar Pradesh were analyzed through RAPD-PCR and maximum polymorphism was obtained by the operon primers of 'E' series. The UPGMA cluster analysis of 284 loci led to the identification of 11 population lines and an outlier. The ITS region amplification with primer ITS 1 & 4 was done and 18 sequences were submitted to gene bank (NCBI). Three beta tubulin gene sequences were also submitted to the gene bank. All the above sequences were granted accession number and were published on web site of the gene bank (http//www.ncbi.nlm.nih.gov).

Project 18: Identification and Evaluation of Disease Resistance in Different Genotypes of Poplar [FRI-353/Path-21/2006-11]

Status: Growth and disease status of G-48, Udai, WSL-22 and WSL-39 at Jawahar Nagar (Udham Singh Nagar) and Maheshwari (Haridwar) nurseries were recorded monthly since July till October. Isolation of different pathogens (Alternaria (5), Drechslera (25), Phoma (2), *Sclerotium rolfsii* (1), etc) from the sample collected from the site and their detailed symptoms were captured. Two generations of crosses (2006 & 2007) of common poplar genotypes are

quantified for growth as well as diseases regularly. One hundred seventy genotypes were also scanned for growth and disease status. Pathogenic reactions of shoot juveniles of G-3 for 33 isolates of Drechslera were tested. Some of the isolates like D-2, D-4, D-19, D-31, D-32, and D-34 were more aggressive in comparison to others as they initiated blight symptoms earliest after 3h. Most of the aggressive isolates (D-2, D-19, D-31 and D-34) exhibited 100 percent foliage blight while two isolates i.e. D-4, D-32 also showed 86.7 and 96.7 percent blighted foliage, respectively within 48h. In another experiment, reactions of stem seedlings against 50 isolates were recorded for G-3 clone. Some of the isolates like D-12, D-18, D-31, D-32, D-40, D-44 and D-45 given wilting symptom within 3h. Blighted symptom was also expressed within the same observation period by isolates like D-9, D-10, D-43, D-48, D-49 and D-50.

Project 19: Creation of Photo Gallery for FRI at Shatabdi Van Vigyan Kendra, Dehradun [FRI-457/Path-31]3

Status: In consultation with the designer hired for designing the gallery the project team has segregated the entire gallery into six sections – Genesis, Architecture, Personalities, Events, Visitors and Research. The civil and electrical works in the gallery are at the verge of completion. More than 200 photographs have been sent for digitization and framing to the firm hired for digitization and framing of the photographs and documents. Artifacts to be kept in the gallery have been identified and their collection has been initiated. Write-ups and titles of the photographs were prepared and stories created.

Project 20: Bioconversion of forest waste lignocellulosic biomass into ethanol [FRI-361/C&P-18/2007-10]

Status: Detoxified hydroly sates of *Lantana camara* and Pine needle were subjected to fermentation with *Saccharomyces cerviseae*. Lantana hydrolysate after fermentation yielded higher alcohol than pine needle after 54 hrs. of reaction time.

In order to decrease the toxicity, increase the fermentability efficiency of the hydrolysate and to make the process economical viable, *Lantana camara* and Pine needle were extracted with different solvents- Petroleum ether, Alcohol Benzene and Methanol. The extractives removal was more in Alcohol benzene in case of Pine needle whereas extractive solubilities were found maximum in Methanol in case of *Lantana camara.* The hydrolysis of extractive free biomass is under progress.

Growth of *Saccharomyces cerviseae*

Project 21: Utilization of soda spent black liquor lignin for value added products [FRI-361/C&P-19/2007-10]

Status: Soda spent black liquors collected from M/S Shreyans Papers Ltd, Ahmedgarh (Punjab) and M/S ABC Papers Ltd. Sailakhurd, Distt. Hoshiyarpur (Punjab) were analysed for their physico-chemical properties. Prototype for process development for carrying out modification reactions was set up. The soda spent black liquors were modified by the sulphonation at room temperature by passing SO_2 gas initially for 20 minutes. The modified products were concentrated for higher dry solid content. Further modification reactions to get optimum sulphonation are under process.

Project 22: Role of Temple Forests in rejuvenating microclimate of some villages of Uttarakhand [FRI-369/Eco-24/April 2007-March 10]

Status: Phyto-sociological studies of vegetation of Nagdev Forest Range have been done. The number varied according to the slope / aspect of the sites. Soil samples collected from both the study sites were analyzed for their physico-chemical properties, which didn't show much difference in both the sites. Daily compilation of Meteorological data from both the weather stations is done. Tabulation, conversion of meteorological data etc. is in progress.

Project 23: Utilization of Fungi for Biofertilizer of Industrial Waste Water [FRI-346/Eco-20/April 2006-09]

Status: Different fungi like *Aspergilus niger, Schizophyllum commune, Earliela scbrosa, Funalia leonine, Lenzylus vespacia, Polyporus gramocephalus, Trametes lactinea, Trametes versicolor* and *Trichoderma viride* were tested with tannery effluent and some of them showed good bioremediation potential. Other fungi were also tested against pulp & paper effluents for their adaptive nature and their capability to decolorize and bioabsorption of heavy metals from the effluents.

Project 24: Development of air pollution biomonitoring station for Air Quality Assessment of Dehradun [FRI-368/Eco-23/2007-10]

Status: Biomonitoring of air quality studies were performed for assessing the air quality by using plant biochemical indicators. Sensitivity index were developed for different species. Air quality index was also developed for Shatabdi Van Vigyan Kendra, Dehradun. Already established correlation between sensitivity index value and Air Quality index for different species were used for air quality estimation of that area.

Project 25: Ecological Impact of urbanization on floral diversity in natural and man-made forests of Doon Valley [FRI-368/Eco-23/2007-10]

Status: Diversity of trees was observed in increasing trend from highly disturbed to partially disturbed forest. Disturbances invite invasion of herbaceous species. Decrease in richness of trees from partially disturbed forest to highly disturbed forest was observed. Temperature decrease from open to partially disturbed forest was observed, whereas it was vice-versa in case of Relative Humidity (%) during sunny day observation. Socio-economic status of the village and towns located on forest fringe reveals dependency on forest.

Project 26: Ecological Impact Assessment of invasion Lantana, its removal and subsequent Restoration of Habitats in Rajaji National Park of Tropical Moist Forests [FRI-367/Eco-22/2007-10]

Status: Monitoring of vegetation was carried out in two years old Lantana removal sites under Sal (*Shorea robusta*) and mixed deciduous forest in Rajaji National Park. Soil samples from these sites were also collected to monitor the change in soil chemical attributes.

Project 27: Biology and control of bamboo, *Phloeobius crassicollis* damaging green standing bamboo [FRI-374/FED-28/2007-10]

Status: Studies on the biology of *Phloeobius crassicollis* was taken up in the laboratory. The beetle emerges during the month of May and June and feeds on the outer surface of the bamboo culms preferably near the nodes. It deposits eggs at the nodes conceded in this scale. Larvae feed on the woody tissues of node and internode and deposit frass inside the hollow. Larval period is prolonged from May-June to April-May. Pupation takes place in a pupal cell near the node in a crowded manner. Pupal period lasts for 20 days. Life cycle is completed in one year.

The incidence of attack was 3.5 to 18% on *Bambusa bambos* at Dehradun and 7.18 to 9.21% at Sahansara, Sakumbhari Range, Saharanpur Forest Division.

Chemical control experiments were carried out in the field using systemic and contact insecticide by internodal injections. Contact insecticide performed better than systemic insecticides.

Project 28: Butterfly diversity in moist temperate forests of Garhwal: Evaluating species of conservation priority and indicator taxa of habitat disturbance in Ban Oak forest ecosystem [FRI-348/FED-23 /2006-09]

Status: Oak forest sites in Garhwal namely, Kedarnath Musk Deer Sanctuary (Chamoli & Rudraprayag District), Govind Wildlife Sanctuary (Uttarkashi District), Benog Sanctuary-Mussoorie-Chakarata (Dehradun District); Kotikimoi RF- Dhanaulty RF- Nagtibba RF-Ghoraghati RF; Bhuddakedar RF -Pangarana RF (Tehri Garhwal District), were evaluated for butterfly diversity under different habitat conditions and altitudes. Data has been collected on the abundance, distribution, habitat preference, food plants and threatened status of over 225 species.

Project 29: Bio-ecology and control of Oak stem borer, *Aphrodisium hardwickianum* (white) (Coleoptera: Cermbycidae) [FRI-348/FED-23/2007-10]

Status: Bio-ecology of the borer was studied on standing dead trees in Dangan village in Govind Wildlife Sanctuary (Uttarkashi district) and Kanatal (Dhanaulty RF in Tehri Garhwal District) and also in the laboratory on Ban and *Moru oaks* along with data on base line parameters of stands. Natural enemies of this borer were also identified.

Project 30: Upgradation and computerisation of National Insect Forest Collection (NIFC) [FRI-233/FED-16/2003-10]

Status: In the year 2008-09 (up to September 2008) digital imaging work was taken up and about 4000 species were digitally imaged. In all, about 50,000 pictures have been taken. Copyright symbol, scale, name of collection, division and institute was also incorporated in each picture. About 20,000 pictures have been edited.

Database for proper management of National Forest Insect Collection (NFIC) is in the process of development. Seventeen thousand insect species, mainly of forestry importance, are represented in the collection. Forty four insect species not represented in the NFIC were also incorporated in the collection.

Project 31: Studies on biodiversity of parasitic Chalcidoidea (Hymenoptera) of Uttarakhand [FRI-375/FED-29/2007-11]

Status: Survey and collection of parasitic Chalcidoidea (Hymenoptera) was done in the Tehri District. Various places where collection was made were: Rani Chauri, Badshahithaul, Chamba, near Tehri dam site, Devali (near Ghansayali) and Kadukhal. Collections were also done in the doon valley to study the temporal distribution of the chalcid families. Various places where collection were done were: Barkot, Lachhiwala, Karvapani and Kalsi etc. Three different collection methods viz. sweeping, yellow pan trap and Malaise trap were used to collect the samples. From the preliminary observations, Family Eulophidae is the most abundant and species rich family in the area followed by Pteromalidae, Encyrtidae, Eucharitidae, Mymaridae, Eupelmidae, Aphilinidae and Trichogrammatidae.

A new record with the description of a new species of genus Cynipencyrtus (Chalcidoidea: Tanaostigmatidae) from India was also made. This new species was collected from Badshahithaul under the *Quercus leucotrichophora* trees.

Project 32: Taxonomic studies of parasitoids belonging to subfamily Microgastrinae (Hymenoptera: Braconidae) of Uttarakhand and Haryana [FRI-371/FED-25/2007-11]

Status: Survey and collection of parasitic Microgastrinae (Hymenoptera: Braconidae) was done in the Tehri district. Various places where collection was made were Rani Chauri, Badshahithaul, Chamba, near Tehri dam site, Devali (near Ghansayali) and Kadukhal. Collections were also done at Barkot, Lachhiwala, Karvapani, Kalsi (Doon Valley) in the Uttarakhand. Chichroli Ambala and Yammuna Nagar of Haryana.

First record with the description of a new species of genus *Cotesia koebelei* (Riley 1889) on *Hyposidra talaca* Walker from India was also made. This new species was collected from Barkot Range.

Collection, identification and Updating of *Cotesia glomeratus* (Linnaeus 1758), on *Pieris brassicae* Linn. *Cotesia taprobanae* (Cameron 1887), on *Stauropus alternus* Walk. *Proapanteles* (Proapanteles) *oblique* (Wilkinson 1928) on *Diacrisia obliqua* Walk. *Dolochogenidea stantoni* (Ashmead 1904) on Pyralidae larvae. Two species of Apanteles, two species of Microplitis are also collected.

Project 33: Studies on the development of biopesticides from *Eucalyptus* hybrid [FRI-344/Chem-16/2006- Sept. 09]

Status: Different extracts and pure compounds were screened for their antifungal and insecticidal activities. Three samples namely EO, MET and AS exhibited antifungal activity against *Ganoderma lucidum* at 0.50%, 1.0% and 2.0% concentration respectively. The above samples did not exhibit insecticidal activity against larvae of *Dichomeris eridentis.* Formulations of MET and EO and ursolic acid were prepared for their antifungal screening. A process was developed for the isolation of ursolic acid from the leaves and patent application filed.

Project 34: Studies on *Sapindus mukrossi* fruits for their utilization [FRI-362/Chem-18/2007-10]

Status: Extraction of the seed kernel was done with methanol. Fractionation of the methanol extract was done in acetone, benzene and methanol fractions. Column chromatography of the acetone extract was done. Chloroform extract of Sapindus seeds collected from FRI and Gyarahdevi were tested against 8 forest fungi namely, *Alternaria* sp., *Colletotrichum gloesporioides, Phoma* sp., *Phomopsis dalbergiae, Fusarium oxysporum, Ganoderma lucidum, Rhizoctonia solani* and *Trichoderma pilluliferum* at different concentrations i.e. 0.5, 1.0, 1.5 and 2.0%. Chloroform extract (FRI) showed IC_{50} against all fungi except *F. oxysporum* (47%) at the highest concentration of 2%. *P. dalbergiae* registered highest inhibition of 88% while *Alternaria* sp. showed lowest inhibition (57%). Chloroform extract of Gyarahdevi exhibited IC_{50} against all the test fungi barring *Alternaria* sp. and *F. oxysporum* (47% each). Further, only *C. gloesporioides* showed less than 70% inhibition while *P. dalbergiae* had highest inhibition of 91%. Minimum Inhibitory Concentration (MIC) of Chloroform extract was also worked against *C. gloesporioides* (2.5%), *Phoma* sp. (3.0%), *P. dalbergiae* (3.0%), *G. lucidum* (1.5%), *R. solani* (4.0%) and *T. pilluliferum* (5.0%).

Chloroform extract of FRI was fungicidal against *C. gloesporioides, Phoma* sp., *P. dalbergiae* and *G. lucidum.* While, Methanol extract of FRI was fungicidal for *C. gloesporioides, Phoma* sp., *P. dalbergiae, G. lucidum* and *R. solani* and fungistatic for *T. pilluliferum*. Effect of Methanol

extract of FRI on spore germination of forest fungi was quantified and it was 94% and 89% inhibition for *C. gloesporioides* after 24 and 48 h, respectively (at very high concentration of 13%). Similarly, varied and high inhibition in the spore germination was recorded for *Phoma* sp. (2.5%; 87 and 83% after 24 and 48h, respectively), *P. dalbergiae* (3%; 89 and 86% after 24 and 48h, respectively), *G. lucidum* (6%; 89 and 86% after 24 and 48 h, respectively) and *T. pilluliferum* (6.5%; 88 and 82% after 24 and 48 h, respectively).

Project 35: Chemical marker of *Eucalyptus* hybrids for wood durability and foliar dense: Characterization, heritability and genetic correlation [FRI 363/Chem-19/2007-10]

Status: Citronellal (CNAL), citronellol (CNOL) and Ursolic Acid (UA) were characterized in the foliage of *Eucalyptus citriodora* (EC) and were found to exhibit bioactivity against *Cylindrocladium quinqueseptatum*. GC-FID method for quantification of monoterpenes in Eucalyptus foliage was developed. Foliage of different phases from EC, *E. torelliana* (ET) and their hybrid were collected monthly and their hexane extracts were prepared to study phenological variability of bioactive foliage monoterpenes. Extraction of the foliage with petroleum ether: acetone (4:1) for phenological variability of the UA was also initiated and continued. Quantification of CNAL and CNOL in EC foliage using GC-FID analysis of their hexane extracts was initiated and continued. Methanol extracts, EC3 and ET3, from heartwood of the EC and ET, respectively were found active against brown rot and white rot fungi. These extracts were further fractionated into ethyl acetate and n-butanol fractions. Gallic acid and protocatechuic acid were characterized in the EC3. Further work is in progress.

Project 36: Isolation and characterization of phytoecdysteroids from *Achyranthes aspera* and *A. bidentata* and their effect on the economic traits of *Bombyx mori* L. [FRI-364/Chem-20/2007-10]

Status: The leaves, stem, roots and seeds of *Achyranthes aspera* and *A. bidentata* were collected from the adjoining areas of Dehradun. The air dried and powdered parts were extracted with petroleum ether, acetone and methanol respectively and yield of the extracts was determined. Two pure compounds were isolated and characterized from the methanol extract of *A. aspera* seeds. Nine extracts and three pure compounds of *A.aspera* and six extracts of *A. bidentata* were tested on silk worm (*Bombyx mori*) for their uniform maturity. Six extracts and two pure compounds exhibited 80% or more maturity of silk worm in 18 hrs. In case of control 69% maturity was observed. The testing of extracts is in progress. The fatty oil content in the *A.bidentata* seeds was found to be 6.1%.

Project 37: Studies on the utilization of seed polysaccharide from *Strychnos potatorum* [FRI-365/Chem-21/2007-10]

Status: Carboxymethylation of *Strychnos potatorum* seed powder was carried out using sodium hydroxide and chloroacetic acid. Reaction conditions viz. effect of reaction time, concentration of monochloracetic and sodium hydroxide and effect of solvent ratio were optimized. Rheological properties of the product with maximum DS (0.33) were studied. A pure compound was isolated from the methanol extract of the seeds.

Project 38: Comparison of Hydrological regime of a micro watershed having dense Oak forest with a degraded micro watershed (in Mussoorie) [FRI-370/Eco-25/ April 2007 to March 12]

Status: Data collection of the two micro watersheds is going on. Laboratory analysis of data samples of sediment yield and isotopic analysis has been completed. Analysis of data of the year 2008-09 has been completed.

Project 39: Quality assessment of timbers by using ultrasound and microwave techniques [FRI-377/FPD/(TM)-63/2007-10]

Status: Studied the effect of moisture content on ultrasonic velocity and microwaves attenuation at 9.89 GHz in timber. Ultrasonic velocity and strength properties (MOE and MOR) of *Cedrus deodara* and *Dalbergia sissoo* have been determined. Testing of *Tectona grandis* and defect detection in timber is under progress.

Project 40: Extent and evaluation of dieback of Shisham (*Dalbergia sissoo*) and identification of disease resistance sources [FRI-385/Path-22/2007-10]

Status:

- Physiological parameters viz., photosynthesis, transpiration, internal CO_2 and leaf temperature in field and laboratory conditions collected.
- Biochemical estimation of chlorophyll, carotenoids, sugars, protein, starch, amino acids, phenols also collected.

Project 41: Clonal screening of *Dalbergia sissoo* in relation to nitrogen utilization and biomass production [FRI-114/Bot-62/2008-13]

Status:

- Nine clones of *Dalbergia sissoo* viz., 9093 (1), 9058 (2); 9058 (1); 9065 (2); 9064 (2); 9063 (1); 9015 (2), 9049 (1) and 9065 (1) shoot was taken from the pot raised plants and prepared softwood cuttings for multiplication.
- After hormonal treatments cutting material was kept in mist chamber for rooting.
- Some hardwood cuttings were also prepared and kept in mist chamber for rooting.
- All material kept for rooting shows sprouting. After that it will be transferred for hardening.

Project 42: Impact of major forest invasive plants on the biodiversity of Chakrata Forest Division [FRI-394/Silva-37/2007-10]

Status: Selected three sites in different altitudinal zones i.e. tropical, sub-tropical and temperate in Chakrata for collection of field data. Field data were collected from the plots, which are affected by the Forest Invasive Species (FIS) as well as from un-affected plots by laying out of nested quadrats in similar ecological conditions. The forest areas included are Sal forest in tropical zone, banj and chir forests in sub-tropical zone and deodar and kail in temperate zone. The species composition and regeneration status of desired species have been found out. The forest areas are affected by the Forest Invasive Species (FIS) like *Eupatorium odoratum, Lantana camara, Aegratum coinizoides, Artemisia vulgaris* and *Sarcococa saligna* etc.

Project 43: Role of allelopathy on regeneration in Silver fir (*Abies pindrow*) and Spruce (*Picea smithiana*) forests – Effect of natural leachates on seed germination [FRI-391/Silva-34/2007-10]

Status: Cones/seeds of Silver fir, Spruce, Deodar, Kail and understorey plants have been collected from Chakrata and Mussoorie. Identification of under story species of Silver fir and Spruce forests has been completed. Leachates/bioassay has also been prepared using specified techniques in laboratories for carrying out effect of leachates on germination of coniferous species.

Project 44: Effect of *Populus deltoides* on shade loving medicinal plants crops [Project No. FRI-305/SF-8/2005-11]

Status: Plants of *Asparagus recemosus* and Chitrak (*Plumbago zeylanica*) are being maintained under the shade of *Populus deltoids* in the Demo plot at Premnagar, Dehradun. Biomass of *Plumbago zeylanica* is taken under poplar shade. Growth of poplar has been recorded. Plantation of *Aloe vera* is done under poplar shade and in open area in Demo plot Premnagar.

Project 45: Tree Crop interactions: Effect of *Melia* spp. on crops [FRI-306/SF-9/2006-11]

Status: Demonstration plots of *Melia composita* are established in farmer's field at Chotla Kalan and Handsera in district Mohali and at Hukran in district Hoshiarpur in Punjab State. Monitoring and maintenance with pruning operation is being done whenever required. Soil studies of the same plots are in progress. Estimation of crop yield has been initiated. Maintenance of seedlings of *Melia composita* has been done. Plants are distributed to the interested farmers every year. Work on canopy management has been done through pruning of *Melia composita* plants.

EXTERNALLY AIDED PROJECTS

Project 1: Status of soils and organic carbon store in Giri Catchments of Himachal Pradesh [FRI-314/FSLR-19/External/December 2007 to December 09]

Status: The new areas of the Giri Catchments were surveyed. Dug out the soil profiles were exposed in Kishankaur, Kirganu, Chakahan, Dhanrain, Shilaji and Chambidhar etc. under different land uses viz. miscellaneous and Chir forests and soil samples were collected from different genetic horizons. Geological studies of these areas were also studied. Soil samples for organic carbon estimation were also collected from different land uses from various locations. Bulk density samples were also collected from the same sites. Soil samples collected so far were analysed for various attributes.

Project 2: Farm Forestry extension and its marketing and economic linkages [FRI-367/RSM-18/External/2005-09]

Status: Draft Final Report submitted to the funding agency and also presented before review committee of Punjab Forest Department. The further suggestions and request of the funding agency is being incorporated in the report.

Project 3: Strengthening of Monitoring, Assessment and Reporting on Sustainable Forest Management [MAR-SFM]

Status: Meetings of National Steering Committee and National Network were convened on MAR-SFM under FAO project.

Project 4: Development of Mechanism for Computation and Forecasting of Growing Stock in strip Forests of Haryana taking into account the yearwise plantation and survival of relevant species [FRI-289/RCS-2/External/2006-10]

Status: Data of growth statistics from the selected three agro-climatic zones of Haryana for all the three types of strip forests have been collected and analyzed by entering in to excel sheets. Collection of data related to felling and volume calculation is in progress. Interim report has been submitted to funding agency indicating that there is wide spatial variability among the dia classes for plantations sites of road and canal side.

Project 5: Development of Non-destructive harvesting methods for medicinal plants [No. GO/UA-07/2006-NMPB/2005-08]

Status: Experimental trials related to non destructive harvesting methods in respect of project species viz. *Bergenia ligulata* and *Valeriana jatamansi* at NWFP Division Nursery and at Chakrata have been conducted. Seed germination of Picrorhiza and Rheum species were also carried out. A shade house at NWFP division Nursery, FRI campus and a poly house at Chakrata Nursery have been constructed. For demonstration of harvesting techniques to farmers and sharing of knowledge with forest officials, a field tour to Rewa district of Madhya Pradesh and in Chamoli district of Uttarakhand were organized.

Project 6: Exploration, conservation & propagation of important medicinal climbers of Garhwal Himalayas [No. GO/UA-15/2006-NMPB/2006-09]

Status: The work as per objective has been accomplished viz. explored 70 wild climber species in Garhwal Himalayas with their medicinal value. Conserved 25-30 species at the conservation site and propagation package has been developed for two species *Celastrus paniculatus* and *Ichnocarpus frutescence* suitable to the region. Extension materials (posters, brochures etc.) have been prepared. Few diseases have been identified in important medicinal climbers in wild and at conservation site.

Project 7: Standardization of drying and storage protocol and quality assessment of selected commercially cultivated medicinal plants of Uttarakhand [GO/UA-08/2006-07-NMPB/2008-10]

Status: Experimental drying and storage of *Asparagus racemosus, Rauvolfia serpentina* and *Aconitum heterophyllum* obtained from farmers cultivating these species in Uttarakhand, has been undertaken and quality profile of these species as per Ayurvedic Pharmacopoeia standards is being worked out.

Project 8: Biological control of root diseases of some medicinal plants using selected antagonistic fungi (NMPB sponsored) [FRI-411/Path-26/External/March 2007-February 10]

Status: Vascular wilt diseases in *Asaparagus racemosus* caused by *Fusarium solani*, in *Stevia rebaudiana* by *Fusarium solani* and *Sclerotium rolfsii*, in *Wrightia tometosa* by *Fusarium solani*, by *Fusarium* sp. in *Rheum australis* and by *Macrophomina phaseolina* in *Valeriana wallichi* have been identified and their pathogenicity was established. Eight isolates of *Trichoderma* species have been screened against *Fusarium solani* and *Sclerotium rolfsii* for their antagonistic efficacy. *T. harzianum* (I), *T. piluliferum* and *T. viride* were found effective against *S. rolfsii* whereas *T. piluliferum* and *T. harzianum* (II), *T. viride* and *T. virens* were effective against *F. solani*.

Field experiments were conducted against *Sclerotium rolfsii* vascular wilt of *Stevia rebaudiana* and *Fusarium solani* vascular wilt of *Asparagus racemosus* using six Trichoderma species in bagasse formulation. *Trichoderma viride* formulation was found significantly superior to all the treatments and control in increasing the number and biomass of leaves of *Stevia rebaudiana*. In *Asparagus racemosus*, *Trichoderma piluliferum* and *T. viride* were significantly superior to other treatments and control in increasing the root biomass.

Project 9: Management of fungal deterioration of medicinal plant produce in storage by the use of botanical fungitoxicants [UCOST funded]

Status: Periodic isolations of fungi were made from the stored *Withania somnifera* (roots), *Stevia rebaudiana* (leaves), *Cinnamomum verum* (bark) and *Carum carvi* (seeds). *Alternaria alternata,*

Aspergillus flavus, A. niger, A. terricola, Botrytis cinerea, Cladosporium cladosporioides, Fusarium solani, Gliocladium roseum, Penicillium implicatus, P. restrictum, Phymatotrichum sp., *Rhizopus nigricans*, *Thielaviopsis bassicola* and *Trichoderma* sp. have been identified during periodic isolations. Volatile effect of lemon grass oil, tulsi oil, peppermint oil, garlic oil and citronella oil and petroleum extracts of leaves of eucalyptus, seeds of ajwain and fruits of camphor were tested for their antifungal activity against storage fungi. All the tested oils except tulsi oil have fungicidal effect on checking the growth of fungi, whereas, tulsi oil has a fungistatic effect for 15 days.

Project 10: Molecular variability in *Cordyceps sinensis* isolates of Uttarakhand (UCOST Funded) [No. UCS&T/R&D/LS-74/07-08/2572/1, dated 01.01.2008]

Status: DNA amplification of 30 isolates of *Cordyceps sinensis* were done with 10 operon primers. The polymorphism was recorded and the population lines were identified based on the cluster analysis.

Project 11: Ecorestoration studies in Uranium Mines

Status: The seven species found suitable for tailing pond revegetation have been further propagated on the tailing pond. Plant growth of these species viz., *Pogostemon benghalense, Colebrookea oppositifolia, Jatropha gossypifolia* and *Dodonaea viscosa, Imperata cylindrica, Furcraea foetida* and *Saccharum spontaneum* has been evaluated. Uptake of radionuclides (uranium, polonium and radium) has been evaluated in seedlings grown on tailing pond as well as raised in experimental containers at H.P.U. Jaduguda. Forest species of ethnobotanical relevance have been recorded on the basis of ethnobotanical survey undertaken in the surrounding villages. Total 81 species are being collected by local villagers for medicinal and other uses.

Project 12: Development of RS base bioclimatic index (Funded by Department of Space, Space Application Centre, Ahmedabad ISR) [FRI-425/Eco-31/External/2008-10]

Status: Selection of areas of change for ground verification (species composition) in Bedni Bugyal has been done. Identification of benchmark points for permanent sites to monitor species composition and validation of changes in timberline and other classes over the few decades in relation to the altitudinal gradient has been done.

Project 13: Utilization of economic potential of *Lantana camara* [FRI-401/Chem-22/External]

Status: Carboxymethyl Cellulose (CMC) was prepared from á-cellulose isolated from *Lantana camara.* Reaction conditions were optimized to prepare CMC by varying concentration of alkali, material to liquor ratio, alkalization time, reaction time, temperature etc. using cheap solvents. Detailed comparisons of carboxymethylation studies from á-cellulose using monochloroacetic acid and its acetate were done to prepare CMC.

Project 14: Prospecting for utilization of unexplored ethnobotanically important medicinal plants of Uttarakhand [FRI-402/Chem-23/External/2007-09]

Status: Tubers from *Dicentra paucinervia* (DP) grown in FRI- NWFP nursery, *Pavetta indica* (PI) leaves and *Scindapsus officinalis* (SO) leaves and stems were collected and processed. Their respective extracts were prepared using different solvents. Presence of protopine and allocryptopine, the physiologically important alkaloids, in the tubers of DP was confirmed by comparison with the authentic compounds. Using the HPTLC method, the quantity of these alkaloids were determined in the tubers of the plant grown in the natural habitat, in Dehradun and were found to be comparable. Ursolic acid and â-sitosterol were characterized in the leaves of PI and SO respectively.

Project 15: Phytochemical examination of bioactive agents from plants of therapeutic value [FRI-419/Chem-25/External/April 2007 to March 10]

Status: Petroleum ether, Chloroform and methanol extracts of *Malaxis acuminata* pseudobulbs, *Drymaria cordata* (whole plant) and *Mussaenda glabra* (bark) were prepared. Fractionation of the methanol extract was done in ethyl acetate and butanol fractions. Column chromatography of the petroleum ether extract of *Malaxis acuminata* pseudobulbs was done. Three pure compounds MAP1, MAP2 and MAP3 were isolated from petroleum ether extract. Column chromatography of the petroleum ether extract of *Drymaria cordata* was done. Three pure compounds DRP1, DRP2 and DRP3 were

Project 16: Creation of Bioinformatics facility under BTIS net Program for Biology Teaching [FRI-443/IT-01/External/2007-09]

Status: The Bioinformatics facility has been created with hardware, software and civil infrastructure. The information system development is going on in domain of Biodiversity. One national workshop has been organized on Biodiversity Informatics

Project 17: Screening and identification of the lower Asarone (β-Asarone) containing variety/populations of *Acorus calamus* L. and its multiplication to enhance its economical and medicinal value [FRI-434/G&TP-22/External/2007-10]

Status: Germplasm of *Acorus calamus* collected from 20 different sources/populations from the natural range of its distribution covering the states of J&K, Uttarakhand and Himachal Pradesh. The collected material has been established at FRI campus in the form of germplasm bank. Morphological parameters of the collected sources were recorded. Root sample of 15 sources prepared for oil extraction and oil extracted of 20 sources. Estimated β-Asarone content from the samples of all 45 collected sources.

Project 18: Study of Floristic Diversity of Shiwalik Hills of Haryana [FRI-399/Bot-56/External/April 2007 to June 09]

Status: Vegetative analysis of different blocks of Haryana was carried out. In the study, new records have been reported for Haryana (such as *Ehretia acuminate* R. Br. *Pavetta indica* sensu Hk.f., *Olea glandulifera* Wall. ex G. Don., *Myrsine fricana* Linn., *Clematis natans* Royle, *Marsdenia roylei* W. & A., *Lepidagathis incurva* D. Don., *Swertia alata* (Royle ex D.Don (Cl) and *Tcucrium quadrifarium* Buch.-Ham.).

Project 19: Development of micropropagation protocol for the economically important bamboos: *Dendrocalamus hamiltonii* and *Gigantochloa atter* [August 2007 to December 09]

Status: Axillary bud break was achieved on MS medium supplemented with BAP for both the bamboos. *In-vitro* shoot of *D. hamiltonii* was multiplied on MS medium supplemented with cytokinin. Experiments are going on for *in-vitro* multiplication of *G. atter*. Initial rooting response was obtained on MS medium supplemented with IBA in *D. hamiltonii*.

Project 20: Planting stock improvement of some indigenous fuelwood and fodder tree species for higher biomass production in relevance to hilly region of Garhwal Himalaya [FRI-337/Bot-51/External/2006-09]

Status: The seeds and cuttings of fuelwood and fodder tree species were collected from superior phenotypes from different altitudes (from 600 to 2000m a.s.l.) of Garhwal Himalaya. Study of seed characteristics (seed length, width, thickness, weight and germination percent) of collected seeds from different altitudes. Seeds of *Quercus leucotrichophora, Robinia pseud-acacia, Grewia optiva, Toona ciliata,* and *Ougeinia oojeinensis* were sown in polybags filled with soil, sand and

FYM in different three nurseries. Cuttings of *Populus ciliata*, *Salix alba*, *Morus serrata* and *Alnus nepalensis* were planted in nurseries. Data were collected from previous planting material growing at different nurseries.Training-cum-distribution of quality planting material was conducted at three nursery sites viz., Fatehgram, Herbartpur, Nagrasu, Rudraprayag and Jarmola, Tons Forest Division, Uttarkashi. Total 129 persons particularly women were trained for nursery technology. Total 340 persons including women were collected the planting material from different three nursery sites.

Project 21: Bamboo improvement for rural and tribal Communities: integrating recent technologies (Funded by National Bamboo Mission) [FRI-416/Bot-61/External/2007-09]

Status: Planting material of hill bamboo species viz., *Sinarundinaria falcata, Arundinaria jaunsarensis, Thamnocalamus falconerii* and *Thamnocalamus spathiflora* were collected from Garhwal region. The collected material of these species have been planted at Hill Bambusetum, Khirshu, Pauri Garhwal. Germplasm Bank of *Dendrocalamus strictus*. The collection of germplasm from different areas of Uttarakhand, Rajasthan, Chandigarh, Himachal Pradesh and Kanpur was done and the planting material was planted in gunny bags and maintained in Plant Physiology Glass house premises. The already collected planting material of *D. strictus* have been field planted at Pavilion Ground of FRI New Forest Campus, Dehradun. The bamboo clonal nursery was inaugurated by Dr. S.S. Negi, Director, FRI, Dehradun. The planting stock is prepared in Physiology glass house premises and transferred to nursery at City Campus, Dehradun. One week training was organised at Clonal Nursery, City Centre, Dehradun for the Forest Officers of Uttarakhand Forest Department.

Project 22: Development of Genetically Superior Planting Material and cultivation technology for increasing productivity of *Jatropha curcas* [DBT Funded] [FRI-286/Silva-23/External/2005-09]

Status: A demonstration plantation of 20 ha was established at Srinagar Garhwal using four accessions with more than 35% oil content. Germplasm bank was maintained. Plants of selected CPTs (produced from seeds and cuttings) were maintained in the nursery for establishing seed orchard, progeny trial, clonal trial and vegetative multiplication garden. Seeds were collected from 149 accessions throughout Uttarakhand and sent for oil analysis and germplasm conservation to agencies authorized by funding agency. About 60 kg seed with more than 33% oil content were collected and supplied to DBT for network trials and demonstration plantations.

Germination studies on effect of storage conditions (i.e. temperature, moisture content) and storage duration were completed.

Project 23: Field Evaluation of Superior Germplasm of *Jatropha curcas* in Uttarakhand as a part of Multilocation Trial (DBT funded) [FRI-440/Silva-41/External/2007-09]

Status: Multilocation trial located at Premnagar, Dehradun 30 20′ 15"N latitude, 77 57′ 40" longitude, 600 m altitude was taken up as per the guidelines issued by funding agency. Quarterly data of growth are being taken. Weekly weather data was collected. Another multilocation trial of ten more accessions was established at Raipur. Seeds of 19 accessions were received from DBT network and seedlings were raised in nursery for establishing half-sib progeny trial.

Project 24: Genetic Improvement of *Jatropha curcas* for Adaptability and Oil Yield [CSIR funded] [FRI-293/Silva-24/External/2005-10]

Status: Maintained the field trial of elite and native accessions of Jatropha at Etah, Uttar Pradesh. Collected field data and identified best accessions for height, collar diameter, no. of

branches and seed yield. Maintained the field trials at Dehradun to standardise spacing, irrigation, fertiliser and pollarding regimes and collected their data.

Project 25: Eco-restoration and Conservation initiatives in the Garhwal Himalayas [428/Ext-01/External/2008-11]

Status: People of rural community in Project area are interacted to know their views on species preference and they are motivated for plantation on community land. Site selection completed. Seedling of different species is procured from Silviculture Division to plant in project area. One thousand five hundred plants of different species have been planted in project area in mansoon season of year 2008 and winter plantation of 1100 Akhrot (*Juglens regia*) plants has been done.

Project 26: Genetic improvement and conservation of different genetic resources of some economically more important bamboo species of North-eastern India (Project funded by MOEF to RFRI Jorhat and partly sent to FRI) [FRI-417/C&P-20/External/2008-10]

Status: Two hundred forty nine clones of bamboo were received for studies on anatomical and chemical characteristics. One hundred clones were analysed for chemical composition and anatomical features.

Project 27: Utilization of natural fibres of Uttarakhand region and natural dye waste for production of handmade paper KVIC Uttarakhand [Funded by Khadi Gramodyog Uttarakhand]

Status: A meeting was arranged in FRI, Dehradun with Khadi & Village Industries Commission and Uttarakhand Khadi Village Board, Dehradun to explore the possibility of using natural grass of Uttarakhand for handmade paper. Natural grasses are yet to be supplied by Uttarakhand Khadi Village Board, Dehradun.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Population genetic analysis and characterization of *Cedrus deodara* germplasm through DNA based markers [FRI 465/G&TP-24/2008-11]

Status: Methodology for the collection of samples and related parameters finalized in consultation with HFRI, Shimla. Available SSR markers on deodar were collected through available literature. Ten sets of SSR primers got synthesized and have been tested in deodar. Needle samples collected from twenty sources (1000 samples) representing Uttarakhand and Himachal Pradesh. DNA extraction protocol standardized. DNA extracted from 1400 samples of seven sources.

Project 2: Genetic evaluation and characterization of different clones for higher productivity and hybridization in *Dalbergia sissoo* [FRI-464/G&TP-23/April 2008 - March 11]

Status: Clonal trials of *D. sissoo* were taken up at two locations. Observations of clonal trials on various morphometric traits were recorded. Root suckers of second-generation selection from the clonal seed orchard of Hoshiarpur were collected for their multiplication. The

germplasm in vegetative multiplication garden coppiced and cuttings obtained from coppice shoots were kept for their propagation in the mist chamber for rooting.

Project 3: Germplasm collection, evaluation and planting of Jatropha and Karanj for improved productivity and higher yield content [FRI-448/G&TP-24/November 2008 to October 11]

Status: Plantations of *Pongamia pinnata* in the states of Uttarakhand and Uttar Pradesh were surveyed. A total of 84 candidate plus trees were marked. Nursery has been made ready for rooting of cuttings and raising of seedlings of desired genotypes.

Project 4: Development of cost effective housing by using pole structures [FRI-454/ ENGG-01/2008-10]

Status: To achieve a proper jointing system for joining round poles with side members as round pole, ply (shuttering grade) and wooden fish plate, a total of 158 structural joints were fabricated with metallic bolt & M.S. washers and got tested. Shutter grade ply found unsuitable to join with pole. A building plan for a moderate in expensive pole house was designed and developed.

Project 5: Exploration of diversity in *Ganoderma lucidum* and its conservation with special emphasis on its medicinal uses [FRI-456/PATH-30–Plan/2008-11]

Status: Specimens of 63 fruiting bodies of *G. lucidum* were collected from Delhi (NCR), Haryana, Punjab, Uttar Pradesh and Uttarakhand on 18 host tree species and 55 have been brought into pure culture. Morphological variations were studied for 40 specimens showing 11 sessile forms, 20 stipitate forms, 5 sub-stipitate forms, 2 imbricate forms and 2 immature forms. Anatomical variation in cuticle structure showed 31 forms with Characoderma and 9 forms with hymenioderma and context was hard in 28 forms and spongy in 12 forms. Variation in cultural characters has been studied in 14 isolates indicating three growth forms fast (7 cm in a week), moderate (6.0-6.2 cm per week) and slow (4.5 – 5.5 cm per week). Extraction of polysaccharides from the fruiting bodies of *G. lucidum* revealed glucose, galactose, arabinose and xylose sugars. DNA analysis of 10 isolates of *G. lucidum* was done using Rfu-18 and Rfu-23 primers. Rfu-23 primer gave maximum 38 bands comprising 25 polymorphic bands, 3 clusters and 4 outliers.

Project 6: Studies on natural resistance of imported woods against insects and decay fungi in Indian environment FRI, component of IWST collaborated project

Status: Seven imported wood samples were put to Accelerated Laboratory Tests for natural decay resistance namely. Teak (*Tectona grandis*) origin Tanzania, (II), Beech (*Fagus grandifolia*) origin France, Honnai Origin Indonesia, Teak (*Tectona grandis*) origin Australia, Ash (*Fraxinus americana*) origin France and Beech wood (*Fagus grandifolia*) origin Belgium using two white rot fungi *Pycnoporus sanguineus* and *Trametes versicolor* and two brown rot fungi *Gloeophyllum striatum* and *Oligoporus placentus*. The three samples of teak were highly resistant to all the test fungi, whereas samples of Honnai wood was not resistant to *P. sanguineus* and *G. straitum*, ash wood not resistant to *T. versicolor* and *O. placentus*, beech wood from France not resistant to *O. placentus* and beech wood sample from Belgium was not resistant to both the brown rot fungi.

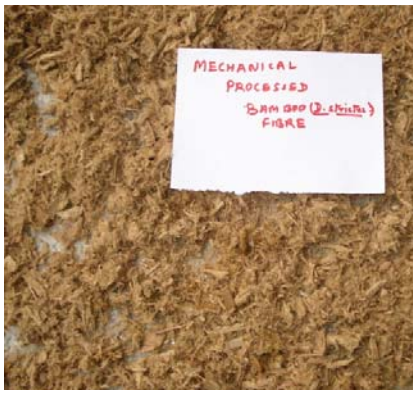
Project 7: To improve white rot fungus strains accessibility in Bamboo for better delignification through mechanical process [FRI-451/C&P-21/2008-11]

Status: Raw material of Bamboo (*Dendrocalamus strictus*) was collected from Forest Research Institute, Dehradun. The bamboos were chipped and chips were air dried to the moisture

content (10-12%). Bamboo chips were processed through mechanical operation to increase surface area for better treatment. Bamboo and destructured chips were characterized for chemical composition, viz. ash content, hot water solubility, cold water solubility, 1% NaOH solubility, Alcohol-Benzene solubility, Klason lignin, Holocellulose, á-Cellulose, pentosans by standard TAPPI method.

Mechanical processing of chips

Bamboo chips



Mechanically processed destructured chips

Pure Cultures of Fungi *Schizophyllum commune* and *Coriolus versicolor* were obtained from Pathology Lab (F.R.I), Dehradun. Sub-culturing of fungal culture was carried out on Agar Slants, time to time, to maintain cultures for future use. Fungi were allowed to grow on Potato Dextrose Agar media in a Petri dish for a different time periods at an optimum temperature and humidity. Culture was transferred from PDA Plate to Broth Medium in a flask to obtain loosely held Mycelium.

Project 8: Studies on the Termites of Family Termitidae (Insecta: Isoptera), with special emphasis on their taxonomic status, identity and distribution [FRI-455/Fed-19/2008-10]

Status: Taxonomic status of the twelve termite species has been discussed. A series of the collection of the twelve termite species was studied, morphometric measurements were taken and slides were prepared for morphological variations, original description of the species were consulted and wherever required 'type' specimens were also studied.

Project No.9: Studies on natural dyes from *Tagetes minuta* and *Terminalia chebula* [FRI-452/Chem-27/2008-10]

Status: *Tagetes minuta* (aerial parts) and *Terminalia chebula* (fruits, wood, bark and roots) were collected. Conditions w.r.t. time, material to liquor ratio and temperatures were optimized for the isolation of dye from the aerial parts of *Tagets minuta* and fruit pericarp of *Terminalia chebula*. Dyeing trials on silk, wool and cotton using the isolated dyes were also done. The colour fastness properties & CIELAB values of the dyed fabrics were determined. Petroleum ether, acetone and methanol extracts of the plant material were also prepared for their chemical examination. The essential oil isolated from aerial parts was analyzed by GC-MS.

Project No.10: Studies on the pectin substances from the fruits of *Diospyros peregrina* [FRI-453/Chem-28/2008-11]

Status: Fruits of *Diospyros peregrina* were collected and deepfreezed at -20^{O}C to impede endogenous enzymes activity. Cell wall polysaccharides were isolated at -20^{O}C as acetone insoluble solids using homogenizer at ~ 50,000 rpm. Pectin hydrolysing enzymes present in the cell sap degrade pectins in cell wall on extraction. For extraction and chemical characterization of pectins in cell wall preparations removal of endogenous activity is necessary.

Reactions were carried out to remove the activity of pectin hydrolysing enzymes viz. pectinesterase, polygalactouranase before separating cell wall polysaccharides. Pectin fraction was isolated using CDTA and sodium carbonate.

Project 11: Wood quality assessment of selected candidates of *Eucalyptus tereticornis* of Australian origin [FRI-308/FPD(WS)-53/2008-11]

Status: Mechanical testing of 16 superior phenotypes of *Eucalyptus tereticornis* has been completed and also FTNIR spectra of same specimens was generated. Chemical estimation of 16 phenotypes was also done.

Project 12: Health assessment of logs and converted timbers by vibration techniques [FRI-458/FPD(TM)-70/2008-11]

Status: Log of *Eucalyptus* spp. was converted into plank/sticks and testing of samples for the measurement of ultrasonic velocity and strength properties is under progress and visual observations of logs for defect detection is also in progress.

Project 13: Development of Phenol- Urea-Formaldehyde (PUF) wood adhesives [FRI-461/FPD(CW)-73/April 2008-March 11]

Status: Peeling of logs were carried out to get the veneers from Poplar and Sal. Preliminary experimental trials were carried out.

Project 14: Development of quality wood composite from lops and tops of mixed plantation species [FRI-460/FPD(CW)-72/April 2008-March 11]

Status: Particle preparation from lops and tops of Eucalyptus and Poplar were carried out. Preliminary experimental trials were carried out.

Project 15: Fabrication and performance study of vacuum based wood dryer for fast and efficient drying of timbers [FRI-462/FPD(WS)-74/2008-12]

Status: A vacuum based kiln was indigenously designed and fabricated. The kiln has been installed at the Wood Seasoning Discipline, FRI, Dehradun.

Project 16: Development of treatment technology for commercially important difficult to treat species [FRI-463/FPD(WP)-75/2008-11]

Status: Eucalyptus samples were pretreated with different pretreatments i.e. steaming, hot water, incising (5mm and 10mm) and then, treated with CCA, CCB, Borax-Boric and ZiBOC preservatives at 4% and 8% concentration by Diffusion and Pressure treatment methods. Hot water treatment followed by pressure treatment has shown encouraging results.

Project 17: Studies on the natural resistance of imported woods against insects and decay fungi in Indian environment [IWST, ICFRE funded project]

Status: Samples received from IWST, Bangaluru were installed at Timber test yard, Dehradun. First quarterly information shows very slight termite attack on few samples.

Project 18 : Digitization of Herbarium (Dehradun Herbarium) of Forest Research Institute [FRI-450/Bot-60/2008-13]

Status: One hundred seventy six genera, 1129 species and 4678 specimen details have been entered into the database. Seven thousand four hundred eighteen photographs of plant specimens have been taken and edited.

Project 19: Taxonomic and Anatomical studies of Exotic Pinus species [FRI-445/Bot-63/2008-11]

Status: Collection of Herbarium material and wood samples carried for eleven species of exotic pines. Their taxonomic and wood anatomical studies are well underway.

Project 20: Fluorescent studies of Indian Woods [FRI-447/Bot-65/2008-11]

Status: Three hundred fifty species were studied for their ultraviolet properties.

Project 21: Inheritance pattern of wood anatomical traits in *Populus deltoides* Bartr. ex Marsh [FRI-446/Bot-64/2008-11]

Status: The project was initiated in April 2008. In the project samples of the parents and offsprings of F_1 generation of *Populus deltoides* were collected from the field. Quantitative data on the dimensions of wood elements viz. fibre and vessel dimensions were collected from the macerated wood samples. Moreover, specific gravity was also determined for the samples of parent trees.

Project 22: Field evaluation of tissue culture plants of *Eucalyptus* hybrids at seven agro-climatic sites [FRI-448/Bot-66/2008-11]

Status: The first year of this ongoing project is completed and observations are as follows. The tissue culture raised plants of *Eucalyptus* hybrids FRI-5 and 14 are in fifth year of age at Dehradun, Hissar, Hoshiarpur, Haldwani, Pantnagar, Meerut and Jodhpur. Field maintenance and collection of field data like plant height, Clear Bole Length (CBL), diameter at breast height (dbh), branch angle etc were completed. The results across the sites shows that the plants of FRI-5 and FRI-14 were tallest at Haldwani (18.6 m) and Hoshiarpur (14.1 m) respectively, while thickest dbh at Pantnagar (15.6 cm) and Hoshiarpur (15.0) respectively. Also plants of FRI-5 and FRI-14 had clear bole at Haldwani (7.4m) and Pantnagar (5.3m) respectively. The branch angle of FRI-5 and FRI-14 was in range of 45^0 - 60^0 and 60^0 – 90^0. On Hoshiarpur and Dehradun site FRI-14 were taller and dbh was thicker than FRI-5 where as at Pantnagar site the result was in contrast. At all these sites where both FRI-5 and FRI-14 were present, FRI-14 had most clear bole.

Project 23: Impact of ban on green felling in Deodar, Blue Pine, Fir and Spruce forests in Uttarakhand [FRI-/Silvi-390/RSM-18/2008-11]

Status: The project area was surveyed and data recorded on the plots prescribed for felling in 1980s. The data was recorded from the compartments of Deodar, Spruce, Fir and Blue Pine forests, which were actually felled and unfelled coupes under Chakrata, Uttarkashi and Badrinath forest divisions. The field data were collected from Chakrata and Uttarkashi forest divisions.

Project 24: Silviculture studies on *Hippophae salicifolia* -A wonder lesser known plant of Uttarakhand [FRI-322/Silvi-26/2008-11]

Status: Survey was conducted on natural population of *Hippophae salicifolia* in Uttarkashi and Chamoli distt. The seeds of *Hippophae salicifolia* were colleted in two different seasons (October and February). Germination studies of *H. salicifolia* was initiated in field and laboratory condition. Experiment was carried out to study the effect of light and temperature on seeds of *Hippophae salicifolia*. Introduction trial was initiated to see the performance of *H. salicifolia* at Chakrata nursery.

H. salicifolia

H. tibetiana

Project 25: Enhancement of seed longevity of *Diploknema butyracea* [FRI-466/Silvi-42/2008-12]

Status: The literature of *Diploknema butyracea* on distribution of natural population and their phenology (flowering and fruiting), ripening/maturation, biology, longevity, viability, vigour, storability and nursery technique of species were consulted. Survey conducted in Pithoragarh Forest Division for locating the population of *D. butyracea*. Fruits of *D. butyracea* were collected from Harkante population, Gurna beat, Pithoragarh Forest Division. Fruits were extracted and processed in Laboratory. Moisture contents, purity and weight of seed were determined. Morphological traits of seed were recorded. Germination, viability and vigour of seed were assessed. Sowing of seeds in nursery was done and selected the sites for soil sampling from natural population. Observations of growth parameters of seedlings were recorded.

EXTERNALLY AIDED PROJECT

Project 1: Second National Communication to UNFCCC

Status: This project is a part of the Second National Communication (SNC) of India to UNFCCC for the estimation of soil carbon stock in forest soil under different species, and forest type over the period from 1995 to 2007 and for assessment of soil carbon dynamics due to land use change from forest to non-forest and vice versa in key forest types. Soil samples were collected from different forest subtypes located in Uttarakhand, U P, Punjab, Haryana, Delhi and Chandigarh. Soil samples for soil organic carbon, bulk density and coarse fragments from 28 forests subtypes (three samples from each forest subtypes as replicates) were collected and analysed for above mentioned attributes. Ten sites in non-forest area adjacent to forest subtypes were also collected for similar attributes and analysed.

PROGRESS OF VAN VIGYAN KENDRAS AND DEMO VILLAGE (2008-2009)

Establishment of Van Vigyan Kendras (VVK)

Status: Total 5 Van Vigyan Kendras (VVK) have been established and nodal officers appointed and ten trainings conducted for farmers/ foresters in the States/UT's under the jurisdiction of FRI.

- In Punjab, VVK at Hoshiarpur established on 4th August 2008. Nodal Officer, Shri R.K. Luna, appointed.
- In Haryana VVK at Pinjore established on 25th August 2008. Nodal Officer, Shri K.S.Chauhan, CCF (Res. & Trg.), appointed.

- In Uttarakhand at Haldwani on 22nd September 2008, Nodal Officer, Shri S.K. Dutta, CCF & Director, Forest Training Academy, Haldwani (Res. & Trg.), Haryana.
- In U.T. Chandigarh at the Botanical Garden and Nature Park on 20th October 2008, Nodal Officer, Shri Ishwar Singh, CF, Department of Forests, Chandigarh Administration.
- In NCT Delhi at Hauzrani City Forests near Saket in Delhi on 15th December 2008, Nodal Officer, Smt. Kamalpreet Kaur, DCF, Department of Forests & Wildlife, Govt. of NCT of Delhi.

MOU have also been signed between FRI and the SFDs for each Van Vigyan Kendra i.e. Punjab, Haryana, Uttarakhand, UT of Chandigarh and Delhi.

As for the establishment of model nursery under the VVK's, sites have been finalized and initial work on the establishment has been taken up at Pinjore and Chandigarh.

The exhibits of FRI innovations, important technologies developed are displayed in the VVKs in Hindi and English and extension material i.e. publications, pamphlets, reports etc. related to forestry are also placed in the VVKs for the visitors.

DEMO VILLAGE

Status: One Demo Village has been established at Shyampur, P.O. Ambiwala, Dehradun and a memorandum of understanding has been signed between FRI and M/s Bhagwan Gram Udhyog Samiti, Shyampur in January 2008.

Various divisions of FRI have been associated in the development of a Demo Village at Shyampur i.e. Silviculture, Non-Wood Forest Products, Chemistry, Pathology, Entomology and Extension Division. The following structures have been developed:

- Low cost mist chamber
- Green house
- Propagation unit
- Water tank with complete fittings
- Mounted angle iron stands
- Root trainers
- Preparation of nursery beds
- Covered seed drying plateform
- Vermicompost under construction.

The following works have been undertaken in the Demo Village at Shyampur:

- Four thousand plant saplings have been raised
- One thousand five hundred seedlings were distributed amongst the villagers
- Two training programmes have been conducted for the farmers.

NATIONAL FOREST LIBRARY AND INFORMATION CENTRE

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

readable database, etc. to its users. During the year, a total 33,358 books were loaned to the users for outside reading. Besides, 70,284 documents were consulted inside the library.

The document collection of the NFLIC was enriched by the addition of 3,167 books and other documents. The NFLIC subscribed to 110 Indian and 114 foreign periodical titles at a cost of about Rs.78 lakh. It also received about 350 periodical titles gratis.

The NFLIC has been selling ICFRE publications through its Book Depot. During the year, 555 books and 38 VCDs were sold to the state forest departments, universities etc.

The Ministry of Environment and Forests, Govt. of India has established an ENVIS Centre on Forestry at the NFLIC. The Centre, during the year, enriched the following Forest database by the addition to new references: Indian Forestry Abstracts, Participatory Forest Management, *Prosopis juliflora*, Poplars, Forests and Environment in Press, Current Forestry Literature, which are accessible through the website of the centre having URL: www.frienvis.nic.in. Besides, the contents pages of journals, forest cover of India, state wise and then district wise, announcements of forthcoming national and international conferences, seminars, symposia, training course were also put up on the website.

Publications: The ENVIS Centre on Forestry published the following publications during the year:

ENVIS Forestry Bulletin: Two special issues of the bulletin on Forest Seed Science and Technology, and Forestry Statistics were published.

Environment and Forests News Digest: Six issues of the Digest for 12 months were published.

FOREST RESEARCH INSTITUTE UNIVERSITY

Forest Research Institute, Dehradun was conferred the status of 'University' by the Ministry of Human Resource Development, Government of India, New Delhi vide Notification No. F.9.25/89 U-3 dated 6th December 1991. In pursuance of the UGC Notification No. F.6-1 (II)/ 2006 (CPP-I) dated the 13.09.2006, the name of Forest Research Institute Deemed University is changed as Forest Research Institute University (Established under section 3 of the UGC act 1956 vide Notification No. F.9-25/89 U-3 dated 6th December 1991).

Academic Courses and Admission

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

(1) M.Sc. Forestry – 2 years duration

(2) M.Sc. Environment Management – 2 years duration

(3) M.Sc. Wood Science & Technology – 2 years duration

(4) Post Masters Diploma in Natural Resource Management – 1 year duration

(5) Post Masters Diploma in Non Wood Forest Products – 1 year duration

(6) Post Graduate Diploma in Pulp & Paper Technology – 1 year duration

Admissions to the above courses are made on the basis of a candidate's performance in all India Competitive Entrance Test.

During the year 2008-09, 102 students were admitted in all the above six courses for the academic session 2008-10 and 2008-09 respectively.

Industrial/Institutional Attachment and Dissertation work

All India based different industries and institutes were approached for the Industrial attachment in December and for Dissertation work/project work from 1st April to 31st May.

All the students of M.Sc. courses were sent to one month industrial attachment to different industries/organizations in December. M.Sc., PMD and PGD students completed their dissertation/project work on specific topic relevant to their subjects.

TECHNOLOGY ASSESSED AND TRANSFERRED

Eighteen gene sequences of internal transcribed spacer of different isolates of fungus *Cylindrocladium quinqueseptatum* submitted to NCBI (http//www.ncbi.nlm.nih.gov) were incorporated in gene bank and accession numbers were allotted.

Three Beta tubulin gene sequences of different isolates of fungus *Cylindrocladium quinqueseptatum* submitted to NCBI (http//www.ncbi.nlm.nih.gov) were incorporated in gene bank and accession numbers were allotted.

1. "A black hair dye composition and a process for preparation thereof" transferred to M/s Mythili's Agro and Nature Care Private Limited, Chennai (License fee Rs. 5.00 Lakhs) by Chemistry Division.
2. One Solar kilns was installed for M/s Haryana Forest Development Corporation at Pipli.
3. The dissemination of technology of clonal development has been made during various programmes of FRI from time to time.
4. Protocol developed for *Swertia chirata* – new technology.
5. The Institute demonstrated the methods for management of diseases and deterioration of bamboo and the preparation of fungicidal solution, spraying and seed treatment to officials of State Forest Departments, farmers and private growers of Chandigarh, Delhi, Haryana, Punjab and Uttarakhand in respective Van Vigyan Kendras.

EDUCATION AND TRAINING

Trainings

Conducted

1. A summer school on the topic "Recent trends on modern biology and biotechnology" for teachers and research scholars of Uttarakhand state from 18th to 29th August 2008.
2. A short-term training for the officials of Punjab Forest Department on the topic "Clonal forestry for higher economic returns" from 11th to 17th November 2008.
3. Training on hands-on training course on harvesting and value addition of medicinal plants for farmers from Shyampur Village from January 27th to 30th 2009.
4. Application of Geoinformatics and Bioinformatics in Forestry' was organized from 11th to 17th November 2008 at Uttarakhand Space Application Centre, Dehradun, for scientists of different disciplines.
5. Applications and Operation of Remote Sensing & GIS Software (ERDAS Imaging 9.3)' was organized from 16th to 20th February 2009 at Division of Bioinformatics and GIS, FRI for scientists of FRI.

6. Applications and Operation of Remote Sensing & GIS Software (ArcInfo 9.3)' was organized from 2nd to 6th March 2009 at Division of Bioinformatics and GIS, FRI for scientists of FRI.

7. Training on Improved Seed & Nursery Technology from 22nd to 26th September 2008.

8. Training on Capacity Building of Communities involved in Sustainable Forest Management under "DEFRA" Project from 17th to 23rd January 2009 at FRI Dehradun.

9. A training on Forest Fire Mitigation & Management from 16th to 20th February 2009.

10. Training on Bamboo Development for field staff of Himachal Pradesh Forest Department from16th to 20th June 2008.

11. A training programme on Medicinal Plant Nursery Raising Technique was organized in Shatabdi Van Vigyan Kendra from 8th to 12th September 2008 for villagers.

12. The Forest Research Institute with the cooperation of Bagwan Gram Udhyog Samiti organized training on Medicinal Plants at village, Shyampur from 8th to 12th December 2008.

13. A training programme in the Demo Village on "Nursery & Plantation Technology of Forestry & Medicinal Plants" at Ambiwala, Shyampur Prem Nagar form 18th to 21st February 2009.

14. A short term training course on "Classification, Grading and Inspection of Timber" from 3rd to 7th November 2008 which was attended by participants from Naval Dockyard Mumbai.

15. Short term training on "Plywood Manufacture" from 4th to 8th August 2008 and participants from different wood based industries participated.

16. A training was conducted on Development of Bamboo nurseries, propagation, and seasoning of bamboo at Shatabdi Van Vigyan Kendra, City Centre, FRI from 7th to 11th April 2008 for Farmers and SFDs field staff and Horticulture Department of Rajasthan, from 19th to 23rd May 2008 for farmers and SFDs field staff of Uttarakhand and from 23rd to 27th June 2008 for farmers and SFDs field staff and agriculture staff of J. & K.

17. A training on Medicinal Plants from 8th to 12th September 2008 was conducted at Shatabdi Van Vigyan Kendra, City Centre, FRI for farmers of Uttarakhand.

18. Five trainings each of five days, were conducted at VVK of Punjab, Haryana, Uttarakhand, NCT Delhi and UT Chandigarh in 2008 on "Awareness Programme on Forestry Research & its Utilization".

19. Five trainings each of five days, were conducted at VVK of Punjab, Haryana, Uttarakhand, NCT Delhi and UT Chandigarh in 2009 on "Propagation, Utilization and Protection of Bamboos".

20. Training on 'Methods for Preparation of Natural Dyes' to the farmers and NGO members was imparted by Shri Rakesh Kumar on 11th December 2008 and 19th February 2009 at Model Village, Shyampur.

Attended

1. Applications of Geoinformatics and Bioinformatics in Forestry at Uttarakhand Space Application Centre, Department of Science and Technology (Govt. of Uttarakhand) from 11th to 17th November 2008.

2. "General Management programme for Senior scientists" from 28th July to 8th August 2008 at Administrative Staff College of India, Bella Vista, Hyderabad.
3. "Eco-tourism vis-à-vis Conservation of Forests" from 20th to 27th September 2008 at JL&R, Bangaluru.
4. 'Statistical Techniques for Research Methodology" 26th December to 7th January at IASRI, New Delhi.
5. Basic Forestry at SFS College Dehradun from 15th December 2008 to 23rd January 2009.
6. 'Geomatics in Disaster Management' on 2nd and 3rd February 2009, organised by Indian Society of Geomatics, Ahmedabad, at IIRS Campus, Dehradun.
7. Participatory Management of watershed project for sustainable livelihood. National Institute of Rural Development Rajendranagar, Hyderabad during 18th to 23rd August 2008.
8. "Standard Operating Procedures for Export Inspection and Phytosanitary Certification. Training organised by National Plant Quarantine Station (NPQS), Rangpuri, New Delhi from 22nd to 26th September 2008.
9. Research Management & Administration from 9th to 13th March at ASCI, Hyderabad.
10. Decision Support Tools & Techniques (Sponsored by Department of Science & Technology, Govt. of India) at Administrative Staff College of India (Hyderabad) from 26th to 28th April 2008.
11. "Evaluation of Trainings" at Uttarakhand Administrative Academy, Nainital from 13th to 17th October 2008.
12. "Advances in Forestry Research and Development" at National Centre for Research on Agroforestry, Jhansi from 24th November to 5th December 2008.

LINKAGES & COLLABORATION

The Institute established linkages and active collaboration with the following organizations:

1. Collaboration with NDMC, New Delhi, State Forest Departments, ICFRE Institutes, Universities, Farmers, NGOs, Bodhgaya Temple Management Committee, Archaeological Survey of India, private entrepreneurs and wood based industries.
2. Collaboration with Central Pulp and Paper Research Institutes, Saharanpur, Saurashtra University, Rajkot, Gujarat, Kurukshetra University, Kurukshetra, Haryana, E.P. Industries, Hyderabad.
3. Collaboration with Uttarakhand Space Application Centre, Indian Institute of Remote Sensing, Indian Space Research Organization and Forest Survey of India.
4. The New Forest meterological data was used by Uttarakhand Irrigation Department, IMA, PWD, Forest Deptt., Researchers of Forest Research Institute and other Organisations/ Universities, State Forest Departments, G.B. Pant Institute of Himalayan Environment and Development, Almora, Department of Atomic Energy, Govt. of India, Mumbai, Space Application Centre (ISRO), Ahmedabad, M/s Faridabad Gurgaon Mineral, New Delhi, Indian Meteorological Department, Poona, DDA, New Delhi, Survey of India, Dehradun.

5. MoU for the use of natural dyes was signed between Forest Research Institute, Dehradun and Uttarakhand Khadi & Village Industries Board on 15th October 2007.
6. A joint project of SKVIB and FRI is being carried out on Project entitled "Identification, Development and Utilization of Natural Dyes from Forest Plants/ Weeds and Agricultural Waste".
7. Linkage and collaboration was developed with H.N.B. Garwal University, Pantnagar University and Allahabad University.
8. Linkage was developed with Managing Director, Uttarakhand Forest Development Corporation, Dehradun.
9. Linkage was developed with Managing Director, State Forest Development Corporation, J &K.
10. Linkages and collaboration was establishment with Uttarakhand, Delhi, Haryana, Punjab and Uttar Pradesh Forest Departments under various on going projects of the division. Under the project on Jatropha funded by DBT, work on multilocation trial of the species is being carried out in collaboration with High Altitude Plan Physiology Research Centre (HAPPRC), Garhwal University, Srinagar. Germplasm is being exchanged with the partner institutes i.e. M.S. Swaminathan Research Foundation, Chennai, NBRI Lucknow, Biotech Park Lucknow and PDKV Akola for establishing the multilocation trial of *Jatropha curcas* under the project. Collaboration was also made with Delhi Govt. for establishment of arboretum, bambusetum and raising of plants for commonwealth games.
11. Linkage and collaboration was also developed with :
    1. Max India, Roper.
    2. M/s Chambal Fertilizer and Chemicals Ltd., Kota, Rajasthan.
    3. M/s Southern Cooling Tower Pvt. Ltd., Kolkata.
    4. M/s Hindustan Petroleum Corporation Ltd., Mumbai.
    5. M/s Cunningham Lindsey International Pvt. Ltd., Mumbai.
    6. Housing Board Haryana, Dharuhera.
    7. Naval Dockyard, Mumbai: A short term training was given to their officials.
    8. Department of Fertilizers, Ministry of Chemical & Fertilizers, New Delhi.
    9. M/s Gujarat Narmada Valley Fertilizers Co. Ltd., Distt. Bhurach, Gujarat.
    10. M/s National Fertilizers Limited, Vijaipur, Guna, (M.P.).
    11. M/s IFFCO, Aonla Unit, Aonla, Bareilly, UP.
    12. M/s IFFCO, Phulpur Unit, P.O. Ghiya Nagar, Allahabad.
    13. M/s IFFCO, Kalol Unit, Distt. Gandhi Nagar, Gujarat.
    14. M/s Deepak Fertilizers & Petrochemicals Co. Ltd., Raigarh.
    15. M/s Indo Gulf Fertilizers, Distt. -Sultanpur, UP.
    16. M/s KRIBHCO, Kribhco Nagar, Surat.
    17. M/s KRIBHCO, Shyam Fertilizers, Shahjanpur, U.P.
    18. M/s Reliance Infra-structure Ltd., Zurinagar, Goa.
    19. Central Engineering Services, Jam Nagar, Gujarat.

20. M/s Reliance Industries Ltd., Patalganaga, Maharashtra.
21. M/s DCM Shriram Consolidated Ltd., Kota Rajasthan.
22. M/s Rashrtiya Chemicals & Fertilizers Ltd., Chembur, Mumbai.
23. M/s Creation Cooling Towers, Distt. Vadodra, Gujarat.
24. M/s Pharpur Cooling Towers Ltd., Kolkata.
25. M/s Paltech Cooling Tower & Equip. Ltd., Gurgaon, Haryana.
26. M/s Gamon Cooling tower Ltd., Mumbai.
27. M/s Koolaqa Tower Pvt. Ltd., Kolkata.
28. M/s Hamon Shri Ram Cottrell Pvt. Ltd., Mumbai.
29. M/s Chembond Drewtraet Ltd., New Delhi.
30. M/s Drew Australia Pvt. Ltd., New Australia.
31. M/s NOVACHEM, Ratanda, Jodhpur.
32. Tripura Forest Development, Agartala.
33. New Zealand High Commission, New Delhi.
34. M/s Madras Fertilizers Ltd., Chennai.
35. M/s National Fertilzers Ltd., Punjab.
36. M/s GE India Industrial Pvt. Ltd., Manglore.
37. M/s A& A Modular System, Mohali, Punjab.
38. Melfrank Engineers, Mumbai.
39. AE (Civil), AGE B/R Ranikhet, Ranikhet.
40. NIT Jalandher.
41. TIFAC, New Delhi.
42. IPIRTI, Bangaluru.

PUBLICATIONS

Books

1. Sangeeta Gupta, 2008. 'Atlas of Indian Hardwoods- their photomicrographs and Anatomical features', FRI publication, Dehradun. Reference Book.
2. Manisha Agrawal & Sangeeta Gupta, 2008. 'Wood Anatomy of Sapindales. Bishen Singh Mahendra Pal Singh, Dehradun. Reference Book.
3. Seed Manual Booklet.

Brochure

Nautiyal, S. and Mishra, A. 2008. चारा पत्ती एवं जलाऊ लकड़ी के वृक्षों की उत्तम किस्म की पौध तैयार करने के लिए पौधशाला की स्थापना।

Newsletters

Non-Wood Forest Product Division published two quarterly Newsletters one entitled "Market Information on Medicinal Plants" and another titled "Market Prices of Farm Grown/ Agroforestry Wood in Punjab".

Bulletins

1. Kaushik, S.; Singh, Y.P.; Kumar, D. and M. Thapliyal (eds.), 2008. Forest Seed Science and Technology Special, 8(1). Dehradun, ENVIS Forestry Centre. 119p.
2. Kaushik, S.; Singh, Y.P.; Kumar, D. and M. Thapliyal (eds.), 2008. Forestry Statistics Special, 8(2). Dehradun, ENVIS Forestry Centre. 84p.

Reports

1. A report on "Modified Conservation Plan for Flora, Fauna and Socio-economic Environment" of Rawghat Iron Ore Project funded by Steel Authority of India Limited (SAIL), Bhilai, Chhattisgarh was published.
2. A project completion report on "Effect of Pine and Oak Forest on Agriculture Crops" has been submitted to ICFRE.

CONSULTANCIES

1. To MoEF on National and International issues of forestry assigned by MoEF e.g. National Committee on Forest Certification, Sustainable Forest Management (SFM), National Working Plan Code Revision, Price fixation of timber for DGS&D supply.
2. Advisory Services to Planning Commission for Greening of Delhi.
3. To Ministry of Defence (Army), New Delhi-1, M/s Multiwal Papers Ltd, Kashipur-01 and M/s J.K. Papers Ltd, New Delhi-3 for Paper Testing of Samples.
4. To M/s American Connexions, Dehradun-4 ,Osmania University, Hyderabad-10 for Wood Sample Testing for Lignin and Holocellulose Content (8 tests).
5. To M/s Star Paper Mill, Saharanpur-2 for Wood sample testing for Moisture Content (2 test).
6. Advisory services provided to Bodhgaya Temple Management Committee for management of heritage tree Bodhi Vriksha.
7. Advisory services provided to Archaeological Survey of India for the management and conservation of trees at Ta Prohm Temple, Siem Reap, Cambodia.
8. Provided advisory services to Forest Department of Uttarakhand for Biostabilization of Varunavat landslide.
9. Provided advisory services to Tehri Hydro Development Corporation Ltd., Tehri for stabilization of left and right bank slopes of Koteshwar Hydro Electric Project with the help of suitable vegetation.
10. Provided advisory services to M/s Sterlite Industries Ltd., Tamil Nadu.
11. A consultancy project on "Preparation and Modification of Conservation Plan for Flora, Fauna and Socio-economic Environment" of Rawghat Iron Ore funded by Steel Authority of India Limited (SAIL), Bhilai, Chhattisgarh has been completed.
12. Consultancy has been provided to Haryana Forest Development Corporation Limited for Installation of a Solar Kiln at Pipli, Haryana Organization. Training on its operation has been imparted to the staff of HFDC.
13. Gave consultancy to M/s HPCL, Mumbai, regarding timber utilization on 14th and 15th May 2008.

14. Provided Consultancy to M/s Kolkatta Port Trust on Sal Timber.
15. Consultancy provided to various organizations on Wood Identification. Identified over 111 wood samples and reported.
16. Consultancy was provided to the Ministry of Rural Development, Govt of India, New Delhi and UNDP for preparation of "Forestry Works Manual of Uttarakhand" under NREGS (National Rural Employment Guarantee Scheme) and NAP (National Afforestation Programme).
17. Consultancy was provided to Department of Environment, Forest and Rural Affairs of UK for preparation of training Module on "Capacity Building of Communities Involved in Sustainable Forest Management."
18. Consultancy was provided to Delhi Govt. for establishment of Arboretum and Bambusetum.
19. Consultancy project was executed for Baseline survey and Social impact assessment of Renuka Dam Project of Himachal Pradesh.

PATENTS OBTAINED/FILED

1. "A process for the isolation of ursolic acid from *Eucalyptus* hybrid leaves" (Application No.361/Del/2009, dated 25/2/2009)
2. Patent on the new technology "Automized Boucherie method" filed.

WORKSHOPS/SEMINARS/CONFERENCES/SYMPOSIA

Attended

The representatives from FRI, Dehradun attended the Workshops/Seminars/Conferences/ Symposia as given below during the period under report:

International

1. "World Conference on Medicinal and Aromatic Plants (WOCMAP IV-2008) held at cape town, South Africa, 9th to 14th November 2008.
2. International Conference on current trends in Biotechnology and Implications in Agriculture held at Sardar Vallabh Bhai Patel University of Agriculture & Technology, Modipuram, Meerut from 19th to 21st February 2009.
3. International Biotechnology Seminar cum expedition/trade show 'Bangaluru Bio' from 24th to 26th April 2008 as part of delegation of Uttarakhand.
4. International Workshop on "Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood" from 15th to 17th April at New Delhi.
5. International Conclave on Medicinal Plants for ASEAN and BIMSTEC Countries held from 11th to 13th December 2008 at Imphal.
6. XXXI All India Botanical Conference and International Symposium on Plant Biology and Environment: Changing Scenario from 17th to 19th December 2008, Allahabad University, Allahabad, India.
7. International Conference on Entomology on 22nd and 23rd February 2009 in Dept. of Zoology, Punjabi University, Patiala.

8. World Biodiversity Congress at Chiang Mai, Thailand from 10th to 13 March 2009.
9. Second International Conference on Polymer Blends, Composites, Membranes, Polyelectrolytes and Gels: Macro to Nano scales (ICBC-2008)' held at School of Chemical Sciences, Mahatama Gandhi University, Kottayam, Kerala, India, from 22nd to 24th September 2008.
10. Asian Symposium on Medicinal Plants, Spices and Other Natural Products (ASOMPS), XIII organized by Indian Institute of Chemical Technology, Hyderabad from 3rd to 6th November 2008.
11. International Conference on New Developments in Drug Discovery from Natural Products and Traditional Medicines held at NIPER, Chandigarh from 16th to 20th November 2008.
12. 'International Conference on Molecular Biology and Biotechnology, from 19th to 21st October 2008 at Banasthali University, Banasthali and Rajasthan.

National

1. Symposium on "Phytochemistry and Ayurveda: Potential and Prospects" held at 1, Inder Road, Dehradun on 27th December 2008.
2. 'Biotech 2009: Present and future perspectives' at Punjabi University, Patiala on 19th and 20th March 2009.
3. National workshop on "Public Private Partnership in Forestry" on 23rd and 24th December 2008 at Vamnicone, Pune.
4. National workshop on "Sustainable Forestry Development and Forest Certification in India" from 22nd to 28th February 2009 at New Delhi.
5. Stakeholders' Workshop on Capacity Building of Communities involved in Sustainable Forest Management under DEFRA project on 28th July 2008 at FRI, Dehradun.
6. Third Science Congress of the UCOST at Roorkee on 10th and 11th November 2008.
7. National Seminar on Status of Biodiversity and conservation at Deptt. of Zoology & Environmental Sciences, Gurukula Kangri University, Haridwar on 27th and 28th February 2009.
8. National Symposium on Emerging Trends of Researches in Insect Pest Management and Environmental safety from 24th to 26th September 2008 at Haridwar.
9. National Conference 'Dhishana' 2008, Streamlining India's Traditional Knowledge towards formulating a Sui Generic Regime held from 23rd to 25th May 2008 at Trivandrum.
10. National Conference on Increasing Production and Productivity of Medicinal and Aromatic Plants through Traditional Practices from 18th to 20th September 2008, G.B. Pant Univ. Agri. and Tech., Pantnagar, Uttarakhand.
11. XXIII Carbohydrate Conference organized by Deptt. of Chemistry, Bhavnagar University, Bhavnager (Gujarat) and Association of Carbohydrate Chemists & Technologists (India) from 22nd to 24th January 2009.
12. National Symposium on Biofuels potential and challenges, at TFRI Jabalapur (M.P.) from 22nd to 24th February 2009.
13. 'Second Edusat Workshop' Organized by IIRS, Dehradun on 20th March 2009.

Exhibits of Cellulose & Paper Division, FRI, Dehradun

14. Exhibition on Hand Made Paper from weeds at Buyer & Seller meet organized by KVIC at Hotel Indralok, Dehradun from 3rd to 7th November 2008.
15. 'XX BTIS net Coordinators Meeting' organized by DBT, New Delhi at NEHU, Shillong on 3rd and 4th February 2009.
16. National Conference on Bamboos: Management, Conservation, Value addition and Promotions to be held at Jabalpur from 12th to 24th March 2008.
17. National Seminar on "Reclamation of Mined Lands of Coalfields" on 5th and 6th August 2008 at State Forest Research Institute, Jabalpur.
18. Symposium on Knowledge systems for ecosystem for ecosystem management and sustainable development, New Delhi from 24th to 28th August 2008.
19. Homi Bhabha Centenary DAE-BRNS National Symposium on "Landscaping for Sustainable Environment" on 20th and 21st November 2008 at BARC, Mumbai.
20. National Seminar on Climate Change: Data requirement and availability at Institute for Social and Economic Change, Bangaluru on 13th and 14th March 2009.
21. Workshop on "Avoided Deforestation Incentive Mechanism for States" at ICFRE, Dehradun on 23rd March 2009.
22. National Symposium on knowledge system for Ecosystem Management & Sustainable Development, NIE, New Delhi on 26th and 27th August 2008.
23. National Conference on Mass Instability and Earthquake Risk Management in Mountainous Regions. Challenger, Lessions learnt and Future Strategy. Disaster Mitigation and Management Centre, Uttarakhand on 27th and 28th June 2008.
24. Conference on "Emerging Trends of Research in Insect Pest Management and Environmental Safety" (organized by Uttar Pradesh Zoological Society, Muzaffarnagar) held at Haridwar from 24th to 26th September 2008.
25. Symposium on "Phytochemistry and Ayurveda: Potential and Prospects" Organized by Universities' Journal of Phytochemistry and Ayurvedic heights, Dehradun on 27th December 2008.
26. National Conference on Innovations in Drug Discovery and Research (NC-IDDR) Organized by Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala from 3rd to 5th March 2009.

27. National Symposium on Emerging Trends in Biomedical Sciences 2009, Organized by SBS (PG) Institute of Biomedical Sciences and Research, Dehradun on 27th and 28th February 2009.
28. "Sensitization program for committee members on prevention of sexual harassment at work place from 6th to 10th January 2009.
29. "Workshop on National Vegetation Carbon Pool Assessment Project (NCP-IGBP)" on 7th and 8th November 2008 at IIRS, Dehradun.
30. Summit on "Sustainable Development, Climate Change and Natural Resources Management: Status, Issues and Way Forward" (Uttarakhand Sustainable Development Summit) on 19th and 20th June 2008 at Dehradun.
31. 'Sensitization workshop on Resource Conserving Technologies' on 27th March 2009 at Central Soil and Water Conservation Research and Training Institute, Dehradun (Uttarakhand).
32. National Seminar on "Bamboo Plantation, Management and its Utilization" from 17th to 19th March 2009 at AFRI Jodhpur, Rajasthan.
33. "Celebration of Vaniki Mela" held at village Handesra, Mohali on 7th March 2009.
34. Twenty third Session of International Poplar Commission at Beijing, China from 26th to 29th October 2008.

Organized

1. A training-cum-workshop on "Farm forestry Extension and its Marketing" for Punjab Forest Department Officials and progressive farmers on 11th September 2008 at Punjab Agricultural University Campus, Ludhiana.
2. A meeting of National Steering Committee (NSC) on MAR-SFM, 7th April 2008 in New Delhi.
3. National Seminar (Geomatics 2009) on "Geomatics and Impact of Climate Change with Specific Reference to Mountain Ecosystems" from 4th to 6th February 2009 at FRI, Dehradun in collaboration with Uttarakhand Space Application Centre (USAC) Dehradun.
4. A meeting was organized by Uttarakhand Khadi & Village Industries Board, Dehradun to discuss the potential of natural fibre of Uttarakhand for hand made paper manufacturing on 26th February 2009 at FRI.

Meeting with Uttarakhand Khadi & Village Industries Board at FRI Board Room, Dehradun

5. One day "IPR Sensitization Workshop" in collaboration with Patent Information Centre, G.B. Pant University of Agriculture & Technology, Pantnagar under the aegis of PFC-TIFAC, Department of Science & Technology (Govt. of India) was organized at FRI on 14th July 2008.
6. National Workshop-cum-Training on "Application of Biodiversity Informatics in Forestry" on 24th and 25th February 2009 at FRI, Dehradun (Sponsored by Department of Biotechnology (DBT), Govt. of India).
7. Two days National Seminar on "Premature Failure of Timber in Cooling Towers – Causes, Challenges and Future Strategies" on 10th and 11th November 2008.
8. A sensitization camp/workshop for wood based sports goods industry of Jallandhar sponsored by TIFAC, New Delhi on 15th October 2008.
9. An International Seminar on "Role of Plant Taxonomy in Biodiversity Management and Human Welfare" from 1st to 3rd December 2008.
10. Celebrated the National Technology Day on 11th May 2008.
11. Celebrated International Biodiversity Day on 22nd May 2008.
12. Celebrated the World Environment Day at FRI on 5th June 2008.
13. Meeting of "Sansadiya Rajbhasha Samiti" on 16th June 2008 was organized in Hotel Pacific, Rajpur Road, Dehradun.
14. Celebrated the 59th Van Mahotsava in the Kendriya Vidyalaya, FRI on 18th July 2008.
15. Asia Regional Workshop on "Role of youth in Mitigating the Impact of Climate Change for Sustainable Livelihood" from 13th to 18th October 2008 at FRI, Dehradun.
16. Vigilance Week was observed at FRI, Dehradun from 3rd to 7th November 2008.
17. A two-day conference on Gender Issues in Natural Resources Management- Perception and experiences in different parts of the world was organised from 16th to 19th November 2008.
18. A Workshop on "Forestry for Common People" was organized on 25th and 26th November 2008.
19. An International Seminar on "Role of Plant Taxonomy in Biodiversity Management and Human Welfare" was organized in collaboration with Association for Plant Taxonomy (APT) from 1st to 3rd December 2008 to mark the 100 years of the establishment of the world famous Herbarium of the FRI, Dehradun.
20. Forest Research Institute participated in the "Kissan Mela" organized by Gobind Ballabh Pant University, Dhakrani, Herbartpur on 15th December 2008.
21. Organized a Vaniki Mela on 7th March 2009 at village Handesra, Distt. Mohali, Punjab.
22. Celebrated the World Forestry Day on 21st March 2009.

AWARD

- Dr. Ashok Kumar, Scientist D, G&TP Division, was awarded Brandis Award (2008) for the paper titled "Planting Stock Improvement in *Gmelina arborea* (Roxb.)". Indian Forester, 132 (6): 691-699.

DISTINGUISHED VISITORS

1. Director, SAARC Forestry Centre, Thimpu, Bhutan visited Timber Mechanics Discipline on 27th June 2008.
2. Shri Paul Vaughan, Trade Commissioner – South Asia and Shri Siddhartha Bhargava, Business Development Manager, C/- New Zealand, High Commission, visited FRI, Dehradun on 14th August 2008 regarding future collaboration on Radiata Pine.
3. Shri Evan D. Shield, Consultor Forestal, Entre Rios 717. Piso 9 Dpto.B 3200 Concordia – Pcia.de Entre Rios, Argentina and Diana E. Diaz, EEA Concordia, C.C.34 3200 Concordia, Entre Rios Argentina visited FRI, Dehradun on 19th March 2009 regarding discussion on *Eucalyptus* utilization.
4. Shri K. Sankara Narayanan, Governor of Nagaland visited FRI, Dehradun on 25th May 2008.
5. Dr. Ratan Lat Jat (State Minister), Chairman, Rajasthan State Seeds Corporation Ltd., Jaipur, visited FRI, Dehradun on 8th July 2008.
6. Shri J.K. Dadoo, IAS, Secretary, Environment & Forest, National Capital, New Delhi visited FRI, Dehradun on 17th October 2008.

EXHIBITION

Displayed the exhibits on natural dyes before the Honorable Chief Minister of Uttarakhand during Khadi Exhibition at Parade Ground, Dehradun on 6th November 2008.

MISCELLANEOUS

1. The Bioinformatics Centre and Geomatics Centre were inaugurated on 24th February 2009 in the Bioinformatics Centre and GIS Division. The Centres are fully operational and being used for training, education and extension purposes. The separate internet leased line connectivity is available in the Bioinformatics Centre.
2. The Institute has been connected to Distant Learning Program of Consortium of Education Communication through EDUSAT Satellite Interactive Terminal. The facility has been established in Conference Hall of FRI University.
3. Evaluation of Fragrance and Flavour Development Centre (FFDC) was carried out, by a team of Dr. Rameshwar Dayal and Dr. V.K. Varshney, for the work conducted by the Centre in the proceeding plan as per the TOR given by the Ministry of Micro, Small and Medium Enterprises (MSME), Govt. of India.

CENTRE FOR SOCIAL FORESTRY AND ECO-REHABILITATION, ALLAHABAD

Centre for Social Forestry & Eco-Rehabilitation (CSFER), Allahabad was established in October 1992 as an advanced Centre under the umbrella of ICFRE, Dehradun. Presently, it is a Centre of Forest Research Institute (FRI), Dehradun. The Centre aims to nurture and cultivate professional excellence in the field of Social Forestry and Eco-Rehabilitation in the state of Uttar Pradesh.

The important research activities of this Centre are in the field of Planting Stock Improvement Programme (PSIP), Wasteland reclamation, Development of Agroforestry

Models, Reclamation of mined areas through Afforestation, Productivity of Ecosystem, medicinal plants etc. A number of research projects, funded by different agencies viz. UNDP, NABARD, World Bank, etc., have been carried out at this Centre. This Centre has also taken up a project on Research and Development of Jatropha sponsored by NOVOD Board.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Assessment of suitable age of seedlings for plantation in Uttar Pradesh [FRI-396/CSFER-2007]

Status:

- Nursery raising of selected species viz. *Holoptelia integrifolia, Albizia* sp., *Terminalia arjuna, Gmelina arborea, Bombax ceiba, Madhuca indica, Aegle marmelos, Pongamia pinnata, Acacia catechu, Tamarindus indica, Azadirachta indica, Artocarpus heterophyllus, Prosopis juliflora, Acacia nilotica, Syzigium cumunii, Pithecellobium dulce, Haterophragma adenophyllum, Dalbergia sissoo* and *Tectona grandis*.
- Field trial of 14 species (one year and two years old seedlings) viz. *Terminalia arjuna, Bombax ceiba, Pongamia pinnata, Tamarindus indica, Azadirachta indica, Artocarpus heterophyllus, Syzigium cumunii, Pithecellobium dulce, Haplophragma adenophyllum, Dalbergia sissoo, Tectona grandis, Albizia procera, Ficus glomerata* and *Acacia auriculiformis* has been done.
- Two sites in RBD design, two years old seedlings have been procured from the Forest Department, Allahabad.
- Maintenance and management of field trial is being done regularly.
- Growth data is being recorded regularly.

Project 2: Development of Agroforestry models for Eastern Uttar Pradesh [FRI-396/CSFER-2008]

Status:

- Field survey and selection of study sites was done in Jaunpur and Barabanki districts to identify farmers practicing agroforestry in their fields.
- In Barabanki district, agroforestry plots of different age groups of Eucalyptus and Teak were identified.
- In Jaunpur district, agroforestry plots of different age groups of Teak and Poplar were identified.
- In Allahabad district, agroforestry plots of different age groups of Aonla and Teak were identified and selected for studies.
- In Gorkhpur district, agroforestry plots of different age groups of Teak and Poplar were identified.
- Data of forestry species viz. age, height, girth etc. were recorded of these selected agroforestry plots.
- Collection of soil samples from the selected sites. Soil samples collected from selected sites of farmers fields are being analyzed for moisture content, electrical conductivity, pH, organic carbon, nitrogen and phosphorus.
- Farmers of selected agroforestry plots are being pursued regularly for crop (wheat) production data.

Project 3: Demand Supply Gap Analysis of Important Tree Species of Selected Districts of U.P. for Extension and Afforestation Projects [FRI-396/CSFER-2009]

Status:

- Random selection of Tahsil wise villages (2% intensity) has been done for Gorakhpur and Deoria district to start survey of villages.
- Survey for demand-supply position of selected species has been completed in selected sixty six villages of Gorakhpur district under different Tehsils.
- Survey for demand-supply position of selected species in forty three villages of Deoria district has been completed.
- Market survey of Demand supply position has been done in the Gorakhpur and Deoria districts.

Project 4: Bio-remediation of Bauxite residue (Red Mud) generated from Aluminum industry by using blue green algae/bio-inoculants [FRI-470/CSFER-2011]

Status:

- Collection of Red Mud samples from Hindalco factory.
- Chemical analysis of Red Mud.
- Procurement of Blue Green Algae species.
- Culture propagation of different species of Blue Green Algae.
- Different species of Blue Green Algae are being cultured with different amendments of Red Mud to observe the effect of Red Mud on growth performance and other characteristics of Red Mud.
- Propagation of Blue Green Algae in Tank is in propagation.

Project 5: To standardize the Nursery techniques of Selected *Ficus* species by using Different Biotreatments [FRI-469/CSFER-2010]

Status:

- Collection and processing of seeds of selected *Ficus* species as Peepal, Bargad, Goolar and Pakad has been done.
- Lay out of experimental design for germination trial has been done.
- The germination trial has been completed.
- To study the effect of different biofertilizers on *F. religiosa*, a nursery pot experiment has been carried out.

EXTERNALLY AIDED PROJECT

Project 1: National Network Programme on Integrated Development of *Jatropha curcas* (Sponsoring Agency: NOVOD Board)

Status:

- National Networking trial I, has been established at Shankargarh in the year 2004-05.
- Progeny trial of marked CPTs and Zonal trial have been established at Central Padilla Nursery in the year 2005-06.

- Block plantation has been established at Shankargarh in the year 2004-05 and Defence land, Jhansi in the year 2005-06 in 10 hectare area each.
- Five Farmers Training and Two Trainers Training have been organized.
- Field Trial Under National Networking, IIIrd trial of 19 promising provenances from all over India, has been established at Central Padilla Nursery in RBD in the year 2008-09.
- Growth data in the nursery and Initial growth data in the field trial have been recorded.
- Fruit collection of the previous networking trial and progeny trial is in progress.

EDUCATION AND TRAINING

Shri A.K. Pandey, IFS, Head, CSFER, Allahabad attended a training on Financial Management at Himachal Institute of Public Administration, Shimla (H.P.) from 9th to 13th June 2008.

PUBLICATION

- A Brochure on Jatropha cultivation and its importance has been prepared.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

Attended

The representative from the centre attended the following Conference/Meetings/ Workshop/ Symposium/Exhibition:

International

1. International Seminar on Taxonomy in Botany Division of Forest Research Institute, Dehradun on 2nd and 3rd December 2008.
2. International Symposium on Afforestation of Medicinal Trees in the 3rd World Ayurvedic Congress held at Jaipur on 20th December 2008.

National

1. National Seminar on "Harnessing Natural Resources towards Socio-economic Development" of North-east India at N.N. Saikia College, Titabor, Jorhat, Assam on 26th and 27th September 2008.
2. National Seminar on "Forestry for Common People" at FRI, Dehradun on 26th and 27th November 2008.
3. National Workshop on "Technological Intervention in Herbal and Medicinal Industry", IMS Varanasi on 21st December 2008.
4. National Conference on Bio-fuel at TFRI, Jabalpur on 25th and 26th February 2009.
5. National Seminar in the Botany Department at Gauhati University on 27th to 28th February 2009.
6. National Seminar on "Bamboo Plantation Management and its Utilization" at AFRI, Jodhpur on 17th and 18th March 2009.

2. Organised

1. A training programme on Bamboo species Cultivation, Harvesting and Sale was organized on 21st May 2008.
2. A training programme on Nursery and Plantation Technology of Important Forestry Species was organized on 26th August 2008.
3. A training programme for farmers on Rehabilitation of Degraded Soils in Uttar Pradesh was organized on 3rd September 2008.
4. A training programme for Farmers was organised at CSFER, Allahabad under the National Bamboo Mission from 13th to 17th October 2008.
5. Farmers Training on Cultivation and Management of Bamboos was organized at Sarnath (Varanasi), U.P. from 2nd to 4th November 2008.
6. Hindi Karyashala organized on 15th December 2008 at CSFER, Allahabad.
7. Demonstration-cum-training progranmme for Farmers on Commercial Cultivation of Medicinal Plants was organised on 17th December 2008.
8. A training Programme for Farmers was organized on the problem of Felling and Sale of Trees in Agroforestry on 27th March 2008.
9. A training programme was organised for farmers on Role of Biofuels in Agroforestry on 27th March 2008.

MISCELLANEOUS

- The Extension calendar has been prepared for the year 2009-10.
- The land has been purchased at Village Silna, Nasirpur and its registry as well as mutation has been done. Proposal of land use change and construction by CCU has been submitted.
- A bamboosetum of different species was established at Padilla Nursery.
- Hindi Rajbhasa Samiti has been formed at CSFER, Allahabad to promote the use of Hindi in official use.

INSTITUTE OF FOREST GENETICS AND TREE BREEDING, COIMBATORE

The Institute of Forest Genetics and Tree Breeding (IFGTB) is a national Institute formed in April 1988 under the Indian Council of Forestry Research and Education (ICFRE), an autonomous Council under the Ministry of Environment and Forest, Government of India. It was formed by upgradation of the Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and College, existing since 15.12.1959. Certain other organizations and schemes viz., Forest Soil-cum-Vegetation Survey (FSVS), Coimbatore, Disease and Insect Survey (DIS), Coimbatore, Indo-Danish Project on Seed Procurement and Tree Improvement (IDPSPTI), Tropical Pines Research Centre (TPRC), Kodaikanal, Eucalyptus Research Centre (ERC), Ooty and Environmental Research Station (ERS), Ooty and merged with the FRC.

An abstract of projects run by the Institute is as follows:

	No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
Plan Projects	7	16	14
Externally Aided Projects	8	6	3
Total	**15**	**22**	**17**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Genetic Improvement of *Eucalyptus tereticornis* through controlled pollination and molecular characterization [IFGTB/RP-3/2002–08]

Findings: Twenty clonal selections were made in *E. tereticornis* x *E. grandis* and *E. tereticornis* x *E. alba* from a 60 months inter-specific full sib family trial developed in Panampally. Both selections could be clonally multiplied. A trial was established using twenty clones (3 tree plots in five replications) at Panampally field station, Kerala.

Project 2: Genetic transformation of Eucalyptus and Casuarina to enhance salinity tolerance [IFGTB/RP-6/2000–05; 08]

Findings: Protocol for regenerating seedling explants and clonal genotypes was standardised. Sporadic shoot morphogenesis and rhizogenesis were obtained from *Casuarina equisetifolia*. Hairy root cultures were established in *Eucalyptus tereticornis*. *Agrobacterium tumefaciens* strains GV2260, EHA105, LBA4404 and pCAMBIA series of plasmid vectors, and gene constructs *Osmotin* and AtNHX were obtained and used for transformation studies in *Eucalyptus tereticornis.* Critical parameters for transformation like media supplements (Acetosyringone, Buffers and Sugars), strains and their concentrations, co-cultivation durations, sonication

duration and antibiotic concentrations were evaluated using the gene constructs/ vectors. Optimum distances for bombardment were found. Transient GUS expression was obtained in *Eucalyptus tereticornis* using Agrobacterium and particle bombardment methods.

Project 3: Identification of conserved motifs in genes conferring salt tolerance to develop strategies for gene isolation from salt tolerant tree species [IFGTB/RP-38/2005-08]

Findings: Genes conferring salt tolerance were classified and tables in excel sheets were created for input of gene information. DNA and protein sequence information for Sodium antiporters, Calcium Transporters, High Affinity Potassium Transporters, Low Affinity Potassium Transporters, Proton Transporters, Water Transporters, Transcription Factors, Cellular Signaling Components, Transcription Factors and Protein and Membrane Protection were downloaded into excel sheets. A prototype database for sodium transporters was created using MySQL and PHP. The sequences were analyzed using Clustal W and PRIFI for identification of conserved regions and deducing PCR primers that could be tested for isolation of genes from salt tolerant tree species.

Project 4: Origin, distribution and genetic diversity of *Jatropha curcas* in India [IFGTB/RP-43/2006-08]

Findings: Fifteen enzyme systems provided a total of 18 locii for the 56 accessions of *Jatropha curcas.* Twenty eight percent of the resolved isozyme locii were polymorphic on an average, 26.67% were found to be polymorphic and mean observed number of alleles per locus was 1.533. Average observed heterozygosity was 0.15 and expected value was 0.14 with a gene flow value of 0.24. DNA extraction procedures were standardized to avoid latex contamination. PCR protocols were optimized by carrying out variations in $MgCl_2$ concentration, primer concentration, DNA and buffer volume. A total of 120 bands whose size ranged between 300 and 2000 bp were produced using 25 primers. Genetic identities at the RAPD level varied from 0.951 to 0.998, not significantly different from the values obtained at the isozyme level. Comparison of genetic variation showed that RAPDs consistently revealed higher levels of variability than isozymes in terms of percentage of polymorphic locii, gene flow and gene diversity. Yet, the numerical congruence between the isozyme and RAPD data suggests an indication that in *J. curcas* the isozyme data provides a fairly good picture of the genetic structure.

Project 5: Evaluation of teak CSO at Walayar using DNA profiling [IFGTB/RP-54/2007-08]

Findings: Twenty teak clones from three different geographical locations namely Topslip, Tamil Nadu (TNT), Nilambur, Kerala (KLN and KLK), Sungam, Kerala (KLS) and South Bhadrachalam (SBL-1) of Andhra Pradesh were screened using seven RAPD primers. Of the 113 fragments, 36 were monomorphic (32%) and 77 were polymorphic (68.0%). Nei's genetic distance separated the 20 clones into 4 major clusters. DNA profiles of clone SBL 1 was unique from the rest. The clone KLN 2 was close to the TNT clones (genetic distance 0.1). TNT 1, TNT 3, TNT 4 and TNT 15 were identified as duplicates in the dendrogram corresponding to 100% similarity in RAPD bands shared between them.

Project 6: Studies on the diversity of bee fauna of the Nilgiris [IFGTB/RP-36/2005-08]

Findings: Survey was carried out in 32 sampling locations in the Nilgiris, covering 9 forest types and 4 plantations. Altogether 60 species of bees, coming under 14 genera were collected.

They include, *Apis* spp. (*Apis cerana, A. indica, A. florae* and *A. dorsata*), *Amegilla* spp., *Braunsapis* spp., *Ceratina* spp., *Chelostoma* spp., *Halictus* spp., *Heriades* spp., *Lasioglossum* spp., *Megachile* spp., *Nomia* spp., *Sphecodes* spp., *Thyreus* spp., *Trigona* spp. and *Xylocopa* spp.

Since the occurrence of bees is closely linked to the availability of flowering plants, data on the vegetation of all these locations was collected and phenological observations of the plants made. Among the natural forests, the Dry Deciduous Forests, Thorn Forests, Moist Deciduous Forests and the Semi-evergreen Forests were found to have the maximum diversity of bees, while the Montane Wet Temperate Forests, wherein cool conditions persist almost throughout the year, had the least diversity. The monoculture plantations of *Acacia mearnsii, Eucalyptus globulus*, Teak and Tea were also found to be poor in bee diversity, mainly due to lack of floristic diversity.

Data on the seasonality of various bee species, the frequency of occurrence and floral associations were also collected. The frequency of occurrence of bee species, in general, was high, during the months of March, April and May, when most of the plant species in the deciduous forests were in bloom. The occurrence was low during the winter and rainy seasons. About 100 species of plants were recorded as nectar/ pollen sources for the bee species in the study area. They include not only tree species, but also herbs and shrubs that flower in different seasons and this diversity enables the bees to sustain their populations throughout the year. The degradation of forests, due to fire and anthropogenic factors, resulting in habitat destruction and loss of floristic diversity were found to be the major threat factors on the bee fauna in this region. Although many species of exotic plants like *Ageratina adenophora, Cestrum* sp., *Cytisus scoparius, Lantana camara, Passiflora mollissima, Ulex europaeus* and *Wedelia trilobata* were also found to act as nectar/ pollen sources for some of the common bee species, the colonization of such exotic species in the forest areas is likely to adversely affect the floristic diversity and, in turn, the bee faunal diversity.

Project 7: Natural regeneration studies on important trees in Silent Valley National Park, Kerala [IFGTB/RP-32/2004-09]

Findings: Regeneration status of different trees in different ecosystems in Silent Valley National Park, Kerala has been studied. A total of about 150 tree species have been enumerated from the park and prepared their population structure. More than 100 species including herbs, shrubs and trees are recorded as addition to the flora of Silent Valley National Park, Kerala.

In forest areas, the regeneration of dominant species like *Palaquium ellipticum, Myristica dactyloides, Reinwardtiodendron anamallayanum, Syzygium laetum, Litsea oleoides, Dimocarpus longan, Mesua ferea, Aglaia lawii, Cullenia exarillata* and *Drypetes elata* etc. was found to be frequent, whereas, species like *Actinodaphne lawsonii, Aphanamixis polystachya, Appollonias arnottii, Diospyros nilagirica, Epiprinus mallotiformis, Holigarna nigra, Hydnocarpus alpina* and *Sysygium densiflorum* showed very poor regeneration.

Tree species recorded in the grasslands in their order of dominance are *Wendlandia thyrsoidea, Glochidion ellipticum, Elaeocarpus serratus* var. *serratus, Ligustrum perrottetii, Symplocos racemosa, Apodytes dimidiata, Phyllanthus emblica, Symplocos cochinchinensis, Syzygium cumini, Maesa indica, Ziziphus rugosa* and *Olea dioica*.

Species generally observed only in wet evergreen forests like *Palaquium ellipticum, Elaeocarpus tuberculatus, Litsea floribunda* and *Litsea oleoides* could also be recorded in various stages of growth viz. seedlings and saplings under the shade of above species.

EXTERNALLY AIDED PROJECTS

Project 1: Germplasm collection and production of improved planting stocks of *Terminalia chebula* Retz and *Terminalia bellirica* [IFGTB/EF-RP-25/2005-08]

Findings: Selection criteria for identifying superior trees in terms of fruit yield and quality have been standardized for *T. chebula* and *T. bellirica*. Superior trees of *T. chebula* (85) and *T. bellirica* (19) were selected based on fruit yield, fruit size and fruit color in various places viz., Talawadi, Kallar, Bargur, Kalrayan hills, Courtallum, Chitteri hills, Javadhu hills and Nagarcoil in Tamil Nadu. Nursery techniques including seed processing, seed treatment, biofertilizer dosage etc., have been standardized for both the species. Vegetative propagation in *T. chebula* and *T. bellerica* have been standardized. Among the rooting of branch cuttings, airlayering, budding and grafting the wedge grafting method found to be relatively successful. Grafting of selected trees was attempted and wide variation was observed for response to cleft grafting. A germplasm bank of 9 *T. chebula* and 3 *T. bellirica* clones has been established at Panampally. Methods for estimation of medicinally active major biochemical compounds have been standardized. Four distinct populations of *T. chebula* and five populations of *T. bellirica* were screened for medicinally important biochemical compounds like total phenols, tannins, gallotannin, free gallic acid and ellagitannins to investigate the relationship between geographic location and the biochemical content. Though different populations showed variation for all these compounds, the tree to tree variation was also high within a population. Significant levels of variation for various active compounds content in fruits of selected superior trees were also observed.

Project 2: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings [IFGTB/EF-RP-09/2003-06] (Extended up to 2008)

Findings: Tree selection strategies were developed for *Aegle marmelos, Saraca asoca, Asparagus racemosus, Gymnema sylvestre, Tinospora cordifolia, Emblica officinalis* and *Oroxylum indicum* based on their distribution patterns, medicinal importance and threatened status. Appropriate seed handlings methods were also worked out. Vegetation propagation techniques and seed germination methods were standardized. Population survey was conducted in the States of Tamil Nadu and Kerala to identify and select trees/plants ased on the selection strategies. *Aegle marmelos* from 14 locations, *Asparagus racemosus* from 9 locations, *Gymnema sylvestre* from 9 locations and *Tinospora cardifolia* from 8 locations were collected, vegetatively propagated and assembled in the Medicinal Plants Seed Production System established in an area of about 1 ha at Anaikatti, Tamil Nadu. Accessions of the above medicinal species from different locations in the states of Tamil Nadu and Kerala were assembled in the Institute. These accessions have been utilized to establish a germplasm bank cum seed production system for medicinal plants at Anaikatti in Tamil Nadu. The system has been established in an area of 1 ha including wild accessions of *Tinaspora cordifolia* (33), *Gymnema sylvestre* (15), *Saraca asoca* (6), *Asparagus racemosus* (20), *Aegle marmelos* (24), *Emblica officinalis* (6), *Strychnos potatorum* (1), *Oraxylum indicum* (2) and *Rauvolfia serpentine* (3).

Project 3: Field Performance of micro and macro-propagated planting stock of selected five commercially important Bamboo Species [IFGTB/EF-RP-17/April 2004-March 2009]

Findings: Twenty five hectares field plantations were established to study the performance of micropropagated plants of three species of bamboos, *B. bambos*, *D. strictus* and *P. stocksii* at four locations in Coimbatore and Salem districts. Among the three species tested, *B. bambos* showed better growth than *P. stocksii* and *D. strictus*, however the utility value of the culms

vary among the species. Micropropagated, seed raised and cuttings propagated plants show similar growth in the field conditions. Initially, cuttings raised plants showed lesser mean number of shoots, however, no significant variation was noticed after 3 years of planting. It may be due to the number of rhizomes developed during the initial phase of establishment. Bamboo propagules over 8 months old at the time of field planting were escaped from rabbit damage, hence to avoid the damage of the shoots by rabbits, it is essential to plant 8 to 12 months old plants. If the newly produced culm is thick, vulnerability to rabbit damage is less. Bamboos prefer well drained loamy soil and growth and production of new culms was highly affected in poor soils like gravel and rocky types. In irrigated conditions, the mean height of the tallest culm of micropropagated *B.bambos* at the age of 1.5 years was 4.2 m, whereas under unirrigated conditions, 4.5 years old plants showed 3.1m height. In unirrigated but good soil type micropropagated *D. strictus* was growing well than *B. bambos* and *P. stocksii*. Enough care need be taken for the plants during the initial years of establishment especially watering and weeding. Farmer's field is preferable for bamboo cultivation than unmanaged areas (Plate). Fire hazards are not uncommon in bamboo fields and to avoid the same regular weeding is essential during the establishment stages. Watering to the bamboo plants once in 15 days is essential in low rainfall areas atleast for initial three years. Number of shoots produced was similar among the propagule types and culm growth is determined by the water availability. Supply NPK along with farmyard manure promoted the growth of bamboo plants than providing farmyard manure alone. A bamboo germplasm garden with 37 genotypes belonging to 19 species was established under this project.

Project 4: Population Structure and Reproduction in Bruguiera and Ceriops: Implication on Conservation [IFGTB/EF-RP-26/2005-08]

Findings: Studies were concluded on the pollination, floral biology and reproductive success in seven rare true mangrove species namely *Bruguiera cylindrica, B. gymnorrhiza, B. sexangula, B. parviflora, Ceriops tagal* and *Ceriops decandra*. Detailed studies were conducted in 6 locations across the East and West Coasts. In the West Coast, Kannur and Ernakulam districts in Kerala were surveyed. The *B. cylindrica* populations in Pitchavaram, East Coast flower during April – May, whereas, in West Coast, they flower during October – November. Both sunbirds and insects pollinate *B. gymnorrhiza*. *B. cylindrica* pollinated by thrips shows the highest reproductive success. *B. sexangula* is exclusively pollinated by sunbirds exhibited the lowest reproductive success. In all the three species, the flowers produce enormous amount of pollen and show very high pollen to ovule ratio. *B. gymnorrhiza* and *B. sexangula* exhibit very high pollen fertility. Regeneration and development of families beneath mother trees was common in all the three *Brugueira* species.

Project 5: Development of post harvest techniques for seed production in *Jatropha curcas* [IFGTB/EF-RP-24/2005-08]

Findings: Phenology studies conducted in a plantation at Anaikatti, Tamil Nadu, over two peak flowering-fruiting seasons indicated that *Jatropha curcas* has high reproductive efficiency. The studies on maturity revealed attainment of physiological maturity when fruits turn yellow as shown by no significant variation in germination percentage among later stages of fruit ripening. With respect to harvesting maturity, though oil content among different maturity stages did not vary significantly, fruit maturity stage had considerable effect on oil physico-chemical characteristics like Acid value, Iodine No., Peroxide Value & Viscosity. The results indicate that fruits need to be harvested at late yellow stage or black pulpy stage and is safer to avoid collecting fruits at dry stage. Effect of drying method on Jatropha oil was studied in seeds extracted from fruits at black pulpy stage. Considering the oil yield, shade drying for

10 days and oven drying at 40°C for 1 day were found suitable methods. However, desirable values for most of the oil characteristics in the oven drying treatment at 40°C for 1 day renders it superior to 10 days of shade drying treatment. Comparing the two fruiting seasons, it is found that during the second season (October-December) the oil yield and quality was more than the first (July-September). Studies on seed processing showed that it is essential to separate the shell or seed coat from seed in order to maximize oil recovery. Hence developed a prototype, "Seed Decoater" for processing Jatropha seeds which separates kernel from seed coat. The seed is broken by milling technique while the separation of seed coat from kernel is through air suction. The prototype is driven by a 1hp motor and a minimum of 10 kg seed per hour can be processed by this Seed Decoater. The separation (80% kernel and 20% seed coat) of kernel enables to check loss of oil through adsorption by seed coat and thereby maximize oil recovery. In addition, the oil from the processed seeds is found to have better physico-chemical characteristics compared to whole seed oil. Seed grading experiment revealed that soaking Jatropha seeds (insect attacked seedlot) for 24 hours in water followed by 2 hours drying helps recovery of good seeds as floaters while insect attacked seeds sink. The infection in the seeds was confirmed through the X -ray images. By this grading method the germination, percentage of a poor seedlot could be substantially improved. Effect of desiccation on Jatropha seeds showed that 6% moisture content is the Lowest Safe Moisture Content to which the seeds need to be dried both with regard to oil quantity and quality. Effect of storage container on seed oil parameters and viability was tested on seeds stored in different containers such as polybag, jute bag, cloth bag, paper bag and black polybag. The most apt material to store Jatropha seeds was found to be cotton cloth bag or jute bag. Effect of different temperatures on storability of Jatropha suggest that seeds need be stored at 10°C (normal refrigerated conditions) for a period of one year to obtain maximum oil content with desirable characteristics. From the midstorage correction trials, it was evident that both roll towel and wet sand treatments were good midstorage correction treatments for about 12 months storage.

Project 6: Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different eco-climatic zones of Kerala and Tamil Nadu [IFGTB/EF-RP-11/2003-06]

Findings: Experimental plots were established with seedlings raised using the seeds collected from seed orchards of *Acacia mangium* (Mangium) in Panampally, Kerala along with ramets of superior trees of Mangium procured from Mysore Paper Mills both in Tamil Nadu and Kerala. Intercropping was done up to third year. Biological productivity was assessed at three years - half rotation age of tree component. Observation on growth parameters at the age of three years revealed that maximum growth was recorded in southern zone of Kerala by registering girth at breast height (gbh) of 36.0 cm and total height of 15 m. The mean commercial bole height recorded was 12.7m in this zone. Minimum growth recorded was in central zone of Kerala with gbh of 24.5 cm and total height of 6.6 m. The gbh and total height recorded in southern zone of Tamil Nadu was 30 cm and 6.1 m respectively. In turn, volume production was highest at southern region of Kerala registering 79.12 m^3 ha^{-1} compared to central zone of Kerala (13.56 m^3 ha^{-1}) and southern zone (10.64 m^3 ha^{-1}) of Tamil Nadu. Results on biomass studies revealed that estimated wood yield (on fresh weight basis) at 3 years was 54.0 MT ha^{-1} in southern zone of Kerala which was 4-6 times greater than that registered in central zone of Kerala (12.0 MT ha^{-1}) and in southern zone of Tamil Nadu (9.0 MT ha^{-1}). While comparing the performance of seedlings of Mangium with that of hybrids of Mangium, more dry matter allocation in branch biomass was observed (17 to 28%) in hybrids of Mangium than in seedling raised plantations (5 to 16%). With heavy branching habit, the hybrids of Mangium are not suitable for agroforestry system.

Among different agricultural crops intercropped with *A. mangium*, blackgram, horsegram, fodder sorghum and beans were found to be compatible and onion was observed to be less compatible. The recommended agroforestry systems are (i) *Acacia mangium* + Green Beans based system for Tamil Nadu and (ii) *Acacia mangium* + Pepper based system for Kerala.

Project 7: Infrastructure development of the Botanical Garden of the Institute of Forest Genetics and Tree Breeding and *ex-situ* conservation of selected Rare and Threatened species (Funding Agency: MoEF) [IFGTB/EF-RP-27/2006-09]

Findings: Infrastructure development work like repair of green house, laying out path and irrigation pipeline and labelling of plants in the garden has been completed. 140 plant species have been introduced and maintained in the Botanical Garden.

Project 8: Establishment of seed production systems for NTFPs of Attapady Hills [IFGTB/EF-RP/2006-08]

Findings: Agriculture and sale of minor forest products are the two traditional income sources to the Attapady tribals. The species selected for the study are the major NTFPs yielding species for the tribal communities which face destruction due to their destructible harvest. Population status of the NTFPs was studied. Seed handling procedures were developed in *Acacia concina, Caesalpinia sappan* and *Terminalia chebula.* Different NTFP species harvested were collected from Attapady Reserve Forest; studies conducted and produced seedlings for the establishment of Seed Production System (SPS). A seed production system has been established in an area of 1.615 ha. The species *Aegle marmelos, Saraca asoca, Oroxylum indicum, Acacia concina, Terminalia chebula, Asparagus racemosus* and *Caesalpinia sappan* have been planted. The espacement followed is 5 x 5 m with pits of size 50 x 50 x 50 cm. The tribal farming society was involved in the establishment of the SPS right from the time of site preparation and has been giving protective watering and maintenance till date. The survival of the plants at the end of 3 months was 84 % on an average (ranging from 78-91 depending on the species) and at the end of 6 months it is 70 % on an average (ranging from 70-90 depending on the species). The Vattaluki Tribal Farming Society (VTFS) is the beneficiary of the project output.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Genetic improvement of *Acacia auriculiformis* through half-sib progeny selection [IFGTB/RP-39/2005-10]

Status: Maintenance activities like weeding and fire tracing were undertaken in all the four progeny trials established at Pondicherry, Vadakkancherry, Panampally and Palode. The trials at Panampally and Pondicherry have been evaluated for growth parameters and stem form. Profound variations were observed for these characters among families and seed sources. Among the four seed sources (Panamapally, Karunya, Behalli and Mumbaru) the families originating from Behalli and Panampally seed orchards were performing better than others.

Project 2: Phenotypic selection, reproduction and propagation in *Ailanthus excelsa*: Perspectives for safety matches industry and farmers in Tamil Nadu [IFGTB/RP-40/2005-09]

Status: Two germplasm banks have been established in BIOTRIM, Tirupati (Andhra Pradesh) and in Kuruvampatti (Tamil Nadu). The survival percentage is 83 and 90 % in Tirupati and

Kuruvampatti respectively. Periodical biometric data from both the germplasm banks have been collected. The analysis of growth of different seed lots collected from different agroclimatic zones in the States of Andhra Pradesh, Madhya Pradesh, Rajasthan, Tamil Nadu and Uttarakhand was undertaken. Results from the analysis showed that the growth performance of Cauvery delta zone (Tamil Nadu) was found to be performing better than other seed sources. Seed parameters also been studied for the seeds collected from different sources.

Project 3: Evaluation and characterization of clones of Casuarina with reference to yield, tree form, biomass, pulping characteristics and key nursery pests [IFGTB/RP-44/ 2007-12]

Status: Established two clonal trials of *Casuarina equisetifolia* (1) at Pugalur, Karur district (sodic site) and (2) at Sirugramam, Cuddalore district (Casuarina growing belt), Tamil Nadu (one hectare area each) in addition to the one at Mayiladumparai, Karur district (Farmer's land) established in the previous year. Eighty-seven clones have been planted in an Incomplete Randomized Block Design with 6 replications at a spacing of 3 x 1.5 m. Quantitative and qualitative data are being collected from these trials at six monthly intervals. The preliminary results from the one year old trial at Mayiladumparai revealed significant clonal variation with respect to the biometric and qualitative traits like stem straightness and branching habits.

A total of 220 clones are maintained in the nursery to study the key nursery pests. Observations (at 15 days interval) on incidence of the targeted insect pests viz., *Icerya purchasi* and *Eumeta crameri* revealed that totally 131 clones have so far been infested by *I. purchasi* and 47 clones by *E. crameri*. Intensity of attack of these pests was observed to range between low to severe. Severe infestation of *I. purchasi* has been observed on 35 clones while moderate to high infestation observed on 59 clones. Whereas, in the case of *E. crameri,* high intensity of the attack has been observed on clones TNPP-3 and TNKP-1. Observations of feeding damage caused by the pest, population build up, abundance were also collected from individual clones. In addition to the targeted pest mentioned above information on incidence of the other pests like Myllocerus beetle, two species of Coccids sap suckers and a species of leaf hopper have also been recorded. Stock cultures of the targeted pests are maintained and their biology being studied.

Project 4: Improvement of teak through selection, quality seed production, hybridization and clonal evaluation [IFGTB/RP-45/2007-12]

Status: Selected around 400 outstanding teak trees from Parmbikulam, Topslip, Konni, Tholpatty and Nilambur in Kerala and Tamil Nadu States based on growth, stem form and branching characteristics. Seeds were collected from 230 trees and characterized for morphological characters using image analyzer. X-radiography of fruits was conducted to determine seed filling for 70 trees. Fruits of 82 trees were sown in nursery for raising seedlings. Flowering and fruiting (number of inflorescences per tree and number of flowers / fruits per inflorescence) was assessed in 475 trees in Walayar CSO and 170 trees in Panampally CSO. Pollinator visitation per unit time per tree was assessed in both the CSOs. Based on flowering behaviour, trees were selected at Walayar for carrying out the control crosses between clones. A partial diallele crossing design has been developed. The 40 selected clones in the VMG were coppiced and being multiplied and about 1100 clonal propagules were produced for establishing a clone trial. The rooting performance of the clones was studied. Thirteen new superior teak trees were selected in the plantations at Pattikadu and Machad Range in Thrissur Division (Kerala State). The teak clonal trial established at Tirunelvely has been evaluated for growth and form traits.

A Vegetative Multiplication Garden (VMG) of teak has been established with 56 clones. The clones were multiplied from VMG for establishing clonal trials. The rooting performance of different clones was studied. Twenty three superior teak trees were selected in the teak plantations in different parts of Kerala.

Project 5: Selection and conservation of red and sweet tamarind in southern India [IFGTB/RP-49/2007-10]

Status: Extensive surveys were made in different parts of Tamil Nadu, Karnataka and Andhra Pradesh States to identify and select the red and sweet tamarind trees. Fifty two individuals of red tamarind and 38 sweet tamarind trees were selected from different sites of the three States mentioned above. Biochemical characterization of red and sweet tamarind was done by quantifying anthocyanin, total sugars, titrable acidity, and ascorbic acid and anti oxidant properties. To test the compatibility levels between red and sweet tamarind trees, control pollination experiment was conducted in Chidambaram, Karaikal and Mayavaram and fruit set for seven full sib families were obtained. Vegetative multiplication of different red tamarind trees was carried out through cleft grafting method. The data were recorded on biometric characters, phenological and reproductive variation.

Project 6: Association analysis of adventitious rooting traits using STS markers in *Eucalyptus tereticornis* and DNA profiling of Eucalyptus clones [IFGTB/RP-53/2007-10]

Status: Phenotyping to identify individuals with contrasting rooting parameters for the generation of association population was conducted by rooting the cuttings collected from coppice shoots over different seasons. Identified association population was analyzed using ten polymorphic SSRs having genome wide distribution for population structure and the STRUCTURE software showed the unstructured nature of the population and its suitability for association analysis. Thirty three Sequence Tagged Site (STS) primers for vegetative propagation traits were PCR amplified with poor and best rooters. One hundred and ten Eucalyptus clones were profiled with 6 RAPD primers and ninety three clones were screened with 7 ISSR primers.

Project 7: Assessment of Population structure using SSR and molecular characterization using RAPD [IFGTB/RP-52/2007-10]

Status: 60 clones of *Casuarina equisetifolia* planted in IFGTB clone bank were screened with 15 ISSR primers. PCR reactions were set up in a 11 ul reaction volume containing 60 ng of template DNA, 1.0mM of ISSR primer, 100mM dNTPs, 2.5mM MgCl2, 10mM Tris-HCl, pH 8.8 and 0.3 U of Taq DNA polymerase. PCR was performed on a JH bio thermal cycler with an initial denaturation at 94°C for 3 min, followed by 30 cycles at 94°C for 0.30 min, 58°C for 0.30 min, 72°C for 1 min, and the last step of final extension at 72°C for 10 min. 30 cloned samples of Casuarina possessing the inserts of SSR fragments were successfully sequenced. The sequence data were assessed using WEBTROLL software for the identification of SSR locii. Simple sequence repeats were identified as (C)10, (CACCT)2, (TGTGC)2, (TG)8, (AG), (GA)n, (CA)n (GAT)n and (AT)n rich repeats. Among the assessed locii of SSR, the CA and GA repeats were found in most of the clones. The (CACCT) 2, (TGTGC) 2 and (TG) n repeats are not common in all the clones. 10 SSR primer pairs were identified (PRIMER-3 database) and it is found to be the most suitable for assessing Casuarina clones.

Project 8: Assessment on carbon pool potential of important tree species at different ages, sites and management regimes [IFGTB/RP-41/2006-11]

Status: Two hundred trees were felled from 69 Casuarina plantations in Cuddalore, Nagapattinam Villupuram, Kanchipuram, Tiruvallur, Ramanathapuram, Pudukottai and Thanjavur districts of Tamil Nadu. Carbon pool of the standing crop under different soil types and under irrigated and rainfed conditions was estimated. Sixty Eucalyptus trees were sampled from 20 plantations in Pudukottai and Aranthangi in Tamil Nadu. Dry matter production of Eucalyptus on per tree basis in 20 plantations was estimated. Soil samples collected from these plantations were analyzed for organic carbon and various other properties.

Project 9: Demonstration of agroforestry technologies for enhancement of livelihood opportunities in different agroclimatic zones of Tamil Nadu [IFGTB/RP-46/2007-10]

Status: This project is being implemented in collaboration with the National Research Centre for Agroforestry, Jhansi and Forest College & Research Institute, Mettupalayam. The agroforestry systems being practised by the farming, communities in five agroclimatic zones were documented along with major tree species and annual crops. Agroforestry demonstration plots were established in 15 ha area in five agroclimatic zones (3 ha per zone) with tree components like *Casuarina equisetifolia, Casuarina junghuhniana, Melia dubia, Tectona grandis, Eucalyptus* spp. and *Ailanthus excelsa* and horticultural species like Mango, Guava, Sapota and lemon along with the annual crops. In the established agroforestry demonstration plots, intercropping activities have been carried out under above mentioned agroforestry systems and the yield assessed. Casuarina with cotton registered highest net income of Rs. 31, 250/ha in Cauvery delta zone followed by Lemon with sunflower (Rs. 18, 750/ha) in Southern zone, Teak with black gram and cowpea (Rs. 14, 650/ha and 12, 500/ha respectively) in western zone and Ailanthus with black gram and cowpea (Rs. 12, 840/ha and 10, 230/ha respectively) in North-eastern zone.

Project 10: Studies on the population structure and reproduction of *Pterocarpus marsupium* in Tamil Nadu and Kerala [IFGTB/RP-37/2005–08]

Status: Based on the Forest map of South India prepared by the French Institute of Punducherry, *Anogeissus latifolia – Pterocarpus marsupium - Terminalia* spp. forest type (>600 msl) under the category of Dry Deciduous Forests in Tamil Nadu and under the category of Deciduous Climax Forests and degradation stages in Kerala was located. Based on physical barriers separating distribution of *Pterocarpus marsupium*, 17 distinct populations on the eastern aspect of Western Ghats in Tamil Nadu and 14 distinct populations on the Western aspect of Western Ghats in Kerala was short listed for field studies. All the 17 populations of Tamil Nadu and 6 populations of Kerala have been surveyed, tagging 579 trees in Tamil Nadu and 133 trees in Kerala for observation. Herbarium specimens have been made for 214 specimens. Morphometric readings of seeds from 72 trees using image analyser have been collected. Morphological parameters and phonological variations have been observed.

Project 11: Evolving silvicultural practices for *Casuarina junghuhniana* ssp. *timorensis* [IFGTB/RP-33/2005–09]

Status: A total of eight field trials have been established at Kattukuppam, Veeravanallur, Vedaranyam, Erakudy, Sriharikota, Tirupathi, Edapady and Uppar dam. Effect of spacing and irrigation is being studied in all the trials spread over five agroclimatic zones of Tamil Nadu. The nursery trials to study the effect of different concentrations and rooting media on root of *Casuarina junghuhniana* and the effect of biofertilizers on seedling growth has been initiated.

Project 12: Assessment of insect pest problems of selected fast growing indigenous tree species in Tamil Nadu and Kerala [IFGTB/RP-42/2005-08]

Status: Pest surveys at nurseries, plantations and in natural forest ecosystem of the selected tree species of *Ailanthus excelsa*, *Melia dubia*, *Gmelina arborea*, *Thespesia populnea*, *Morus alba*, *Bombax* sp. and *Dalbergia sissoo* were carried out at 12 selected locations in Tamil Nadu and 9 selected locations in Kerala. Totally 28 tours were undertaken. Out of 35 insect species recorded, 6 insect species on *A. excelsa*, 5 insects species on *M. alba*, 4 insect species on *B. ceiba*, 6 insect species on *D. sissoo*, 6 insect species on *G. arborea*, 4 insect species on *T. populnea* and 4 insect species on *M. dubia* were recorded.

The cercopid, *Clovia* sp. on *G. arborea*; the lepidopteran leaf roller, *Sylepta derogata* and the sap sucker *Paracoccus marginatus* on *T. populnea*; the mealy bug, *Rastrococcus iceryoides* on *B. ceiba*; the sap sucker, *P. marginatus* on *A. excelsa*; the defoliator, *Abirus* sp. on *D. sissoo* were recorded for the first time on these host plants. 3 different *Coccinellid* beetles on the mealy bug, *P. marginatus* of *A. excelsa* and *M. alba* and 2 different species of spiders on *Atteva fabricilla* were recorded as predators. A strain of entomopathogenic fungus was isolated from the naturally infected pupae of Eligma, the Ailanthus defoliator. Influence of biotic and abiotic factors such as temperature, humidity and soil factors on the pests incidences were also recorded.

Project 13: Performance of selected clones of *Casuarina equisetifolia* for insect pests and disease tolerance and their response to biofarming practices [IFGTB/RP-48/2007-10]

Host plant resistance for insect pest

Status: A clonal trial at Sirkali (Nagapattinam district, Tamil Nadu) was established to assess the incidence of bark feeder, *Inderbela quadrinotata* and, thereby, to select the resistant candidates. Field screening of trees in the clonal and provenance trials of Casuarina at Coimbatore and Punducherry for incidence of the bark feeder carried out. Feeding preference and growth of the bark feeder, *I. quadrinotata* on different Casuarina clones studied in the lab and field condition. Wood samples of selected provenances of Casuarina were analysed for phenols, lipids and tannin contents to correlate the feeding preference or deterrence of the bark feeder.

Pathogenicity test was carried out by inoculating *C. equiesetifolia* seedlings with trichosporium spores under controlled condition and symptoms of infection identified and assessed. Analysis of physical properties of the soil samples showed that the alkaline pH and poor drained clay soil tends to enhance infection by *T. vesiculosum* at Panampally Field Research Station in Kerala. Blister bark disease symptoms was not observed in the trees grown in fertile sandy soil with low moisture holding capacity at Karunya Nagar, Coimbatore.

Chemical properties of macro, micro-nutrients and growth regulators of Panchagavya and Dasagavya were analysed. Seedlings of Casuarina, Eucalyptus and Teak in a nursery trial were sprayed with 12 concentrations of Panchagavya & Dasagavya. Spraying of 3-10% solution of Panchagavya and Dasagavya in nursery showed reduction of 25% gall infection in Eucalyptus, 15% reduction of scale insect in Casuarina and 15% reduction of Mealy bug in Teak as compared to control.

Project 14: Screening and identification of potential isolates of Ectomycorrhizal fungi for increased productivity of Acacia, Casuarina and Eucalyptus tree species in nursery [IFGTB/RP-51/2007-10]

Status: Pure cultures of different isolates of Ectomycorrhizal (ECM) fungi such as *Laccaria fraterna* and *Pisolithus albus* were made and maintained in the culture bank. Standardized

suitable culture medium for mass production of different isolates of selected ECM fungi under *in vitro* condition.

Data on growth parameters such as shoot & root lengths, leaf numbers, collar diameter, fresh and dry weights of shoot and roots of both ECM inoculated and uninoculated (control) seedlings of Acacias viz, *Acacia auriculiformis* and *A. mangium* were recorded at different intervals of time. The results revealed that the seedlings inoculated with basidiospore and vegetative mycelial inocula of ECM fungi showed better growth performance, followed by alginate bead and basidiospore inoculum of ECM fungi over uninoculated control.

Studies on morphological and anatomical features of roots of both ECM fungi inoculated and uninoculated (control) seedlings of *Acacia* species for assessing the persistence of the inoculant ECM fungi revealed that more mycorrhizal tips in the roots of *Acacia auriculiformis* and *A. mangium* grown in sterilized (autoclaved) potting medium as compared to unsterilized potting medium.

Project 15: Evaluation of improved germplasm of *Eucalyptus camaldulensis* and *E. tereticornis* for productivity, wood traits, tolerance to insect pests and diseases and management for higher seed production [IFGTB/RP-47/2007-10]

Status: Wood samples of 37 prioritized clones collected from Karunya and Sathyavedu were submitted to IWST, Bangaluru, Kerala Agricultural University (KAU) and Tamil Nadu Paper Mills Ltd., for various wood traits (the fibre length, fibre width, lumen width, wall thickness, fibre length/fibre width ratio, and specific gravity) and pulping quality (Kappa number, Pulp yield, Strength properties such as Tear factor, Breaking length and Burst factor, soft wood, hard wood and bark ratio). Analysis of pulping characters for 37 clones and wood traits for 14 clones have been completed. Among 37 clones, 7 were found to be the best for pulp yield and pulp quality.

Continued Insect pests and diseases surveys carried out on 80 clones of Eucalyptus in 5 replications at Sathyavedu, 50 clones in 5 replications at Kulathupuzha, 100 clones in 5 replications at Karunya and 27 clones at Forest campus, Coimbatore at a regular intervals revealed the incidence of different species of insects (stem borer, termite, aphid, grass hopper) and diseases (leaf spot caused by *Cercospora eucalypti*, leaf blight caused by Alternaria and Pink disease caused by Cylindrocladium), including the major problem of gall insect during different seasons. The per cent incidence and intensity of attack and identity of these pests and diseases and influence of biotic and abiotic factors on occurrence and spread of the pest and diseases were assessed. Based on the field observations so far collected, the clones were categorized (less susceptible, Moderately susceptible and Highly Suceptible) for the key pests and diseases problems.

Pretreatment observations on seed yield viz., number of fruiting branches, number of bunches in each branch and number of fruitlets in each bunch at two SPAs of *Eucalyptus camaldulensis* and *E. tereticornis* completed and the trees were selected and marked for imposing treatments to increase seed yield. The data on height and gbh of selected Eucalyptus trees were recorded. Initiated action for imposing different treatments to increase seed yield in Karunya (Tamil Nadu) and Panampally (Kerala).

Project 16: Studies on efficacy of secondary plant derivatives of *Aegle marmelos* on important insect pests of teak [IFGTB/RP-50/2007-09]

Status: Variation of different groups of bioactive compounds of secondary plant metabolites were analysed from the extracts of three different tissues of *A. marmelos* and *A. sapota* (fruit,

unripen fruit and seeds). The identified elutants of phenols, phenolics and polyphenols were further fractionated and analysed through TLC-UV method of characterization, and about 11 fractions of each tissue (total 30 fractions) were purified by HPLC and GC-MS-MS methods in comparison with 11 standards (sigma standards). About 13 individual compounds (identified from 3 tissues of *A. marmelos* and *A. sapota* viz. fruit, unripen and seeds) were tested for their bioactivity on the target pest, *H. puera* larvae. Only three compounds were showing biopesticidal effect at the concentrations ranging from 250 to 1000 ppm. Project got extended for two years (2009-2011) for conducting further experiments in order to conclude the results for making preformulation.

EXTERNALLY AIDED PROJECTS

Project 1: Establishment of Bamboo model Plantations in different Agroclimatic Zones of Tamil Nadu using Quality planting Stock [IFGTB/EF-RP-21/2005-08]

Status: Bamboo model plantations were created in 20 ha area during 2006-07, 40 ha in 2007-08 and 30 ha in 2008-09 using quality planting stock raised through seedling, macro-propagation and tissue culture of *Bambusa bambos*, *Bambusa nutans*, *Bambusa tulda*, *Bambusa vulgaris*, *Bambusa balcooa*, *Dendrocalamus strictus* and *Dendrocalamus stocksii*. The plantations were raised in different locations covering six agroclimatic zones of Tamil Nadu namely North-Western zone, North-Eastern zone, Northern zone, Cauvery Delta zone, Western zone and high altitude zone. A total of 90 ha plantations have been created as against the target of 100 ha. Preparatory works are on in remaining 10 ha area and planting will be carried out during monsoon. Bamboo Planting stocks of various species (seedling, macropropagated and Tissue Culture) are maintained in the nursery for planting out in the field. The growth performance of bamboo species within a location and across locations have been assessed periodically. Data on rainfall, temperature, humidity have been collected and soil analysis both for macro and selected micro-nutrients were completed for all locations. *B. tulda, B. nutans* and *B. balcooa* grow well in all the zones. *B. vulgaris* produces more culms while *B. tulda* produces moderate number of culms in all the zones. *B. bambos* grows well in plains with moderate culm production. Further observations are required to arrive at definite conclusion. The project has been extended till 2010.

Project 2: Bamboo Location Trial (BLT) – Funded by NMBA, TIFAC, DST [IFGTB/EF-RP-23/2005-07]

Status: This is a coordinated project carried out throughout the country, funded by the National Mission on Bamboo Applcations, through the Bamboo Coordinating Centre, GB Pant University of Agriculture and Technology, Pantnagar. In Tamil Nadu, the trials were laid out at IFGTB Field Station, Bharathiyar University Campus, Coimbatore during September–October 2007. The trials include species trial and Irrigation trial, Fertilization trial and Spacing trial with one species. The trials are not yet due for assessment. The project has been extended till 2010.

Project 3: Ecorestoration for Tsunami devastated coastline of Andaman Group of Islands [IFGTB/EF-RP-20/2004-08] (Extended upto June 2009)

Status: The objective of the project is to create "bioshield" in 60 ha along the vulnerable coastal area of different islands of Andaman group of Islands. Out of the total target, an area of 50 ha. has been completed so far in Sippighat, Chouldari, Kadakachang, Adajig, Rangat, Long Island and Casuarina Bay. About 300 Forest Department staff of Andaman have been trained in the establishment and management of nurseries and plantations. Insect pest problem on the

younger plantation was addressed. The nursery and planting activities has provided opportunities for the local people to improve their economic status.

Project 4: Bio-production of secondary metabolites from *Aegle marmelos* [IFGTB/EF-RP-28/2007-09]

Status: Metabolite profile of roots, stem, leaves, and primary branches of the wild plants was developed. Compact callus aggregates for callus obtained from different explants was optimized for increased growth in suspension cultures. Analysis of secondary metabolites in suspension cultures was carried out. Plant and human pathogens were tested with extracts from callii obtained using different explants to assay the efficacy of the active principles in the callii. Active principles present in the callii showed inhibitory effects on the pathogens.

Project 5: Differential Analysis of Transcript Expression in Casuarina – Trichosporium Interaction to Isolate Defense – Related Genes [IFGTB/EF-RP-26/2006-10]

Status: The project aimed at isolating defence–related genes from *Casuarina equisetifolia* during pathogen elicitation. Profiling was conducted in untreated and elicitor treated tissues of *C. equisetifolia* and differentially expressed transcripts were identified. The transcripts showing significant similarity to existing genes in public domain database included chitinase, glucanase, resistance genes, nodulin, arabinogalactan, proteasome and cytochrome oxidase. Presently, full length gene isolation is in progress for chitinase, glucanase, resistance gene, arabinogalactan and cytochrome oxidase. A simple and cost effective protocol for isolation of total RNA from different tissues of tree species using non hazardous chemicals and the downstream synthesis of cDNA synthesis using un purified RNA has been developed and is in the process for filing of patent.

Project 6: Developing strategies for describing, testing and registering varieties of forest tree species in India [IFGTB/EF-RP-30/2006-08] (Extended up to 2009)

Status: The project aims at development of descriptors for genetically superior genotypes of Eucalyptus and Casuarina for the purpose of testing and registration of varieties. IFGTB has developed genetically superior clones of Eucalyptus and Casuarina through the systematic breeding programmes implemented during the past decade. These clones were studied for their unique characters to discriminate each of them. Leaf samples were collected from the trial plots of *Eucalyptus camaldulensis, E. tereticornis, Casuarina equisetifolia* and *C. junghuhniana* and characterized for their leaf morphology. Flower samples were also collected from these clones and subjected to image analysis. Probable characters which can be used as descriptors for these species were identified. These characters include both vegetative and reproductive characters. About 30 clones of Eucalyptus were characterized using morphological descriptors and Image Analyser data. The characteristic features of cladodes of Casuarina clones were recorded. The needle colour, number of scaly leaves per node and cladodes thickness was studied to distinguish the clones.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Progeny testing of selected clones for establishment of clonal and seedling seed orchards in Eucalyptus [IFGTB/RP-55/2008-14)

Status: The Institute has identified about 110 clones from the first generation seed orchards of Eucalyptus. These clones have been tested for their growth superiority in three different

locations established during 2000. In this project, the genetic worthiness of their progenies need be tested and Clonal Seed Orchards (CSO) be established with tested clones for production of genetically superior seeds. During this year, the clonal trials of Karunya Nagar, Sathyavedu and Kulathupuzha were assessed and identified about 50 best performing clones. Seeds of these clones were collected and their progenies were raised in the nursery. About 25000 seedlings belonging to 50 families were raised for establishment of progeny test in two different locations. A Vegetative Multiplication Garden (VMG) was established for mass multiplication of these best performing clones. Shoots were collected from the VMG and multiplied clonally for establishment of CSOs. About 10,000 clonally multiplied plants belonging to 50 clones were raised for establishment of CSOs in 10 ha area in Tamil Nadu and Andhra Pradesh.

Project 2: Developing Genetic Improvement of Casuarina Species through Second Generation Orchards [IFGTB/RP-56/2008-14]

Status: Selected 250 outstanding trees in terms of growth, form and wood traits from 8 first generation orchards located in Andhra Pradesh, Punducherry and Tamil Nadu. Collected open-pollinated seeds from the selected trees and raised seedlings with family identity. Established two progeny trials-cum-second generation seedling seed orchards with 150 families each at Pugalur (Tamil Nadu) and Tirupati (Andhra Pradesh). These trials were planted in incomplete block design with 6 replications and each family was represented by a 4 trees plot in each replication. Assessed all the plants in both the trials for survival and growth at 6 months age. The survival has been above 90% in both the trials with a mean height of 2.5 m in Pugalur and 2 m in Tirupati.

Project 3: Developing Cloning Techniques for Raising High Yielding Clonal Plantations of *Casuarina equisetifolia* L. [IFGTB/RP-57/2008-11]

Status: Identified the experimental sites at Karunya Nagar and Panampally and initiated the studies. Selected trees were coppiced at various heights (15, 30, 45, 60, 100 and 150 cms from the ground level) and applied 3 treatments (fertilizer, mulching and growth regulator application). Coppice shoot initiation was observed in 89% of the trees felled. Coppicing at 45 and 60 cm was found to be better for shoot induction. Cladodes and needles collected from these coppice shoots were kept for rooting studies in the model nursery. Rooting could be observed in both cladodes and needle explants. Attempts are being made to standardize the technique to develop plantlets from individual needles.

Project 4: Allelic diversity of CCR gene in *Casuarina equisetifolia* [IFGTB/60/RP-2008-11]

Status: Fifty clones of *Casuarina equisetifolia* wood samples were collected using increment borer from IFGTB Model nursery. Cellulose content was estimated using UV/VIS spectroscopy method. Based on the absorption mean, twenty five clones were selected for the proximate analysis. An estimation of hollo cellulose and lignin content was evaluated for 25 selected clones. The range between the hollo cellulose was 74% to 80%, whereas in lignin, content was 24% to 53% among the twenty five clones. Nucleotides of CCR gene in Eucalyptus, Leuceana, Pines and *Populus* species were downloaded from NCBI data Library. Twenty two CCR gene primers were designed and synthesized.

Project 5: Identification of biochemical markers linked to sex determination in *Casuarina equisetifolia* [IFGTB-61/RP-2008-11]

Status: Twelve Isoenzymes (AAT, ADH, EST, PPO, POD, GDH, IDH, SOD, MDH, ME, LDH and G6PDH) were optimized in *Casuarina equisetifolia* clones. Casuarina young needles were collected from IFGTB model nursery and leaf tissues were extracted using 0.1M Tris Hcl

extraction buffer with additives. Isoenzymes were profiled in 10% polyacrylamide gel electrophoresis system, stained with specific substrates for 12 different isoenzymes and the images were documented. Observations were made on the banding patterns of male female individuals, five enzymes (AAT, POD, IDH, LDH and GDH) were shown distinct banding profiles between male and female clones.

Project 6: Quantitative Trait Locii (QTL) mapping in eucalypts for salinity tolerance and adventitious rooting [IFGTB/RP-62/2008-11]

Status: Pollen and seed parents of *E. camaldulensis, E. tereticornis* and *E. grandis* were selected for the development of inter-specific hybrids. Controlled pollination work on *E. camaldulensis* x *E.grandis* was completed to generate F_1 hybrids for the establishment of mapping population. Twenty microsatellite primer sets were synthesized and their transferability to *E. camaldulensis* was assessed.

Project 7: Identification of secondary xylem specific cellulose synthase genes from *Eucalyptus tereticornis* [IFGTB/RP-63/2008-11]

Status: Nucleotide and protein sequences of Cellulose synthase were assembled from public domain database, aligned and primer pairs were generated. The primer pairs targeting different groups of cellulose synthase were amplified in the wood tissues of *E. tereticornis* with complementary DNA as the template. Amplicons generated were sequenced and their similarity with the existing genes was determined.

Project 8: Studies on response of important tree species to elevated CO_2 levels under simulated temperature and moisture regimes at seedling stage [IFGTB/RP-69/2008-09]

Status: Project was initiated in July 2008. Fabrication of Open Top Chambers (OTC) with CO_2 analyzer and the SCADA platform-the controlling device is in progress. After the OTC becomes operational, the experiments will be initiated in June 2009.

Project 9: Studies on the suitability of *Eucalyptus tereticornis* and *E. camaldulensis* clones for various agroclimatic zones of Southern India [IFGTB/RP-58/2008-13]

Status: Shoots of thirty clones of *Eucalyptus tereticornis* and *E. camaldulensis* were collected from Satyavedu and Karunyanagar clonal trials and raised in the root trainer. With these ramets Vegetative Multiplication Garden (VMG) was established in Bharathiar University during September 2008. Forest departments of Punducherry and Andhra Pradesh and the Agricultural College at Karaikal have allotted land for the trials. Land has been inspected in six locations, viz., Punducherry, Karaikal, Warangal, Rajmundhry, Hyderabad and Tirupati. The multiplication of the clonal material is in progress.

Project 10: Status and influence of microbial inoculants associated with Eucalyptus clones in established breeding populations [IFGTB/RP-65/2008-11]

Status: Rhizosphere soil samples collected from 31 clones of Eucalyptus at three different clonal trials of Eucalyptus located at Sathyavedu (Andhra Pradesh), Karunya (Tamil Nadu) and Kulathupuzha (Kerala) were analysed for presence of AM fungi and PGPRs . AM fungi, *Glomus viscosa* and *G. geosporum* and the PGPRs, *Bacillus meagaterium*, *Pseudomonas striata, Azatobacter insignis* and *Azospirillum brasilense* isolated from the soil samples of certain clones were multiplied in sterilized soil and artificial media respectively. Interestingly, specific association of certain PGPRs with certain clones was observed. These PGPRs were multiplied in nutrient broth as well as carrier material (Charcoal) as shelf life forms.

The PGPR, *Bacillus megaterium* was tested on Eucalyptus stem cuttings and found that it induces rooting in stem cuttings. Stem cuttings of 17 selective clones collected from Sathyavedu and Karunya clonal trials and inoculated with PGPRs. Stem cuttings treated with IBA were kept as control. The results obtained showed significant variations on rooting percent age and time taken for rooting among the clones tested. The rooting percentage was observed to vary from 45-81 while the time taken for rooting varied from 14-20 days.

Project 11: Characterization and evaluation of allelochemical profiles of some economically important, insect pest resistant tree species [IFGTB/RP-68/2008-10]

Status: Regular field screenings of *Acacia mangium*, *A. auriculiformis* and *Ailanthus excelsa* populations for selection of insect pest resistant candidates were carried out and level of incidence and extent of damage caused by the pests, *Myllocerus* sp. on *Acacia* sp. and *Eligma narcissus* and *Atteva fabricella* on Ailanthus seed sources/ provenances were assessed. In order to understand the biochemical basis of resistance in Casuarina, Teak and Eucalypts against the targeted key pests estimation of chemical constituents like Tannins, phenols lipids in the leaves of teak and Eucalypts and bark and wood of Casuarinas carried out.

Project 12: Characterization of Eucalyptus clones for Physiological and Nutritional parameters [IFGTB/RP-59/2008-11]

Status: For establishment of field trials to evaluate the Eucalyptus clones for water and nutrient use efficiency, vegetative multiplication garden was established and the production of ramets is under progress. Fields were identified in Tirunelveli, Sivagangai and Pudukottai for establishment of field trials. For the short-listed 30 Eucalyptus clones, parameters like chlorophyll A, chlorophyll B, total chlorophyll and total leaf area were worked out. For carrying out the carbon isotop discrimination studies for estimation of water use efficiency of 30 clones, wood samples were collected and powdered for analysis at University of Agriculture Sciences, Bangaluru.

Project 13: Some phytochemical, toxicological, pharmacological investigations of *Aegle marmelos* for a new product [IFGTB/RP-66/2008-11]

Status: The different tissues, leaf, ripened & unripened fruits of *Aegle marmelos* were sequentially extracted with aqueous and other organic solvents. Extracts fractionated through XAD- 16 resin packed column were analysed for chemical analysis such as primary nutrients, phenols, alkaloids, flavonoids, tannins, saponins, enzymes like PO, PPO, PAL, TAL, individual fatty acids etc. in order to evaluate the tissue specific pharmacological screening of the extracts. And, assessed the efficacy on CUMS (Chronic Unpredictable Mild Stress) especially on stress, antioxidant, behaviour etc. The dried micro-sieved crude powder of those tissues tested for preliminary pharmacological screening on animal showed, that leaves shown less antioxidant activity in super oxide and nitric oxide scavenging activity, ripen and unripen fruits exhibited similar antioxidant activity in super oxide and nitric oxide scavenging activity and all the three crude extracts shown similar reducing power activity. Among the three antioxidant activity studied super oxide scavenging activity found to be better. The observation has to be further confirmed and compared with the extracts. The work is in progress.

Project 14: Bioinformatic approach to data mine wood forming genes of Eucalyptus [IFGTB/RP-64/2008-11]

Status: Sequences have been downloaded for the following wood formation genes PAL (Phenylalanine Ammonia-Lyase), 4CL (4-Hydroxycinnamoyl CoA ligase), C3H (p-Coumarate 3-hydroxylase): Identification of conserved regions and primer designing carried out for the above genes.

EXTERNALLY AIDED PROJECTS

Project 1: New biocontrol opportunities for prickly Acacia : exploration in India [IFGTB/EF-RP-32/2008-11]

Status: Availability data of young *Acacia nilotica* plantations with the State Forest divisions of 17 districts of Tamil Nadu and 3 districts of Karnataka were collected. Field visits were made to the plantations at these districts and 20 suitable sites for regular surveys selected. Two rounds of Surveys at *Acacia nilotica* tank bed plantations, isolated trees in the agricultural lands and at the roadside at 63 locations in 17 districts of Tamil Nadu and 1 round of survey at 9 locations in 3 districts of Karnataka were carried out. About 48 species of insects and 13 species of pathogens infesting different parts of *A. nilotica* were documented.

Out of 48 insect species, 29 were identified.

Out of 13 species of pathogens, 8 were identified.

Herbarium of (32), host (19) and pathogens (13) and preservation and pinning and labeling of 48 species of insects were done.

Out of 48 species of insects and 13 species of pathogens recorded so far, 4 species of insects (1 sap sucker and 3 defoliators) and 6 species of pathogens were prioritized for further host specificity and pathogenicity studies. Stock culture of these species were raised and being maintained in the lab. Host specificity study with 2 species of defoliators and Pathogenicity study with 3 species of pathogenic fungi were initiated at the glass house. Exclusion trial to assess the impact of insects and pathogens on seedlings of *A. nilotica* has been established and 12 data on incidence of insects and pathogen and 6 data on growth parameters have so far been collected.

Project 2: Improving productivity of bamboo in farmlands of Tamil Nadu [IFGTB/EF-RP-34/2008-11]

Status: The project is funded by the National Bamboo Mission. During April-May 2008, a visit was made to North-East India and planting stock for silvicultural trials and germplasm for the bambusetum were procured and assembled in Coimbatore from the States of Assam and Arunachal Pradesh. Around 30 species for bamboo germplasm bank were collected from Assam and Arunachal Pradesh while 24 Candidate Plus Clumps (CPCs) for bamboo multiplication garden were assembled from Rain Forest Research Institute, Jorhat, Assam. Around 9,180 nos. of quality planting stock belonging to 4 species for the silvicultural trials were assembled from Forest Department nurseries at Guwahati & Kokrajhar in Assam and from State Forest Research Institute, Itanagar in Arunachal Pradesh. Silvicultural trials have been established at Alagampatti, K. Nedungulam and Kayathar in southern agroclimatic zone.

Project 3: A value chain on industrial agroforestry in Tamil Nadu [IFGTB/EF-RP-34/2008-11]

Status: In this project funded by the World Bank through the Indian Council of Agricultural Research, as a part of the National Agricultural Innovation Project, through a Consortium consisting of Research Institutes, Paper Industries and Farmers, the Institute is required to produce and supply genetically improved quality planting stock of Eucalyptus and Casuarina for planting in the farmers' fields and also identify new genetic material for improved productivity. During the year, a Vegetative Multiplication Garden of Eucalyptus was established

over 0.5 ha and a clonal plantation of Eucalyptus was established over 1 ha. A progeny trial of *Casuarina equisetifolia* was established in 2 ha.

TECHNOLOGY ASSESSED AND TRANSFERRED

- Standardized suitable culture medium for mass production of different isolates of Ectomycorrhizal fungi (*Laccaria fraterna* and *Pisolithus albus*) under *in vitro.*
- Serious pest problems in nursery and plantations of fast growing indigenous tree species such as *Ailanthus excelsa, Melia dubia, Gmelina arborea, Thespesia populnea, Bombax* spp. and *Dalbergia sissoo* in Tamil Nadu and Kerala were identified.
- Eucalyptus clones categorized based on the susceptibility for key pests and disease problems.
- Post harvest techniques on *Jatropha curcas* was disseminated to farmers and foresters.
- Seed handling techniques of important NTFPs was disseminated to farmers in the technical workshop on tree cultivation.

EDUCATION AND TRAINING

A. Conducted

- Profitable cultivation of Casuarina at Solasiramani village, conducted by Sehsasayee Papers and Boards Limited, Erode on 9th October 2008 and 19th March 2009.
- Profitable cultivation of Casuarina and Eucalyptus at Tamil Nadu Newsprint and Papers Limited, Kagithapuram on 23rd February 2009.
- Training programme for Foresters, Farmers, NGOs and others on Tree Borne Oilseeds with special emphasis on *Jatropha curcas* on 12th and 13th August 2008, IFGTB, Coimbatore.

Training Programme on Tree Borne Oil Seeds.

The National Oilseeds and Vegetable Oils Development Board sponsored five "Farmers training programmes and two Trainers Training Programmes". The Training of Trainers (ToT) programme for field functionaries of Forest, Agriculture, Horticulture and Rural Development departments, on Tree Borne Oil Seeds (TBOS), was organized on 2nd February 2009 and 26th March 2009 to enhance their skills and knowledge on TBOS with the objective to train the farmers and other user groups involved in cultivation and management of TBOS. It was also to popularize such crops among farming community for adoption. About 200 officials participated in the training programme. The farmers training programme was organised at Coimbatore (30th January 2009), Tiruvannamalai (13th February 2009), Sathyamangalam (28th February 2009), Tirunelveli (20th March 2009) and Salem (25th March 2009) to reach out to a larger section of the farmers across districts in the State. A total of more than 600 farmers participated in the training. The training covered all aspects of TBOS like cultivation and management of important oilseed crops suitable for Tamil Nadu, seed handling and storage techniques, TBOS based agroforestry models, genetic improvement strategies and pest and disease management.

Training Programme on Bamboo Cultivation and Management

The Institute organized three five days training programme on Bamboo Cultivation and Management for officers of the Agriculture and Horticulture Departments of Tamil Nadu. The Training Programme was sponsored by Tamil Nadu Horticultural Development Agency

(TNHDA). A total of 100 officers were trained. The officers were provided with an overview of the bamboo resources in India, the cultivation and management of various bamboo species in farm fields, bamboo cultivation in agroforestry, nursery management, disease and pest management, harvesting of bamboo, the marketing issues, etc. The participants were taken to fields where bamboo is planted and managed, Bambusetum maintained by the institute, KFRI and Bamboo Development Society at Palakkad. Hands on training was imparted on nursery techniques. The training was conducted by the internal resource persons and persons from KFRI, Peechi.

Training on Post Harvest Techniques of Jatropha

- Hands on training on post harvest techniques of *Jatropha curcas* was given for Tribal Women's Self Help Group of Vattalukki village, Attapady on 23rd March 2009 at IFGTB, Coimbatore. The training was sponsored by Department of Biotechnology, New Delhi.
- Hands on two days training programme for farmers, foresters, NGOs and others on "Tree Borne Oilseeds with special focus on *Jatropha curcas*" under the DBT project on *Jatropha curcas* on 12th and 13th August 2008 at IFGTB.

B. Attended

- Molecular methodologies for assessing and applying genetic diversity in crop breeding conducted by ICRISAT, Hyderabad from 17th to 28th November 2008.
- 'Project formulation, Implementation and Evaluation' from 21st April to 2nd May 2008 at the Administrative staff college of India, Hyderabad.
- Research Management at the Administrative staff college of India, Hyderabad during March 2009.
- Main Streaming Biodiversity for Impact Assessment at Wildlife Institute of India, Dehradun from 18th to 22nd August 2008.

LINKAGES AND COLLABORATION

- Following a request from the Orissa Forest Sector Development Project, prepared a project proposal titled "Establishing Advance Generation Seed Orchards of Casuarina species in Orissa" and sent to Orissa Forest Department for collaborative implementation.
- Following a request from the Forest Department of Gujarat, prepared a technical guidelines and statistical design for "Evaluation and selection of genetically improved Eucalyptus seeds source(s) suitable for planting in Gujarat" and sent along with seedlots on 21st July 2008.
- Linkages and collaboration were established with the Rhizogenesis group, Institute de Recherche pour le Dévelopment (IRD), 911 Avenue Agropolis, BP 64 501, 34394, Montpellier Cedex 5, France in the areas of Development of post transcriptional gene silencing approaches as a tool for functional analysis in Casuarina.
- The research cum extension project on 'Demonstration of agroforestry technologies in different agroclimatic zones of Tamil Nadu' has been formulated in discussion and collaboration with National Research Centre for Agroforestry (NRCAF) and Forest College and Research Institute (FC&RI) to disseminate the agroforestry practices and technologies developed by IFGTB, NRCAF and FC&RI. The project is being implemented from July 2007. Interaction meeting was held at IFGTB on 13th May 2008 with scientists from NRCAF-Dr. O.P. Chaturvedi, Dr. A.K. Handa, Dr. A. Venkatesh, and Dr. M.P. Divya, Associate professor, FC&RI. In the discussion meeting, suggestions were made on the promising tree components for different agroclimatic zones of Tamil Nadu.

- The National Agricultural Innovation Project (NAIP) is being implemented in collaboration with the Forest College & Research Institute of the Tamil Nadu Agricultural University, Tamil Nadu Newsprint and Paper Ltd., Seshasayee Paper and Boards Ltd. and clusters of farmers in two districts.

PUBLICATION

- Nicodemus, A., 2009. Casuarina: A Guide for Cultivation. Institute of Forest Genetics and Tree Breeding, Coimbatore.

CONSULTANCIES

- Andhra Pradesh Paper Mills, Rajahmundry on genetic improvement of Casuarina through seed orchards from 31st July to 2nd August 2008 and from 18th to 20th March 2009.
- A consultancy for three months period (January 2008 to April 2009) on DNA profiling of Eucalyptus and *Acacia* hybrids for Mysore Paper Mills, Bhadravathi, Karnataka.
- Preparation of Forest and Ecological Management Plan for Sriharikota Island, awarded by the Department of Space, Government of India.
- Paration of Catchment Area Treatment (CAT) Plan for bauxite mining in Jarrela blocks of Reserve Forests, Visakhapatnam, Andhra Pradesh, awarded by Andhra Pradesh Mineral Development Corporation (APMDC) Ltd., Hyderabad, Andhra Pradesh.
- Preparation of Environmental Impact Assessment (EIA)/Environmental Management Plan (EMP) for diversion of forest land for bauxite mining in Jarrela blocks of Reserve Forests, Visakhapatnam, Andhra Pradesh, awarded by Andhra Pradesh Mineral Development Corporation (APMDC) Ltd., Hyderabad, Andhra Pradesh.
- Preparation of Environmental Impact Assessment (EIA)/ Environmental Management Plan (EMP) for diversion of forest land Iron ore mining areas in Ankua Iron ore deposits, Manoharpur, Jharkhand, Awarded by JSW Limited, New Delhi.
- Preparation of Environmental Impact Assessment (EIA)/Environmental Management Plan (EMP) for Sankosh multipurpose Hydroelectric project, Bhutan awarded by Tehri Hydro Electric Development Corporation Ltd.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

1. Attended

The representatives from Institute of Forest Genetics And Tree Breeding, Coimbatore attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

(a) International

1. "Advanced Protein Domain Workshop" at Lyon, France from May 18th to 20th 2008.
2. "Forest Adaptation 2008" an International conference organized by the FAO of UN, IUFRO and SLU, Sweden at Umea, Sweden from 24th to 28th August.
3. International Congress of "Global Warming on Biodiversity of Insects: Management and Conservation", organized by Department of Zoology, School of Life Sciences Bharathiar University, Coimbatore, from 9th to 12th February 2009.
4. International Seminar on "Multidisciplinary Approaches in Plant Systematics", from 11th to 13th October 2008 , Kalyani University, Kalyani, West Bengal.

(b) National

1. National symposium on "Agroforestry Knowledge for Sustainability, Climate Moderation and Challenges Ahead" held from 15th to 17th December 2008 at National Research Centre for Agroforestry, Jhansi.
2. National symposium on "Herbal Drug Research" held on 25th and 26th September 2008 at Bharathiar University, Coimbatore.
3. National symposium on "Sustainable Utilization and Conservation of Medicinal Plants" held on 21st and 22nd August 2008 at Department of Biology and plant Biotechnology, Nirmala college for Women, Coimbatore.
4. National Seminar on "Biodiversity- Status, Conservation and Management", organized by Kongunadu Arts and Science College, Coimbatore on 12th and 13th September 2008. (Sponsored by the Indian Science Congress Association, Kolkata.
5. National workshop on "Sustainable Management of NTFP" on 18th and 19th January 2008, TFRI, Jabalpur.
6. National Seminar on "Bamboo: Plantation, Management and its Utilization" organized by Arid Forest Research Institute, Jodhpur from 17th to 19th March 2009.
7. National Seminar on "Progress, Prospects and Problems in Bamboo Research", Department of Botany, Mercy College, Palakkad.
8. Seminar on "Bamboo Cultivation Practices", Department of Horticulture, Tamil Nadu, at Anamalai hills.
9. International Conference on "Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood", New Delhi from 15th to 17th April 2008.
10. Participated in a Workshop on "Tree Cultivation" on 7th and 8th March 2009 at IFGTB.
11. "Two Institutional Bio-Safety Committee" (IBSC) meetings were organized from 15th October to 30th December 2008.
12. National symposium on "Herbal Drug Research" at School of Life Sciences, Department of Botany, Bharathiar University, Coimbatore on 25th and 26th September 2008.
13. "Facets of Cecidology : Intricacies of Insect – Plant Interactions" organized by Prof. T.N. Ananthakrishnan, Ex-Director Zoological Survey of India, Chennai on 5th December 2008.

2. Organised

1. One week refresher course on "Recent advances in forestry research" was organized for IFS officers from 1st to 5th December 2008.
2. IFGTB organised Tree Growers Workshop on 7th and 8th March 2009 in collaboration with the Extension wing of Tamil Nadu Forest Department. The workshop was inaugurated by Dr. C.K. Sreedharan, PCCF, Tamil Nadu, Dr. Rabindra Kumar, DDG (Extension), ICFRE presided.
3. An interactive meeting was held between the officials and scientists of IFGTB and officials of the Tamil Nadu Forest Department on 12th November 2008 at the Forest Headquarters, Chennai. Dr. C.K. Sreedharan, IFS, Principal Chief Conservator of Forests delivered the key note address and emphasized the need for research on catchment area management,

biodiversity assessment, planting on private lands, carbon trading, etc. relevant for the state.

4. An interactive meeting between Department of Environment and Forests, Andaman and Nicobar Islands and IFGTB on Forestry Research was held on 12th January 2009.
5. An interactive meeting was held with the Punducherry Forest Department at IFGTB on 6th February 2009. Dr. P. Devaraj, Conservator of Forests and Chief Wildlife Warden, Punducherry explained in detail the activities carried out by the Department.
6. Meeting on Finalization of List of Non-target species (Plants & Insects) for Safety Testing for Parasitoids of Eucalyptus Gall Wasp was held at IFGTB on 25th February 2009. The Meeting was chaired by Dr. R.J. Rabindra, Director, National Bureau of Agriculturally Important Insects (NBAII), Bangalore. Dr. N. Krishnakumar, Director, IFGTB, co-chaired the meeting. The list of non-target plants /insects for safety testing was drawn.
7. An Interactive workshop between IFGTB and wood based industries of Tamil Nadu and Kerala was held on 5th March 2009 at IFGTB.

MISCELLANEOUS

- Womens' harassment cell meeting was conducted.
- Quality seeds of *Eucalyptus camaldulensis*, *Casuarina equisetifolia* and *C. junghuhniana* were collected from seed orchards established by IFGTB and supplied to Forest Departments, farmers and wood based industries.
- Organized International biological diversity day on 22nd May 2008 at IFGTB Coimbatore.

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY BANGALURU

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

An abstract of projects run by the Institute is as follows:

		No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
IWST, Bangaluru	Plan Projects	13	10	14
	External Aided Projects	7	19	10
FRC, Hyderabad	Plan Projects	2	2	1
	External Aided Projects	Nil	Nil	Nil
	Total	**22**	**31**	**25**

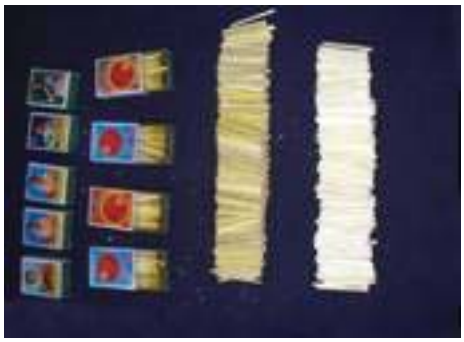
PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Processing and evaluation of plantation grown *Simarouba glauca* DC from Orissa [IWST/WPU/X-59/2006-09]

Findings: Studies carried out on *Simarouba glauca* showed that the timber is dimensionally stable. Dries very quickly (4-6 days from 80% to 14-16%) without any sawing and seasoning defects. The timber was classified as moderately heavy, weak, not tough, very soft and very steady.

The timber has been found suitable for making artifacts and meet the requirements. The timber was also found suitable for match sticks. The timber can be used for tool handles, light furniture, light packing cases and found good for making 'BWR' grade plywood. Preliminary work indicated the potential of using wood for pencil making. Larger quantity of wood is required for commercial application. The timber has around 62-65% cellulose content. The seeds of the tree contain around 50-55% oil.



Various products made out of *Simarouba glauca* DC

Project 2: Evaluation of wood quality of Eucalyptus clones and plantation grown *Grevillea robusta* A. Cunn. Based on Spiral grain [IWST/WPU/XI-73/2007-09]

Findings: Sixty poles of Eucalyptus clones have been procured from two different locations (Mandya and Kolar) and also 5 trees of *G. robusta* for determination of specific gravity, shrinkage, spiral grain angle and nail holding properties. Heritability study of spiral grain and description of gross anatomy were also made. Screening of clones based on lesser grain distortion and shrinkage values completed. Data being analyzed for identifying better clones. Project completion report is under preparation.

Project 3: Effect of particle size on properties of wood filled polypropylene composites [IWST/WSP/X-53/2006-09]

Findings: Combining biological fibres and commercial plastics can bring in transition to safer and more environmentally friendly composites. Addition of wood flour to polypropylene, at all levels, resulted in more rigid and tenacious composites. Particle size and filler morphology was found to have significant effect on properties of filled composites. Particles having size between 52 and 85 mesh provides the best properties. A micro-mechanics model was developed based on shear lag theory. The properties predicted by the model were in good agreement with experimentally observed values.

A fast and reliable method to measure elastic constants using vibration method was developed. A significant improvement in density, dynamic MoE and shear modulus was observed in wood-filled polypropylene composites with the increasing wood content. The improvement in modulus was nearly 100% as against 17% improvement in density at 50% filler loading. Higher aspect ratio in wood flour resulted in better MoE. The changes in the modulus of the composites with the change in filler content were further explained using Halpin Tsai model. The model predicted values were in close agreement with the experimentally observed values.

Project 4: Studies on the durability of treated and untreated timbers of selected species [IWST/WSP/X-34/2004-09]

Findings: Six species of plantation grown timbers (12-15 years) *Artocarpus heterophyllus*, *Lophapetalum wightianum*, *Lagerstroemia lanceolata*, *Spodias pinnata*, *Melia azadirachta* and *Sterospermum personatum* were subjected to pressure treatment by adopting full cell process with conventional wood preservatives like Copper Chrome Arsenic (CCA), Copper Chrome Boric (CCB) composition for 4 different loading of absorption viz. 4, 8, 12 and 16 kg/m^3 and with Creosote + Furnace oil (1:1) the absorption was 40, 80, 120 and 160 kg/m^3. The treated specimens were exposed to field test in the Test yard along with untreated controls. After 45 months of exposure, it was found that the *Lagerstroemia lanceolata* is the highly durable and the *Lophapetalum wightianum* is the least durable timber as all the specimens destroyed by the termites within 18 months of exposure. All the treated specimens are in sound conditions showing that even 4 kg/m^3 of preservative is sufficient to increase the durability non-durable timbers.

Coppiced and non-coppiced poles of *Eucalyptus tereticornis* and *Eucalyptus camaldulensis*, 2.15 m - 3.10 m length and girth varied from 5 cm to 24 cm. were treated in green condition by sap displacement method and Boucherie method using 2 different concentration of CCB preservative with 2 treatment time. Distribution of preservative along the length of the pole was analyzed. Results show that the specific gravity of coppiced wood was less than the

non-coppiced. In both coppiced and non-coppiced poles, BIS recommended absorption for structural poles and fence posts is 16 kg/m^3 which can be easily achieved in both treatments with 4.25% concentration preservative for 4 days in sap displacement method and 3 hours in Boucherie method. Analysis of preservative chemicals shows that chromium and copper were present throughout the length of the pole. The treatment is more effective at higher moisture content of the pole and it also reduces the treatment time. The absorption of preservatives in coppiced poles is more than that in non-coppiced poles in *Eucalyptus tereticornis* and almost same in the *Eucalyptus camaldulensis*. Dried poles (Moisture content <15%) can also be treated by vacuum pressure method by adopting the treatment schedule, initial vacuum for 30 minutes followed by pressure of 3 kg for 3 hours followed by the final vacuum for 15 minutes. Depending upon the end uses and available facility, proper treatment schedule can be followed to enhance the service life of the coppiced wood and can be used rationally for better purposes without much wasting of the natural resource.

Project 5: Isolation and anti-fungal activities of the chemical compounds of *Baccaurea courtallensis* Muell.Arg. - A wild edible plant of Western Ghats [IWST/CFP/X-64/2006-09]

Findings: Fatty oil content was found to be 22.5% in *Baccaurea courtallensis* Muell. Arg., an endemic tree species of Western Ghats. One saturated fatty acid namely palmitic acid showed 43% and one unsaturated fatty acid namely oleic acid showed 36% as major constituents in the oil which are the first reports so far as fatty oil content and fatty acid composition of this species are concerned. Qualitative phyto-chemical analysis of ethyl acetate extract of the fruit rind of *Baccaurea courtallensis* showed the presence of Tannins and Flavanoids and methanol extract showed the presence of Tannins, Flavonoids and Quinones. Ethyl acetate and Methanol extracts of the fruit rind of *Baccaurea courtallensis* were found to be highly inhibitive to *Fusarium oxysporum* fungi as tested under laboratory conditions.

Project 6: Investigations on chemical composition and utility of AESP oil from exhausted sandal wood powder [IWST/CFP/X-60/2006-09]

Findings: The exhausted sandal wood powder which was considered to be a waste was subject of study for which the optimum acid treatment to yield maximum amount of new oil named AESP oil from exhausted sandalwood powder was determined. UV and GC analysis of AESP oil has been carried out and found that this oil was altogether different from sandal wood oil. The oil was evaluated and found acidic and pungent in nature and the colour of the milky white soap is getting changed. The cosmetic value of the oil is very poor and is not suitable for its application in soap making. Cost effectiveness for 1 kg of AESP oil was worked out. Its potential for other uses has to be worked out.

Project 7: Analysis of active principles in *Gymnema sylvestre* and *Phyllanthus amarus* from the forest of southern India [IWST/CFP/X-46/2005-June 2008)

Findings: They study was conducted in five states namely Karnataka, Tamil Nadu, Andhra Pradesh, Kerala and Goa. Among these five states, 35 MPCA (Medicinal Plant Conservation Area) were selected on the basis of climatic condition. Results show higher active principle content at drier part of MPCA when compared to moist region. It was seen that the variation of active principle ranged from 2% to 6% in *Gymnema sylvestre* and in *Phyllanthus amarus*, Phyllanthin varied from 0.3% to 0.6%. Results show that Kolli hills and Davaryan durga contain highest active princeples respectively. Results are also showing higher active principles content in coastal, dry deciduous and scrub jungle region.

Project 8: Screening and evaluation of wild varieties of *Emblica officinalis* fruit in various agroclimatic zones of Western Ghats [IWST/CFP/X-48/2005-June 2008]

Findings: This study was conducted at ten different locations within the agroclimatic zones of western ghats. Results show that two places of western ghats namely Thenmalai and BRT hills contain high ascorbic acid content. So far as fruit yields are concerned, trees from BRT hills gave higher yield than trees from Thenmalai. Results show that fruit yield is higher in deciduous forests and ascorbic acid content was found to be higher by about 30-40% in deciduous forests.

Project 9: Productivity and interaction studies in *Acacia* hybrid based agroforestry practices in Karnataka [IWST/TIP/X-40/2004-09]

Findings: *Acacia mangium* hybrid block plantation and line planting field trials in Doddaballapur and Kolar (on-farm trials) in 2004-05 were established. In 2008, in Kolar the average ht and gbh of *Acacia* hybrid in line planting was 12m and 40 cm and in Gowribidanur it was 8m and 22 cm, respectively. The average height and gbh of *Acacia* hybrid in Block planting in Kolar was 13m and 28 cm and in Gowribidanur, it was 6m and 17 cm respectively. Intercropping carried out for 3 successive years. Nearly 25-30 % reduction in intercrop yields was observed within 5m distance from tree line under line planting method. Canopy and root management practices helped in minimizing loss in agricultural crop yields in line planting method of planting in both sites. Above Ground Biomass (AGB) was 20-25% more in *Acacia* hybrid trees under line planting. The AGB consisting of stem, branches and leaves in block planting method ranged from 70-80 kg/tree and 90-100 kg/tree in line planting in Kolar site.

Project 10: Assessment of seed quality in unimproved populations, seed production areas and seed orchards of *Tectona grandis* [IWST/TIP/X-48/2005-09]

Findings: Seeds were collected from unimproved populations and SPA at Virnoli, Barchi, Baghwathi and Tittimathi, from CSO at Tittimathi and SSO at Tirupati. Fruit, seed and seedling variability studies showed that overall Tittimathi seed sources was better as compared to other seed sources. Subsequent studies from fruits collected from unimproved population, SPA and CSO at Chandrapur, Maharashtra and Warangal, Andhra Pradesh revealed that germination was highest for seeds from SPA, Chandrapur. Morphological parameters, germination and seedling growth studies revealed improvement in quality of SPA seeds as compared to unimproved populations.

Project 11: Comprehensive tree improvement program for *Gmelina arborea in* Karnataka Phase I- Progeny trial [IWST/TIP/X-41/2004-09)

Findings: Progeny trial was established using progenies of 27 plus trees (17 from Karnataka and 10 from Andhra Pradesh) during July 2007. The progeny trial was established in three replicates with nine seedlings per replicate. Growth data at 15 months indicated that the best performing families were SGA-17 from Karnataka and Andhra Pradesh-10 from Andhra Pradesh. Growth data indicated that best growth in terms of height was seen in case of SGA-17 (192.00 cm) and Andhra Pradesh-10 with average value of 101.33 cm. SGA-7 and Andhra Pradesh-3 were the poor performing families with respect to height growth with values of 90.00 cm and 53.33 cm, respectively. Similar trends were observed for collar diameter with high average values of SGA-17 (23.33 mm) and Andhra Pradesh-10 with average value of (13.33 mm). Whereas, lower values for CD were observed in case of SGA-7 (7.40 mm) and Andhra Pradesh-3 (6.66 mm). It was noted that some of the families from Andhra Pradesh after good initial growth suffered with dieback problem.

Project 12: Fuel properties of important forest weeds [IWST/WE/XI-75/2007-09]

Findings: Study on calorific value, proximate analysis (ash content, volatile content and fixed carbon content) and elemental parameters (carbon, hydrogen, nitrogen and sulphur content) of two forest weeds i.e., *Lantana camara* and *Eupatorium* spp. was carried out. The above study was undertaken with an aim to evaluate the selected forest weeds as a raw material for energy production. Basic density of *Lantana camara* and *Eupatorium* spp. was determined. The calorific value of leaves and stem of *Lantana camara* were found to be 19.17 MJ/kg and 19.02 MJ/kg, respectively. The calorific value and other fuel properties of *Lantana camara* are comparable to *E.* hybrid and *C. equisetifolia*, prominent fuelwood species. The calorific value of *Eupatorium* spp. was found 18.73 MJ/kg. The lower calorific value of *Eupatorium* spp. may be due to their higher ash content (6.07%) as compared to *Lantana* (1.00%). The amount of ultimate carbon in *Eupatorium* spp. and *Lantana camara,* ranges from 43 to 48%.

Project 13: Database Development of IWST Xylarium [IWST/IT/X-58/2006-09]

Findings: Web database prepared for IWST xylarium, GASS forest museum wood specimens collection and IPRITI wood specimens collection. It contains wood specimens related information like xylarium rack number, specimen access number, binomial name of specimen, specimen collector name, specimen collection area, specimen collection date, specimen collection country, specimen collection continent, number of specimen available, whether it is available for mutual exchange, scientific classification of wood specimen, kingdom, division, class, order, family, genus, subgenus, species, author of species, common/trade name, vernacular name, distribution of species, uses, normal picture of specimens anatomical picture of specimens, references.

EXTERNALLY AIDED PROJECTS

Project 1: Study of anatomy and properties of lesser known timbers of North-Eastern State of India with particular reference to Nagaland (Funding agency: Nagaland State Forest Department) [IWST/WPU/EXT/Nagaland SD/019/2007-08]

Findings: Project is completed and a hand book on 25 Nagaland timbers is being prepared. The hand book contains information on trade name, local names, tree form, general features, gross and minute anatomy alongwith photomicrographs. Information on properties and uses wherever available is also provided.

Project 2: Investigations on the mechanisms of success of *Mytilopsis sallei* (Recluz.) in managing toxic load arising out of biodeterioration control measures (Funding agency: Department of Science and Technology, Government of India, New Delhi) [IWST/WBD(M)/EXT/DST/020/2005-08]

Findings: *Mytilopsis sallei*, the marine fouling bivalve, collected both from Visakhapatnam and Kakinada ports responded to background levels of copper and hydrocarbon concentrations, positively. It can release the excess load of copper when transferred to clean seawater, rapidly. The bivalve can accumulate leachates from CCA treated wood according to the amount leached out. The ability to accumulate copper is more in animals collected from Kakinada than at Visakhapatnam. The animal hosts numerous microbes among which two were found to be tolerating heavy concentrations of copper. When exposed to copper and the broad spectrum antibiotic, Streptomycin, the animal accumulated less copper compared to animals exposed to copper concentrations without antibiotic, as the microbes get either killed or their activity reduced. The microbes present in the gut may be helping the bivalve in tolerating and accumulating copper at higher concentrations.

Project 3: Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species (Collaborative project–IWST, KFRI and IFGTB) (Funding agency: Department of Biotechnology) [IWST/TIP/EXT/DST/021/2004-09]

Findings: Established germplasm bank of 21 industrially important bamboo species in 0.5 ha area at Gottipura, Bangaluru. Out of the 21 bamboo species, Candidate Plus Clumps (CPCs) germplasm consisted of 7 industrially important bamboo species. Established field trials of micro and macropropagated five important bamboo species in 15.0 ha area in Karnataka (Gottipura, Nallal near Bangaluru and Yelwala, near Mysore) and Andhra Pradesh (Dulapally, FRC, Hyderabad). Field trials viz; (i) type of planting material (seed base, macro and micropropagated plants) in 5m x 5m spacing (ii) spacing trial (5m x 5m, 5m x 7m and 5m x 9m) and fertilizer trials (*Bambusa bambus* and *D. strictus*) in 5m x 5m spacing were established during July–August 2005. Survival after 6 months varied from 85-100%. Minimum survival was in *D. asper* and maximum is in *D. strictus.* Micropropagated plants were comparable with seed and cutting raised plants. At the age of 40 months, maximum height (4.34 m in Bangaluru and 3.92 m in Mysore and 3.38 m in Hyderabad) and collar diameter (22.25 mm in Bangaluru, 18.10 mm in Mysore and 16.25 mm in Hyderabad) was observed in *B. balcooa,* followed by *D. strictus* and *B. bambos*. Minimum height was observed in *D. asper* (1.83 m in Bangaluru, 1.75 m in Mysore and 1.42 m in Hyderabad). Maximum culm numbers were observed in *D. asper* (15.0 in Bangaluru, 11.8 in Mysore and 10.9 in Hyderabad. Effect of fertilizer was distinct and compost and inorganic fertilizer proved the best for better growth in terms of culm height and number in *B. bambos* and *D. strictus*.

Project 4: Multilocational introduction cum demonstration trials and field evaluation of six important bamboo species viz. *Bambusa balcooa, B. nutans, Dendrocalamus asper, D. hamiltonii, Guadua angustifolia* and *Pseudoxytenanthera stocksii* in Andhra Pradesh, Karnataka, and Goa (Funding agency: Department of Biotechnology) [IWST/TIP/EXT/022/2004-09]

Findings: Established 25 ha trials (20 ha in Andhra Pradesh and 5 ha in Goa) during 2007 and 20 ha during 2008 (in Karnataka) using six industrially important bamboo species viz; *B. balcooa, B. nutans, D. asper, D. brandisii, D. stocksii* and *Guadua angustifolia*. Mortality replacement at Buggapadu site in Andhra Pradesh was also completed. Some general observations about the species performance at Andhra Pradesh and Goa are as follows:

- Observation at ten months showed that *B. balcooa* and *B. nutans* performed better in terms of survival and subsequent growth, followed by *D. hamiltonii*.
- In general, tissue culture plants were performing better than micropropagated plants among various species.
- Growth performance at Agalote (Goa) was comparatively poor than that at Chintalapudi due to under storey planting.
- *D. asper* and *G. angustifolia* performance was poor at all the three sites.

Project 5: Development of Package of Practices for the management of powder post beetles in ITC timber yards (Funding agency: ITC, Bhadrachalam) [IWST/WBD/EXT/ITC/023/2007-08]

Findings: Studies were conducted in ITC timber depots at Bhadrachalam and Ongole to assess the seasonal incidence and intensity of infestation of powder post beetles on subabul logs (*Leucaena leucocephala*) stocked for paper production. The beetles were identified as *Sinoxlon anale* and *S. conigerum* (Bostrychidae) and cultured in the laboratory. Laboratory evaluation of botanicals and chemicals for the management of the pests was undertaken. Field experiments were conducted with chemicals and botanicals at ITC timber depots at Bhadrachalam. Effectiveness of the control measures was assessed and documented. A package of practice was developed for timber storage in depots.

Project 6: Evaluation of phosphine as fumigant to control insect pests in logs, chips and sawn boards (Funding agency: M/s UPL Ltd.) [IWST/WBD/EXT/UPL/024/2007-08]

Findings: Investigations to ascertain the efficacy of Phosphine as a substitute of methyl bromide for fumigation of infested wooden logs was conducted both by laboratory bioassays and field fumigation experiments. Laboratory *in-vitro* assays with different concentrations of phosphine (25, 50, 100, 150 and 200ppm) were done. One hundred percent mortality of common wood infesting insects viz. *Lyctus africanus* and *Lyctus brunneus*, *Synoxylon anale*, *S. conigerum* and *Odontotermes* sp. was obtained at 200 ppm phosphine level after a short exposure period of 24 hrs. Field trial of fumigation with with medium and high girth infected logs of Eucalyptus and Subabul was conducted in timber depots at Rajamundry and Bhadrachalam, Andhra Pradesh. In the field fumigation trails using 3g and 4g/m^3 phosphine, it was found that at 3g/m^3 dose, 100% mortality of insects was achieved indicating suitability of phosphine in wood fumigation.

Project 7: Insect plant relationships with special reference to herbivory in the mangroves of South India (Funding agency: Ministry of Environment and Forests) [IWST/WBD/EXT/MoEF/025/2005-09]

Findings: Herbivorous insects belonging to 12 orders, mainly, Coleoptera, Diptera, Orthoptera and Lepidoptera were documented from the mangroves of Karnataka. Total number of herbivorous species of insects recorded was 153. Twenty nine species of flower visiting insects were recorded and details of 11 major pollinators of three major mangrove species were studied. Using digital image analysis, the damage by insect herbivory in the mangroves of Karnataka was assessed, the extent of damage differing in the young and mature leaves. Damage range in young leaves was 0.13% - 5.12 in *Rhizophora mucronata*, 0.15% - 16.29% in *Avicennia officinalis* and 2.04% - 8.4% in *Sonneratia alba*. Folivory damage in case of matured leaves was 0.62%- 4.62% of leaf area loss in *R. mucronata*, 0.51% - 27.11% in case of *A. officinalis* and 1.91%- 13.44% in *S. alba*. Insects belonging to three major orders viz. Coleoptera, Lepidoptera and Diptera were found to comprise fruit affecting insect guild. Germination study was conducted to elucidate the impact of insect frugivores in the regeneration of mangroves.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Detection of natural and biological defects in timbers by non-destructive testing techniques [IWST/WPU/X-63/2006-10]

Status: Studied the effect of moisture content on ultrasonic velocity in wood of *Acacia mangium*, *Grevillea robusta* and *Mangifera indica*. Studied the effect of grain orientation on ultrasonic velocity in wood of *Acacia mangium*, *Grevillea robusta* and *Mangifera indica*. Studied the effect of defects (hollowness) on ultrasonic velocity in wood samples of *Acacia mangium*, *Grevillea robusta* and *Mangifera indica*. Studied the strength properties (MOE, MOR, FS at LP) of *Acacia mangium* and *Grevillea robusta* and *Mangifera indica* by conventional test method. The relationship between hollowness and ultrasonic velocity is being established.

Ultrasonic Wood Tester to detect defects in wood

Project 2: Study on utilization aspects of plantation grown *Acacia mangium* Willd. from Orissa [IWST/WPU/X-57/2006-10]

Status: The shrinkage study is completed and based on the retention of shape figure, the timber is classified as steady timber and grouped along with *Dalbergia sissoo* and *Adina cordifolia.* The timber took 47 days to reach 18% moisture content from initial moisture content of 80% after drying in dehumidifier kiln. Studies on anatomical properties for 4 trees completed. The physical and mechanical properties like specific gravity, weight, static bending, compression, hardness, shear, tension, nail and screw holding are completed in the green condition. Tests on airdry material are in progress. Installation of preservative treated samples at Nallal field station for durability study completed and periodic inspection on the condition of the samples were recorded. Some products like chair, artifacts were made as shown below.

Furniture and carvings made from *Acacia mangium* wood

Project 3: Studies on influence of microwave treatment on drying characteristics and treatability of wood [IWST/WSP-XI-69/2007-10]

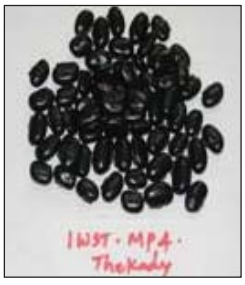
Status: Treatment of silver oak using microwave with varying thickness and time completed. Comparison of drying behaviour of microwave treated and untreated wood evaluated. Experiments with Eucalyptus and Silver Oak drying using MW carried out. Ray cell of Silver Oak and Eucalyptus were found to rupture by MW treatment for 20 minutes. Dehumidification drying characteristics of MW treated and untreated silver oak and rubber wood was studied. Studies on the drying behaviour of Teak and Rubber wood completed.

Project 4: Isolation and estimation of L-DOPA from *Mucuna prurines* Linn collected from South India [IWST/CFP/XI-66/2007-10]

Status: Seeds collected from different MPCA area in Karnataka, Shimoga (Sagara, Barige and Ikkeri), Kerala (Thekady). Savandurga, Devarayanadurga, Chitradurga (Jogi matti, Neerthadi and Devaragudda), Kollur plots were identified where Mucuna population exists for collection of fruits. Preliminary work of standardization of procedures for extraction of L-DOPA carried

Mucuna prurines seeds from Barige, Shimoga

Mucuna prurines seed from Ikkeri, Sagara



Mucuna prurines seeds from Thekady

Mucuna prurines seeds from Sagara

out. HPLC has been carried out for Standard L-DOPA for comparison of samples from different areas.Isolation and crystallization of L-DOPA has been carried out for seeds collected from Jogimatti (Chitradurga) and Devarayanadurga (Tumkur), Thekady (Kerala) and Sagar (Shimoga).

Project 5: Laboratory testing for the assessment of the durability of timbers against powder post beetles – standardization and evaluation [IWST/WBD/X-55/2006-10]

Status: Using the standardized test methods, adults and larvae of *Lyctus africanus* and *Sinoxylon conigerum* were employed as the test insects for studying the durability of plantation timbers against borers. Natural durability of *Mesopsis eminii, Hevea brasiliensis, Grewilia robusta, Acacia mangium, Melia dubia* and *Acacia auriculaeformis* against the beetles were tested. Wood treated with neem products, CNSL, extractives from *Dysoxylum malabaricum* and insecticides, Chlorpyriphos and Imidacloprid were tested by exposure of adults and larvae of *L. africanus* and *S. conigerum. In-vitro* assays with different concentrations of Phosphine was conducted to prove the susceptibility of life cycle stages of the powder post beetles.

Project 6: Studies on the natural resistance of imported wood against insects and decay fungi in Indian environment [IWST/WBD/XI-74/ 2007-11]

Status: To study the natural durability of imported timbers, observations up to one year after implantations were taken at Trivandurm, Bangaluru, Visakapatanam, Hyderabad, Jodhpur and Jabalpur. Experiment at Dehradun condition has been initiated. Observation on the natural durability of 5 imported timbers against fungus has been completed. Durability observation up to one year after exposure has been taken in marine condition. So far 20 species of termites have been identified.

Project 7: Studies on age related durability of plantation grown timbers [IWST/WBD/X-50/2005-12]

Status: Durability studies against decay fungi of plantation grown timbers of low rainfall area are completed. *A. auriculiformis* and *A. mangium* of 10, 15 & 20 years timber can be classified under Class I where as 5 years comes under Class II. *E. tereticornis* showed good resistance against decay fungi (Class I) *G. robusta* belongs to class III and *M. dubia* falls under non-resistance class IV. Studies of high rainfall area grown timbers are under progress.

Project 8: Seed infestation by insects among the emergent rainforest canopies at Makutta, Western Ghats [IWST/WBD/XI-68/2007-10]

Status: Sampling work during the pre-monsoon period yielded seed fall from very few species, *Knema attenuata* and *Dipterocarpus indicus*. Although Knema had low infestation by insects (<5%), all the seeds of Dipterocarpus were damaged by insects. Data on seedling establishment of the previous year has also been recorded. The seedlings are dominated by those from *Vateria indica*. Germination and regeneration data from 61 square metre sample plots have been noted. No seeding was recorded during the January to March 2009.

Project 9: Ethnobotanical studies of Northern-Eastern Ghats in Andhra Pradesh [IWST/WBD(M)/X-170/2007-11]

Status: Conducted seven field tours to tribal areas of Srikakulam, Vizianagaram and Visakhapatnam districts. Recorded ethnobotanical data on wild genetic resources, edible, medicinal, material and social cultural aspects on 137 plant species from the tribes of Savaras, Khonds, Jatapus, Kondadoras, Nukadoras and Porjas. Collected 101 plant species, made into herbarium and Identified. Scrutinized and screened ethnobotanical data with available literature. The important medicinal plants, namely, *Drynaria quercifolia* (L.) J. E. Sm., *Stemona tuberosa* Lour. and *Trichosanthes tricuspidata* Lour. were collected from the tribal areas and their uses reported for the first time.

Project 10: Studies on genetic fidelity of the micropropagated plants of bamboo-*Bambusa bambos* and *Dendrocalamus stocksii* [ICFRE/IWST/TIP/XI-65/2007-10]

Status: Established new cultures from the Candidate Plus Clumps of *B. bambos* and *D. stocksii* from germplasm bank. *In-vitro* established cultures were multiplied in MS liquid and agar gelled media with additives + NAA (0.25 mg/l) + BAP (1.0 – 2.5 mg/l). *In vitro* shoot clumps (2-3 shoots/clumps) rooted in MS/4 basal salts medium with IBA/NAA (1.0 mg/l). Rooted plants were hardened in polytunnel in green house for 3-4 weeks, followed by 2-3 weeks in shade before keeping in open nursery. Established callus cultures of both the species and multiplied in MS medium with additives + 2, 4-D. Callus cultures were used for somatic embryos induction. Standardized DNA isolation, purification and quantification in both the species. Standardized PCR reaction mixture and cycles for DNA amplification of the mother plants and micropropagated plants of both the species for the genetic fidelity studies.

EXTERNALLY AIDED PROJECTS

Project 1: Establishment of Advanced Wood Working Training Centre at IWST (Funding agency: Italian Trade Commission/ACIMALL) [IWST/EXT/ACIMALL/026/2003-13]

Status: Advanced Wood Working Training Centre, an Indo-Italian joint project by IWST-ICE-ACIMALL entered into the seventh years of operation. The centre is equipped with 21 advanced wood working machines. A new CNC machine was installed during the year 2008-09 and CNC course has been introduced from January 2009. During the year 2008-09, the centre has imparted training to 387 trainees for conventional course and 35 trainees for CNC course. About 95% of the unemployed trainees have been benefited for employment with this training. The AWTC also participated in "DELHI WOOD 2009" which was held at Pragathi Maidan, New Delhi in February 2009.

Project 2: Investigation on Tree ring analysis (Dendrochronology) of certain species in Western Ghats to monitor climate changes and its relevance to wood quality (Funding agency: Ministry of Environment and Forests) [IWST/WPU/EXT/MoEF/029/2006-09]

Status: Two JRFs joined at the end of May 2007. Basic training was provided to JRFs at IWST. Stereo-Zoom Microscope was installed and basic training was obtained. TA system was installed. Increment borer was purchased. Teak discs were collected from Madikeri, Mundugod of Karnataka and Thane, Chandrapur from Maharashtra. Meteorological data and information on sites from Karnataka and Maharashtra were collected. Teak samples were prepared by using special technique to expose growth rings. Field training for 2 JRFs in collaboration with IITM, Pune to Bandipur, BR Hills, Kallahalla and Shimoga completed. Training provided to JRFs at IITM, Pune for handling COFECHA and ARSTAN programmes in tree ring analysis and also for handling RESPO programme. Specific gravity, ring width and age of 36 discs completed from Madikeri & Mundagod (Karnataka) and Chandrapur & Thane (Maharashtra). Study on vessel morphology completed for 30 discs from Karnataka and Chandrapur of Maharashtra. Cross dating and standardization of 30 discs from Karnataka and Chandrapur (Maharashtra) carried out using COFECHA and ARSTAN programme, respectively. Collection and sanding to expose growth rings completed for 6 core samples of *Myristica* spp. Determination of age of 6 cores of *Myristica* spp. completed.

Teak discs with wounds due to (i) Fire (ii) Insect attack

Stereo-zoom microscope with TA system for tree ring analysis

Project 3: Studies on acoustical behaviour of plantation timbers for musical instruments and wall paneling (Funding agency: CSIR) [IWST/WPU/EXT/CSIR/028/2006-09]

FFT analyzer to record sound waves from Dholak

Status: Evaluated strength properties of 7 species. Determined sound absorption coefficient and effect of different wood parameters (grain orientation and thickness) in 7 species. Generated data on commercially available 3 musical instruments (Veena, Violin and Dholak). Determined anatomical properties like fibre and vessel dimensions of 7 species. Evaluated strength properties like modulus of elasticity, modulus of rupture, and hardness. Determined sound absorption coefficient and effect of different wood parameters. Generated data on commercially available musical instruments like Veena, Voilin and Dholak. Studied the effect of anatomical parameters and strength properties on frequency spectrum generated by the commercially available musical instruments. Fabrication of Veena from plantation species (*Acacia auriculaeformis, Artocarpus heterophyllus, Azadirachta indica, Eucalyptus tereticornis, Grevillea robusta* and *Melia composite*) to find their suitability in musical industries.

Project 4: Development, augmentation of efficacy and improvement of dissemination systems of Metarhizium based mycoinsticide for the management of major pests in forest plantations and nurseries (Funding agency: DBT) [IWST/WBD/EXT/DBT/031/2006-09]

Status: Twenty five Metarhizium isolates were maintained in the laboratory for studying the virulence and biocontrol potential against major pests on important forest tree species. The teak defoliators, *Hyblaea puera*, *Paliga machoeralis* and pests of *Ailanthus excelsa* were found susceptible to most of the isolates but pathogenecity varied among the isolates. Bioassay with Mahagony borer, *Hypsipyla robusta* reared using artificial diet revealed that 7 isolates were pathogenic to them. Pathogenecity of different isolates against arboreal termites, *Odontotermes* spp. was tested in the laboratory with different dosages/time and the LD50 and LT 50 were calculated. Field evaluation of selected isolates against Ailanthus pests showed mortality of 30-.34%. Mass multiplication of fungus in grains, solid media and agro wastes was tested.

Project 5: Investigations on Microsporidia affecting major Lepidopteran pests of important forest trees of South India and their prospects as biocontrol agents (Funding agency: DST) [IWST/WBD/EXT/DST/032/2007-10]

Status: A total of 94 lepidopterans were tested and microsporidian parasites were isolated from 29 species. Bio-assay study was carried out on *Hyblaea puera*, *Catopsilia*, *Papilio demoleus* and *Papilio polytes* larvae by inoculating different concentrations of spores isolated from their respective hosts. Morphometry of 29 species of microsporidia were studied. Studies on morphology, Pathogenicity, rate of multiplication and lifecycle of microsporidian spores in

Hyblaea puera and 3 butterfly species was conducted. Cross infectivity studies were carried out using *H. puera* spores to other forest pests to examine the infection potential.

Project 6: IWID: Indian Wood Insect Database– A Database on diversity of indigenous and exotic wood insects/pests in India (Funding agency: DSIR) [IWST/WBD/EXT/DSIR/033/2007-09]

Status: IWID, a web based database for Indian wood insects was developed in collaboration with FRI, Dehradun. The insect museums in different research institutions, universities, national collections at ZSIs and BSI were visited and wood insects documented. The data pertaining to about 1000 wood species and 2500 wood insects have been entered into the database. The entries were checked and edited. The work is in final stages.

Project 7: Bioecology, damage potential and management of Gall formers of *Pongamia pinnata* (L.) Pierre (Funding agency: DST) [IWST/WBD/EXT/DST/035/2006-09]

Status: The biology of gall inducers of Pongam viz., leaf gall inducer *Aceria pongamiae* and the ovary gall inducer *Asphondylia pongamiae* have been studied and their lifecycles have been determined. The population dynamics of both gall inducers have been observed for two years and the analysis is underway. Experiment to evaluate the efficacy of miticides against leaf gall inducing mite has been completed. Yield loss assessment by ovary gall inducer was done in Mandya, Bangaluru urban and Chickbellapur districts.

Project 8: Investigations on the fungi and insects associated with fruits and seeds of selected endemic trees of western ghats (Funding agency: Ministry of Environment and Forests) [IWST/WBD/EXT/MoEF/059/2006-10]

Status: Pathogenicity of major pathogenic fungi and their control measures and biology of major insect pests were completed. Seventy five to Ninety percent Fusarium infection was found in *D. malabaricum* fruits and seeds. In *C. sulpharatum* seeds though there was fungal infection (80%), viability of the seeds was not affected. In *S. malabaricum, M. longifolia* and *H. ofponga,* fungal infection was less (30%). Total 150 fungal species were isolated from the seeds of selected plants. Out of which, 40 species were pathogen and rest of the species were saprophytic fungi. The extent of damage and the host range of causative organisms were assessed. Seven insect species were obtained. Percent of incidence of Coleopteran was 37.78, Lepidoptera was 26.50 and Dipterans were 36.22. Diversity of insects in Subramanya was more (H= 1.8099) and in Makuta, it was less (0.808).

Project 9: Need for conserving forest canopies assessing the diversity of canopy insects in the Western Ghats (Funding agency: Ministry of Environment and Forests) [IWST/WBD/EXT/MoEF/037/2006-09]

Status: Canopies of *Vateria indica* suitable for sampling were identified, three types of passive insect collection traps–canopy pitfall traps, canopy light traps and canopy yellow pan traps were tested. Sampling using the traps has been done and collections processed for identification and assessing the diversity of insects.

Project 10: Monitoring of biofouling at Visakhapatnam Port. (Funding agency: Ministry of Shipping, Road Transport and Highways, Government of India through National Institute of Oceanography, Goa) [IWST/WBD(M)/EXT/NIO/039/2006-09]

Status: Test panels exposed at three test sites, i.e., Slipway Complex, Ore Berth and Marine Foreman Jetty in Visakhapatnam Port were retrieved at monthly/long term intervals. Observations on the composition, growth, surface spread and biomass of fouling organisms and incidence of wood borers were recorded. Voucher specimens of different forms were prepared and maintained.

Project 11: Utilization of alternative timber species for catamarans to conserve traditional tree species of Eastern Ghats (Funding agency: Ministry of Environment and Forests) [IWST/WSP/EXT/KFD/052/2007-10]

Status: Durability, leaching tests for *Maesopsis eminni, Tetrameles nudiflora* and *Albizia lebbek* initiated and work is in progress. Untreated control timber panels of *Albizia lebbek* were completely destroyed by pholadid and tereinid marine borers within 14 months of marine exposure trials in Visakhapathnam harbor whereas panels treated with Copper-Chromium-Arsenic (CCA) incurred only 3% to 7% destruction and those treated with Copper-Chromium-Boron (CCB) 8% to 13% damage within the same period depending upon the preservative loading. Untreated controls of *Tetramellus nudiflora* were totally damaged due to marine organisms attack in 12 months, while CCA treated panels showed 8% to 25% deterioration and CCB panels 18% to 28% deterioration at the end of 14 months. Fabrication of catamaran of *Bombax cebia* (5 Catamarans), *Albizia lebbek* (5 Catamarans), *Tetrameles nudiflora* (10 catamarans) and *Measopsis eminni* (5 Catamarans) (Total 25 Catamarans) completed. Interactive meeting with fishermen of Kuppum village, Chennai was conducted and list of beneficiary from this village has been finalized for distribution of catamarans.

Project 12: Studies on assessing growth performance of *Guadua angustifolia* Kunth under different management schedules (Funding agency: NMBA) [IWST/TIP/EXT/NMBA/043/2006-09]

Status: Established field trials viz; spacing (5mx5m and 5mx9m) and fertilizer trials consisting seven treatments at two sites viz; Yelwala near Mysore and Gottipura (Hoskote) near Bangaluru in 1.3 ha each site in 2005. Intercropping has been done in succeeding years with horse gram. Survival rate < 50% in Hoskote and < 10% in Mysore by the end of third years indicating the unsuitability of this species under semi-arid conditions.

Project 13: Conservation of Sandal (*Santalum album* L.) germplasm, production of quality planting stock and promotion of sandal cultivation practices (Funding agency: NMPB) [IWST/TIP/EXT/NMPB/046/2006-09]

Status: Produced 50,000 quality seedlings of sandal wood during 2007-08 and provided to the SFDs, farmers, sandal based industries and NGOs. Sandal stake holders meeting programmes have been conducted in Murdeswar, Kolar and in Shimoga districts in Karnataka. Two on- farm demonstration trials of sandal based agroforestry one ha each has been established in Mantralaya (Andhra Pradesh) and in Chikmaglur (Karnataka). Nearly 100 grafted sandal plants from various identified clones produced for restocking in germplasm bank at Gottipura.

Project 14: Commercial cultivation of bamboo in Kodagu District: Raising of Quality Planting Material (QPM), Establishment of Demonstration plots and Bamboo based value addition facilities (Funding agency: NMBA) [IWST/TIP/EXT/NMBA/044/2006- July 2009]

Status: This is a multi institutional collaborative project involving College of Forestry (CoF) Ponnampet (University of Agricultural Sciences, Bangaluru), Kodagu Model Forest Trust (NGO) and IWST. This project is being coordinated by IWST. Farmers interaction meet organized in Coorg in February 2009 involving farmers and various stakeholders to discuss various prospects of bamboo cultivation. A vegetative propagation centre with capacity to produce 50,000 rooted cuttings of bamboo in one year was established in College of Forestry, Ponnampet. Nearly 25 has of *D. asper* (edible bamboo) plantations involving 77 farmers established in Coorg with planting material supplied by the IWST.

Project 15: Cultivation of *Guadua angustifolia* Kunth and *Dendrocalamus asper* Backer in Kerala and Karnataka (Funding agency: NMBA) [IWST/TIP/EXT/NMBA/045/2006-09]

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

Project 16: Bamboo Locational Trials - BLT (Funding agency: NMBA) [IWST/TIP/EXT/NMBA/048/2005-10]

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

Project 17: Vegetative Propagation Centre (VPC) for the production of quality plants of *D. stocksii, D. brandisii* and *Guadua angustifolia* (Funding agency: NMBA) [IWST/TIP/EXT/NMBA/042/2006-09]

Status: Plants were raised by rooting of culm cuttings in *D. stocksii,* from leafy branch cuttings in *Guadua angustifolia* and rhizomatous cuttings in *D. brandisii.* Total 18,000 plants have been raised. Plants raised have been used for plantation activities under NMBA and DBT funded projects and have also been supplied to Karnataka and Tamil Nadu Forest Departments and farmers for plantation. Training have been imparted to officials of Karnataka Forest Department and farmers on vegetative propagation of bamboo.

Project 18: An integrated approach of bamboo improvement propagation, agroforestry models, protection, processing and utilization (Funding agency: NBM) PI: S.C. Joshi, Co- [IWST/TIP/EXT/NBM/049/2007-10]

Status: Collected offset cuttings/plants of 15 economically important bamboo species from RFRI, Jorhat, Nagaland State Forest Department, State Forest Department, Rajamundry, KFRI, Peechi and FRL HT, Bangaluru for widening germplasm bank of bamboo species at Gottipura, Nallal. Collected CPC material of *B. balcooa, D. brandisii* and *T. oliveri* from various sources for germplasm bank. Carried out studies on effect of auxin, period of collection and size of cutting in *D. brandisii*. Established agroforestry trials at two locations of industrially important bamboo species in Karnataka. Surveyed bamboo nurseries and plantations in Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Goa to get information on insect pest attack and collected samples for laboratory studies. Samples of bamboo species treated with insecticide and preservatives were tested in field for durability. Fabrication of Boucherie and microwave dryer were completed. Studies on drying of *D. stocksii* carried out in microwave dryer. Drying behaviour of round *B. bambos* was studies in desiccant based dehumidification wood dryer. Specimens of *D. stocksii* were treated with CCA and CCB by sap displacement and Boucherie methods. Elemental analysis of nitrogen, oxygen and sulphur contents were carried in *D. strictus, D. brandisii, D. stocksii* and *B. bambos.* Basic densities of these four species varied from 0.48 ± 0.03 to 0.61 ± 0.3 and value was highest in *B. bambos.* Conducted demonstration of bamboo

based technologies viz; vegetative propagation, cultivation, ammonia fumigation and sap displacement in FRC of SFD, Hyderabad and VVK, Kadugodi, Bangaluru for the SFD and VFCs at farmers in ten training programme during the past one year period.

Project 19: Development of bamboo fibre reinforced thermoplastic composites (Funding agency: National Mission for Bamboo Application) [IWST/WSP/NMBA/027/2006-09]

Status: Composites of bamboo and polypropylene were prepared to study the effect of fibre loading, coupling agent, process additives and particle size on mechanical properties of the composites. Results show that at 50% loading of bamboo flour the tensile strength increases by 45% and flexural strength by 83%. The modulus of elasticity exhibited an increase of 300%. Composites prepared with m-TMI grafted polypropylene as coupling agent exhibited superior mechanical properties over composites prepared with MAPP as coupling agent. The study on the effect of particle size showed that particles having 60 to 80 mesh size provides the best properties.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Anatomical approach to evaluate treatability of timbers [IWST/WPU-XI-84/2008-11]

Status: Under the project, phase contrast microscope was purchased and one technical Assistant on contract basis was appointed. Totally 9 species, were taken up for study. They are *Hevea brasiliensis, Melia composita, Greviellea robusta, Acacia auriculaeformis, Acacia mangium,Populus* spp, *Gmelina arboborea* and two *Eucalyptus* spp. Of the 9 species wood samples were brought to moisture condition and specific gravity was determined for four species (100 samples each).

Project 2: Performance of Coatings on Modified Wood Surfaces [IWST/WSP/XI-90/2008-12]

Status: Reaction conditions of Acetylation and Benzoylation of wood has been standardized. The stands for natural weathering were fabricated.

Project 3: Studies on the permeability of selected imported timbers marketed in Karnataka [IWST/WSP/XI-83/2008-11]

Status: Five species of imported timbers namely *Xylia dolabriformis* (Pyinkado), *Instia biguga* (Merabau), *Dipterocarpus* spp. (Gurjan) and two *Shorea* spp. (Red meranti and Balau) were procured. Of these, 300 permeability samples (size: 22 x 22 x 22 mm) from two species were undergoing conditioning prior to measurement of flow rates. On the other hand, test stakes of (size: 19 x 19 x 450 mm) *Xylia dolabriformis* and *Shorea* spp. were being exposed under field condition.

Project 4: Study on Morphology and Properties of Natural Fibre Filled Polypropylene Composites (NFFPC) [IWST/WSP-XI-77/2008-11]

Status: Raw material i.e. Jute, Rubber wood powder, bamboo powder and the thermoplastic-Polypropylene and m-TMI procured for compounding both the material.

A Torque rheometer for studying the rheological properties of wood polymer composites has been procured and standardized.

Project 5: Synthesis of organometallic complex replacing arsenic component in CCA preservative by organic ligant (plant extractive) and evaluate as semi biopreservative [IWST/CFP/XI-85/2008-11]

Status: Procured leaf and bark of *Cleistanthus collinus* Roxb. and *Prosopis juliflora* DC. Optimized the extraction procedure to obtain maximum yield of plant extract with different solvents. Trials have been carried out for the reaction of $CuSO_4$ and CrO_3 with plant extract for further study as preservative.

Project 6: Studies on the insect pest problem of sandal under cultivation and their management [IWST/WBD/XI/80/2008-11]

Status: Three agroforestry models (Sandal and Mango; Sandal, Tamarind and Amla; *Eucalyptus* hybrid, *Dalbergia sissoo* and *Pterocarpus santalinus*) located in Bevanahalli, Mudennahalli and Gottipura (Karnataka) were selected for studying the pest and disease problems in sandalwood. The major pests collected were sap suckers followed by defoliators. At Jarakbande, sandal plantations grown along with *Acacia auriculiformis* had severe shoot borer problem by a Cerambycid pest. Sandal plants of pencil thickness, were found attacked leading to stunted growth and mortality of plants.

Project 7: Characterization of marine lignicolous fungi in traditional wooden craft [IWST/WBD(M)/XI/86/2008-12]

Status: The major fishing village in Visakhapatnam city, the Pedajalaripeta, was surveyed for identification of fungal infested traditional wooden craft and wood infested with fungi were collected from a catamaran made of *Paraserianthes falcataria*. Mixed culture of fungi present in the wood carried out and based on morphological variations, they were separated and maintained as pure cultures. Wooden test coupons were treated to a gradient of CCA absorptions and are being tested for infestation of fungi to arrive at threshold loading of CCA required to prevent fungal infestation.

Project 8: Incidence and diversity of marine borers in mangrove habitats of northern Andhra Pradesh [IWST/WBD(M)/XI/89/2008-11]

Status: Surveyed the mangrove habitats in Srikakulam, Visakhapatnam, East Godavari and Krishna districts, collected infested plant material and assessed the damage caused to vegetation. Extracted various wood boring organisms, namely, *Sphaeroma terebrans, S. annandalei, S. travencorensis, Bactronophorus thoracites, Dicyathifer manni, Lyrodus pedicellatus, L. medilobatus, L. takanoshimensis, Teredo furcifera, T. parksi, T. bartschi, Nausitora dunlopei, Bankia carinata, B. campanellata, B. brevis, B. gouldi, B. gracilis* and *B. rochi* and enumerated their incidence.

Project 9: Studies on scale up of protocols for *in vitro* propagation, hardening, production of cloned plants and establishment of field trials of Sandalwood (*Santalum album* L.) [IWST/TIP/XI-78/2008-11]

Status: Established shoot initiation cultures from the ramates of the clones from germplasm bank. Multiplied old cultures of five clones of diverse origin. Initiated studies on rooting of *in vitro* shoots under *in vitro* and *ex vitro* conditions. Established fragile callus cultures of four clones. Multiplied the embryogenic callus for somatic embryo induction.

Project 10: Variability studies in *Hardwickia binata* – a multipurpose tree species in Karnataka, Andhra Pradesh and Tamil Nadu [IWST/TIP/XI-79/2008-13]

Status: Survey has been carried out in different parts of Karnataka to identify the populations of *Hardwickia binata*. Preliminary morphological observations have been recorded and core samples have been collected from different aged plantations to document the variability for tree traits.

Project 11: Ecological, economic and socio-cultural evaluation of a ficus based traditional agroforestry system in Mandya district of Karnataka [IWST/TIP/XI-82/2008-11]

Status: Secondary data collection completed. Fifty percent of individual surveys covering 100 respondents and 8 village surveys completed. Litter traps under Ficus trees set up for ecological experiments. Crop yield measurements were conducted under various species of ficus.

Project 12: Studies on seed variability, propagation and *ex-situ* conservation of *Canarium strictum* Roxb. and *Hydnocarpus pentendra* (Buch.-Ham.) Oken - threatened medicinal trees [IWST/TIP/XI-81/2008-11]

Status: Survey had been conducted in and around Agumbe, Koppa and Ponnampet for identification of population of *Canarium strictum* and *Hydnocarpus pentendra.* Germination studies revealed that both the species have seed dormancy. In *C. strictum* dormancy is coat imposed, while in Hydnocarpus it is physiological. Cracking of seed coat enhanced germination in Canarium, while in Hydnocarpus pretreatment with GA3 resulted in seed germination.

Project 13: Study on combustion characteristics and fuel properties of roots from selected agroforestry tree species [IWST/WE/XI-91/2008-June 2009]

Status: A detailed study on fuelwood properties (proximate and elemental analysis) of roots of selected agroforestry species i.e., *G. robusta, C. equisetifolia, E. hybrid* and *A. nilotica* was carried out. Study on combustion characteristic under oxidizing and inert atmosphere is under progress.

Project 14: Development of database on Red Sanders (*Pterocarpus santalinus* L.) [IWST/ITCell/XI-87/2008-10]

Status: Purchased the required equipments. Recruited Project Assistant. Model design of website was prepared. Visited Tirumala hills and Sri Venkateshwara University, Tirupati for data collection.

EXTERNALLY AIDED PROJECTS

Project 1: Improvement of Weathering Properties of Wood Surfaces by Chemical Modification (Funding agency: CSIR) [2009-12]

Status: New Project initiated on 1st March 2009.

Project 2: Second National Communication (NATCOM-II) Project on "Assessment of Soil Carbon Stocks and Dynamics in Forest Soils of India for the Period 1995-2007" (Funding agency: UNDP/GEF-MoEF) [2008-09]

Status: Soil samples from 53 selected points of 16 different forest types including 8 points of non forest areas have been studied and collected from 0-30 cm depth and analysed for total organic carbon content and bulk density. The report was submitted.

Project 3: Development of package of practices for the management of teak heart wood borer, *Alcterogystia cadambae* (Moore) (Funding agency: Karnataka Forest Department) [IWST/WBD/EXT/KFD/034/2008-09]

Status: Surveyed the pest incidence in the identified study areas: Doginal and Kirwatti in Yellapur division of Karnataka. Installed 3 light traps (One is solar powered) for the monitoring of the pests in the infested plantations. Adult activity monitored from light trap collections from the infested plantations. Mechanical control by larval traps and soil traps were tested and role of bird predators documented. Biocontrol by nematode injections into infected trunk was tested at Doginal plantation.

Project 4: Improvement of planting Stock of forestry species using ecofriendly biofertilizer like VAM fungi (Funding agency: Karnataka Forest Department) [IWST/WBD/EXT/KFD/054/2008-09]

Status: Survey was carried out in Shimoga, Hasan and Mysore district collected rhizosphere soil. Spore count and percent of infection was estimated from the rhizosphere soil of selected plants. Spore density varied from one species to another and also with different location. All the selected plant species showed AM infection, but with varying frequency, altogether ten species of fungi belonging to 5 genera were recorded. Predominant species were Gigaspora, Glomus and Sclerocystis in Shimoga area and only Gigaspora and Glomus are dominating in Hasan area. 30-50% of increase in growth was observed in treated seedlings. Highest percent growth increment was observed in Eucalyptus followed by Casuarinas, Acacia and Teak. Three demonstration programmes were conducted in Kadugodi and IWST, Bangaluru. Two thousand five hundred copies of brochures, both in Kannada and English were prepared.

Project 5: Testing the efficacy of TBTM-MMA preservative developed by NMRL in Visakhapatnam and Kochi ports (Funding agency: Naval Materials Research Laboratory, DRDO, Ambernath, Mumbai) [IWST/WBD(M)/EXT/NMRL/038/2008-11]

Status: TBTM-MMA treated wooden test panels of *Paraserianthes falcataria* and *Bombax ceiba* along with controls were exposed at Slipway Complex, Visakhapatnam port and North Jetty, Naval Base, Kochi. Monthly observations were made on the fouling organisms settling on the panels and wood boring organisms attacking them. The untreated panels of both the species were destroyed in 6-12 months. Treated panels at Kochi were attacked by sphaeromatids but those at Visakhapatnam harbour remained free at the end of 12 months.

Project 6: Investigations on marine fouling and wood boring organisms in Machilipatnam and Nizampatnam ports, Andhra Pradesh (Funding agency: Ministry of Earth Sciences, Government of India, New Delhi) [IWST/WBD(M)/EXT/MoES/040/2008-2010]

Status: Wooden test panels of 150 x 80 x 20 mm size were exposed at Machilipatnam and Nizampatnam ports to trap marine fouling and wood boring organisms. They were retrieved at monthly intervals and observations made on the percent cover of panel surface by fouling organisms, species of fouling organisms, their number/density, size attained, etc. Wood boring organisms were extracted and identified. All the species of fouling and wood boring organisms were maintained as voucher specimens. Water samples were collected and analyzed for hydrographical parameters like temperature, pH, salinity, dissolved oxygen and nutrients. Long term panels were exposed at a time and retrieved at monthly intervals to study the recruitment of fouling organisms at the end of 2, 3, 4…….12 months.

Project 7: Structure, diversity and germination syndrome in tropical evergreen forest – A case study from Western ghats of Karnataka using permanent preservation plots (Funding agency: Karnataka Forest Department) [IWST/TIP/EXT/KFD/047/2008-09]

Status: Vegetation analysis of data collected of PPPs in 3 sites; Makuta, Muchiladuka and Malemane falling in South, Central and Northern part of tropical wet evergreen forests of Western ghats, Karnataka from 1937-2008 completed. Parameters like diversity index, similarity index, population structure worked out. Regeneration trends of these forest types represented by the PPPs worked out according to four regeneration category classes.

Project 8: Distribution, natural regeneration and identification of seed stands and candidate plus trees in *Chloroxylon swietenia* (Funding agency: Karnataka Forest Department) [IWST/TIP/EXT/KFD/056/2008-09]

Status: *Chloroxylon swietenia* is an important species which falls in vulnerable category as reported by IUCN. Regeneration status of this species was documented. Three seed stands and three candidate plus trees have been identified. The seed stands can be used as a source of seed collection.

Project 9: Seed dormancy and germination behaviour in *Buchanania lanzan* Spreng. and *Diospyros melanoxylon* Roxb. [Funding agency: Karnataka Forest Department) [IWST/TIP/EXT/KFD/057/2008-09]

Status: Seeds of *B. lanzan* were collected from Tumkur, Shira, Bidar and Agumbe and for *D. melanoxylon* from Kollegal, in Karnataka, Chandrapur in Maharashtra and Jabalpur in Madhya Pradesh. Between the species were found to have seed dormancy. In *B. lanzan*, fully mature depulped seeds treated with gibberlic acid enhanced germination percentage, while in *D. melanoxylon* pretreatment with bleaching powder, followed by gibberlic acid treatment enhanced germination. Natural regeneration in both species is predominantly by root suckers.

Project 10: Theoretical analysis of sorption isotherms by Brunaeur, Emmet and Teller theory and standardization of optimum conditions for seed storage of *Bambusa bambos* and *Jatropha curcus* (Funding agency: IFS/Sweden) [IWST/TIP/EXT/IFS/058/2008-11]

Status: Purchased BOD incubator, glass dessicators, chemicals, colour printer and sys-stat software. Collected seeds of *Jatropha curcus*.

TECHNOLOGY ASSESED AND TRANSFERRED

- Technology on bamboo fibre filled thermoplastic composites is being transferred to an entrepreneur.

EDUCATION AND TRAINING

Training-cum-Demonstration Programs

- A training-cum-demonstration program on "Nursery Technologies", "Wood Utilization" and "Portable Distillation Unit" was conducted on 10th July 2008 at Van Vigyan Kendra, Andhra Pradesh.
- A training-cum-demonstration program on "Nursery Technologies" was conducted on 25th July 2008 at Van Vigyan Kendra, Bangaluru.
- An extension program at Van Vigyan Kendra at Forest Administrative Training Institute, Kadugodi, Bangaluru on 19th September 2008.

- Demonstration programmes on Forestry and Wood Science Technology was organized at VVK Karnataka from 15th to 17th October 2008.
- A demonstration-cum-lecture programme was organized at VVK, Hyderabad on 28th November 2008, Mrs. D. Venmalar and Dr. Ashutosh participated in the programme.
- Training-cum-demonstration programme was organized at Kadugodi, VVK, Bangaluru on wood utilization, portable distillation unit, nursery techniques and wood biodegradation on 23rd December 2008.
- A demonstration workshop on "New Bamboo Species Cultivation and Sandal" was conducted in Forest Department, Koppa on 16th December 2008.
- A training-cum-demonstration programme was conducted on bamboo treatment and management at VVK, Hyderabad on 23rd December 2008. A Portable distillation unit was installed.
- A training programme on "Nursery Practices, Propagation and Agroforestry Models" was organized for the farmers of Byranahalli village (Demo) at IWST, Bangaluru on 8th January 2009.
- Demonstration programme on "Wood Utilization" and "Portable Distillation Unit" at VVK, Kadugodi on 21st January 2009.
- A demonstration workshop on "Forestry and Wood Science Technology" was organized at Somwarpet on 31st January 2009.
- Training programme on "Sandal Seed, Nursery and Cultivation" was organized at IWST from 9th to 14th February 2009.
- A training program on "Nursery Techniques and Management" was organized at Van Vigyan Kendra, Kadugodi, Karnataka on 17th February 2009.
- A demonstration workshop on "Forestry and Wood Science Technologies" was organized at FRC and VVK, Andhra Pradesh.
- Two trainings were imparted to PG students of M.S. Ramaiah College, UAS, GKVK and IISc, Bangaluru on "Extraction, Chromatographic Techniques and Instrumental Analysis" from 1st to 3rd January 2009 and 10th to 12th February 2009.

Short Term Training Programs

- "Wood Seasoning & Preservation" from 15th to 19th September 2008.
- "Nursery practices of Sandal" from 24th to 26th September 2008.
- "Wood Protection" on 20th October 2008.
- "Timber Joinery" from 24th to 28th November 2008.
- "Classification and Grading of Timber" from 1st to 3rd December 2008.
- "Extraction/Chromotography Techniques and Instrumental Analysis" from 1st to 3rd January 2009.
- "Extraction/Chromotography Techniques and Instrumental Analysis" from 10th to 12th February 2009.
- "Plant Tissue Culture" for State Forest officials of Goa State Forest Department from September 8th to 10th October 2008.

Training Received

- "Statistical Techniques for Research Methodology" for scientist of ICFRE organized by Indian Agricultural Statistics Research Institute during 26th December 2008 to 7th January 2009 at New Delhi.
- "Integrated Pest Management" sponsored by NCIPM, New Delhi from 11th to 19th February 2009.

LINKAGES AND COLLABORATION

International

- Department of Forest Products Technology, Helsinki University of Technology, Finland.

National

- Collaboration with CCRI, Chikkamagalur (for the revised PCR preparation), University of Agricultural Sciences, Bangaluru, Orissa State Forest Department, Karnataka Forest Department, Office of the Development Commissioner, Handicrafts, Bangaluru.
- Andhra Pradesh Forest Department; Fisheries Department; Andhra University, Visakhapatnam; Central Marine Fisheries Research Institute, Visakhapatnam; Central Institute of Fisheries Technology, Visakhapatnam; National Institute of Oceanography, Visakhapatnam and Goa; Naval Materials Research Laboratory, Ambernath, Mumbai; State Institute of Fisheries Technology, Kakinada; Visakhapatnam Port Trust, Indian Navy, Visakhapatnam and Indian Institute of Remote Sensing, Dehradun.
- Linkages with State Forest Department, Karnataka, Andhra Pradesh Forest Department, Goa Forest Department, Bangaluru University, Bangaluru, University of Agricultural Sciences, Bangaluru, University of Agricultural Sciences, Dharwad and Indian Institute of Sciences, Bangaluru.
- Linkages developed with National Institute for Malaria Research and Institute of Bioinformatics and Applied Biotechnology, Bangaluru.

PUBLICATIONS

- **Pamphlets (Telugu)**

  1. Sandal
  2. Nursery Practices
  3. Portable Distillation Unit
  4. Sap Displacement Techniques for treating small girth timber and bamboo
  5. *Ficus bengalensis*
  6. *Pongamia pinnata*
  7. *Tectona grandis*
  8. *Moringa olifera*
  9. *Casuarina equisetifolia*
  10. *Acacia nilotica*
  11. *Dalbergia sissoo*

- **Pamphlets (Kannada)**
  1. Sandal
  2. Nursery Practices
  3. Portable Distillation Unit
  4. Sap Displacement Techniques for treating small girth timber and bamboo
- **Pamphlets (English)**
  1. Sandal
  2. Nursery Practices
  3. Portable Distillation Unit
  4. Sap Displacement Techniques for treating small girth timber and bamboo
- **Pamphlets (Konkani)**
  1. Nursery Practices
  2. Portable Distillation Unit
  3. Sap Displacement Techniques for treating small girth timber and bamboo
  4. Ammonia Plasticization
  5. Ammonia Fumigation

Handout on Institute Activities

- Proceedings of National Seminar on "Conservation, Improvement, Cultivation and Management of Sandal" was published.

CONSULTANCIES

- Analytical service was rendered to Police Department, Forest Department and public in analysis of essential oils from sandalwood samples. A number of technical inquiries on utilization of various Non-Wood Forest products from Government Departments and public were attended to and advice given.
- Quality certification and development of criteria with regard to purchase and maintenance of Vahanam Thandlu/Dwajasthambams for use in TTD Temples.
- "Wood Seasoning and Wood Protection" to Mr. Jagdish Verma, Green Craft, Mumbai on 24th February 2009 at IWST, Bangaluru.
- Preparation of EIA/EMP studies for diversion of forest land for bauxite mining in Jerrela blocks of reserve forest in Visakhapatnam of APMDC, Hyderabad.
- Preparation of Catchment Area Treatment Plan for diversion of forest land for bauxite mining in Jerrila blocks of reserve forest in Visakhapatnam of APMDC, Hyderabad.
- Preparation of EIA/EMP for diversion of forest land for Iron Ore mining in Ankua Iron Ore Deposits, Jharkhand in favour of JSW Limited, Jharkhand.
- EIA/EMP studies of Sankosh Multipurpose Hydro Project, Bhutan (THDC) in favour of Tehri Hydroelectric Development Corporation Ltd.
- Study on diversion of Gorrepeta Vagu impact assessment on flora and fauna in favour of SCCL, Manuguru, Khammam district.
- Consultancy on Ammonia fumigation to SUTHAR, Bangaluru on 29th May 2008.

- Wood Treatment Technology to M/s Om Shantidham, Bangaluru during November 2008.
- Consultancy on Wood Seasoning and Protection to Green Wood Craft, Noida, UP during 24th and 25th February 2009.

PATENTS OBTAINED/FILED

A patent application on "An Improved Bamboo Fibre Polypropylene Composite and a Process for Obtaining the Composite Thereof" filed.

COMMERCIALIZATION OF TECHNOLOGY

A technology on Bamboo fibre filled polypropylene composites is being transferred to a polymer industry for commercialization.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

1. Attended

The representatives from Institute of Wood Science and Technology, Bangaluru attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

(a) International

- International Symposium on "Wood Science and Technology 2008 (IAWPS2008) at North-east Forestry University, Harbin, China from 27th to 29th September 2008.
- FORTROP II - International Conference on "Tropical Forestry Change in a Changing World" at Kasetsart University, Bangkok, Thailand held from 17th to 20th November 2008.

(b) National

- Institute participated in Krishi Melas at Mandya on 28th and 29th November 2008 and at Suttur (Mysore) from 22nd to 27th January 2009.
- Institute participated in Delhi wood 2009 from 14th to 17th February 2009 at Pragati Maidan, New Delhi.
- Institute participated in Tree Growers Mela organized by Institute of Forest Genetics and Tree Breeding, Coimbatore together with Extension Wing of Tamil Nadu Forest Department on 7th and 8th March 2009.
- Institute participated in Ply and Panel Asia 2009 organized by Ply and Panel Asia 2009 and Space Crafts at Palace grounds, Bangaluru from 20th to 22nd March 2009.
- RE division of MoEF, conducted 8th meeting of expert group on conservation and sustainable utilization of natural resources on 4th and 5th December 2008.
- Workshop on "Extension Strategy in Forestry Research" at ICFRE on 15th and 16th January 2009.
- XIVth meeting of the wood and other Lignocellulosic Products Sectional Committee, CED 20th in Joint Session with Sub-Committees CED 20:1 and CED 20:6 organised by Bureau of Indian Standards, New Delhi, BIS, Bangaluru Branch, Peenya, Bangaluru on 24 March 2009.
- National Seminar on wood based handicrafts held at Mysore on 23rd and 24th December 2008 organized by Office of the Development Commissioner (Handicrafts), Ministry of Textiles, Chennai.

- Training programme on "Technology Commercialization at ASCI", Hyderabad from 14th to 25th October 2008.
- "Vegetation Carbon Pool Assessment" workshop at IIRS, Dehradun on 7th and 8th November 2008.
- National Symposium on "Non-Chemical Insect Pest Management" held at Entomology Research Institute, Loyola College, Chennai on 5th and 6th February 2009.
- "National Seminar on "Wood based Handicrafts", Mysore on 23rd December 2008.
- Training on "Mainstreaming Biodiversity in Impact Assessment" at WII, Dehradun from 18th to 22nd August 2008.
- International workshop on "Nocturnal Pollination: Patterns & Process" at IISc. from 23rd to 27th March 2009.

2. Organized

(a) International

- One day Indo-Italian Seminar on "Standardization of wood testing processes" was conducted on 5th November 2008.

(b) National

- An Interactive Meeting with fishermen of Kuppam (Kovallam) village near Chennai, was conducted on 22nd June 2008. Director, IWST explained the objectives of the meeting and informed the fishermen that the Institute will be distributing catamarans made of alternative timber species under MoEF project. The farmers were informed about the economic benefit on using such catamarans.
- An interactive meeting with the farmers of Byrenahalli village (adopted for transfer of technologies) was organized on 3rd July 2008.
- Liaison meeting with stakeholders was held on 15th July 2008.

AWARDS

- The Director General, ICFRE has announced the "ICFRE Awards for Excellence" in Forest Protection for the year 2005-06 to Dr. O.K. Remadevi, Scientist-F and Head, WBD in May 2008.

DISTINGUISED VISITORS

- Sri J.C. Kala, Former DG (Forests), Special Secretary to Govt. of India and Member, ICFRE Society visited the Institute on 11th April 2008.
- Additional Chief Secretary (Forests), Government of Maharashtra visited the institute on 30th April 2008.
- Sergio Mina, Director, BIESEE visited the Institute on 17th July 2008.
- Mr. Chowna Mein, Honourable Minister Rural Development & Rural Works Department, Arunachala Pradesh visited the Institute on 1st September 2008.
- Prof. (Dr) Lidia Szpyrkowicz, Scientific Counsellor, Embassy of Italy, New Delhi visited the institute on 5th November 2008.

- Rajan Gurukkul, Vice Chairman, Mahathma Gandhi University, Kottayam; Dr. R.S. Deshpandey, Director, ISEC; Dr. Michael Tharakkan, R.K. Hegde Chair, ISEC; Dr. N.H. Ravindranath, Professor and Chairman ASTRA visited the Institute and held interactive meeting with the scientists on 17th December 2008.
- Sri. Sudhir Pandey, former DG (Forests), MoEF, Government of India and Advisor, NMBA visited the Institute on 27th February 2009.

MISCELLANEOUS

- Celebrated International Day for Biological Diversity (IBD) 2008 on 22nd May 2008.
- Timber testing: During the year, 104 enquiries for identification (246 samples) including enquiries of confidential nature, 30 enquiries (72 samples) for moisture content and bulk density, 2 enquiries (16 samples) for strength properties tests were attended.

FOREST RESEARCH CENTRE HYDERABAD

The Forest Research Centre (FRC), Hyderabad started functioning under the administrative control of Institute of Wood Science and Technology, Bangaluru from July 1997. The Centre was established to cater research needs of the states of Andhra Pradesh, Karnataka and Goa in the field of forestry. It is situated 22 km away north of Secunderabad railway station. The campus is spread over 100 acres of area in Dulapally reserved forests facilitated with office administrative buildings, laboratories, library, rest house, research nursery, experimental plots and a residential quarters for the office staff. The research activities have began to meet the research needs of the Southern Dry Deciduous Ecosystems of the states of Andhra Pradesh, Karnataka and Goa on all aspects in the field of forestry research.

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Reclamation of Iron Ore Minespoil in Karnataka through afforestation

Findings: Eucalyptus the physical, chemical, biological analysis of Iron Ore Minespoil, and selection of suitable plant species for the Iron Ore Minespoil in the nursery were completed. *Pongamia pinnata*, Eucalyptus, *Casuarina equisetifolia*, *Cassia siamea*, *Emblica officinalis* were selected in the nursery experiment for the afforestation of Iron Ore Minespoil. Planting of 5 tree species with different soil amendment techniques were also completed by imposing the treatment with biofertilizers VAM, Rhizobium, Azospyrillum, *Pisolithes tinctorius*, mulching, sowing of cover crops such as *Senna angustifolia*, *Catharanthes roseus* were done in the Iron Ore Minespoil. The growth data were collected. Interpretation of growth data, soil chemical data collected from the Iron Ore Minespoil is in progress. Iron Ore Minespoil amended with biofertilizer along with cover crops have encouraged better growth compared to other treatments. The preparation of the final project report is being continued for submission.

Project 2: Bioecology and Integrated management of Insect Pests of Aonla, *Emblica officinalis* Gaertn.

Findings: The seasonality of insect pests of Aonla was recorded at two locations at Hyderabad and Rajahmundry. Fifty one insect species of economic importance and twenty spider species

were recorded during the study period. The following were identified as key insect pests in Aonla production system and needs deliberate management tactics to be followed for realized yield potential of aonla cultivars.

1. Aonla aphid, *Schoutedenia* (=Cerciaphis) *emblica* Patil & Kulkarni
2. Gall insect, *Betuosa stylophora* Swinh.
3. Bark eating caterpillar, *Indarbela* sp.
4. Sphearical mealybug, *Nipaecoccus viridis* (Newstead)

S. emblica density was rated on a scale of 0-10, where 0 is for no incidence and 10 for highest density. The mean rating of density of *S. emblica* was 1.7. In cultivars Krishna, Kanchan and PD, *S. emblica* density was higher than the over all mean density and in the rest of the cultivars it is lower. Cultivar Kanchan was recorded for highest density (2.8) and Anand for lowest aphid density. In case of stem galls caused by *B. stylophora*, mean no. of galls per plant were highly variable. In cultivars Krishna lowest number of galls (3.5) per plant was recorded. On the other hand in Anand (27.2) followed by Kanchan (22.2), highest number of galls per plant were noticed. Number of galleries caused by *Indarbela* sp. were maximum in the cultivar Francis (8.7) followed by the cultivars LU (8.2) and Anand (7.5). Cultivar PD was noticed with minimum number of galleries per plant.

Five synthetic and one botanical insecticide viz., Dimethoate, Imidacloprid, Spinosad, Profenophos, Neem Seed Kernel Extract, and Acetamipride were evaluated under field conditions at Hyderabad in the month of March 2008 against aonla aphid, *S. emblica* on the cultivar Chakiya. Experiment was replicated thrice with three trees per replication. One untreated control was maintained. In this preliminary trial, normal dosages that are recommended in tree crops for were followed. Absolute counts of number of aphids per determinate branch (5^{th} or 6^{th} from the growing tip) were taken with the help of a hand lens. Counts were taken before the treatment and one day after treatment (DAT), 3 DAT, 5 DAT and & 7DAT. Perusal of data revealed that before the treatment aphid population was distributed homogeneously on all the treatments. After the spraying all the insecticides were found effective. However Dimethoate, Confidor, and Profenophos were found highly effective. Neemarin was least effective.

PROJECTS ONGOING DURING THE YEAR 2008-2009

EXTERNALLY AIDED PROJECTS

Project 1: Development of Multitier Cropping Models for Medicinal Plants in Andhra Pradesh

Status: Three crops of medicinal plants namely, *Andrographis paniculata, Oscimum sanctum* and *Withania somnifera* were raised in six ha area in combination with Teak+Sandal, Rosewood+Sandal, Eucalyptus+Sandal trees and in combination with Teak and their respective sole crops. Rosewood+Sandal combination was found to be very suitable for the growth of all the three medicinal plants. *A. paniculata* followed by *O. sanctum* and *W. somnifera* are found to be better suited in that order. The germplasm of Asparagus was collected from Darwar, Vishakhapatnam, Ranga Reddy, Medak Districts Mahabubnagar and Srisailam. Seed was harvested from *O. sanctum* and *A. paniculata*. The growth data of Teak trees reveal better growths in inter crop as compared to control.

Project 2: Genetic Improvement of *Melia dubia* and *Melia azardirach* through plus tree selection assessment of genetic variation and establishment of progeny trail (phase – I)

Status: 1. Raising of *Melia dubia* seedlings for progeny trial establishment. Collection of seeds from plus trees of *Melia dubia* and *Melia azardirach* for oil extent estimation. Studied morphological attributes of seeds of *Melia dubia* and *Melia azardirach.*

NEW PROJECT INITIATED DURING THE YEAR 2008-2009

Management of insect pests of *Gmelina arborea* Roxb. with particular emphasis on *Tingis beesoni* Drake (Tingidae: Hemiptera) and disease surveillance.

EDUCATION & TRAINING

- Training on "Mainstreaming Biodiversity in Environment Impact Assessment" held in Wildlife Institute of India, Dehradun during 18th to 22nd August 2008.
- One week compulsory training programme for the senior Forest Officers at Indira Gandhi National Forest Academy, Dehradun in the month of October 2008.
- Tissue culture training organised at IWST, Bangaluru was attended from 1st to 7th February 2009.
- Tissue culture training organised at IWST, Bangaluru was attended from 21st to 25th January 2009.
- Training on "Pest Management" held in NCIPM, IARI, New Delhi during 10th to 19th February 2009.
- Training on Vegetation Carbon Pool Assessment on Biomass estimation in Forests and outside Forests by IIRS, Dr. Sarnam Singh at Srisailam, Mahabubnagar from 8th to 12th December 2008.

LINKAGES & COLLABORATION

FRC, Hyderabad presently has two ongoing projects in collaboration with NMPB, Hyderabad.

CONSULTANCIES

1. Consultancy on Biomass estimation and Carbon Sequestration Carbon foot prints ITC Infotech, Bangaluru.
2. "Study on diversion of gorrepata vagu impact assessment on flora and fauna – Singareni Colleries Company Limited, Manuguru, Khammam, Andhra Pradesh".

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/ EXIHIBITIONS

1. Attended

The representatives from Forest Research Centre, Hyderabad attended the Workshops/Seminars/ Conferences/Symposia as given below during the period under report:

International

- International seminar on Green Growth on 18th December 2008 in ICFAI Business School, Hyderabad organised by ICFAI Business School, Hyderabad and Andhra Pradesh Forest Academy.

National

- National workshop on Biopiracy oraganised by Andhra Pradesh State Biodiversity Board on 23rd August 2008.
- National Workshop on "Vegetation Carbon Pool Assessment (ISRO-GBP)" at Indian Institute of Remote Sensing, Dehradun on 7th and 8th November 2008.

2. Organized

- One day training organised for 30 graduates in Pharmacy College on 18th February 2009 on Conservation of Biodiversity and cultivation of Medicinal plants.
- One day training organised for 50 members from Andhra Pradesh Forest department Andhra Pradesh forest Academy, Nursery growers, Carpenters and Saw Mill owners on 19th March 2009.
- Training organised for 25 farmers from semi-arid regions on 23rd March 2009 on Agroforestry systems with special reference to cultivation of medicinal plants.

MISCELLANEOUS

- Vana Mahostava was organised in the campus on 29th July 2008.
- Vigilance Week Celebrated from 3rd to 7th November 2008.
- Hindi Diwas was celebrated on 22nd December 2008 and awards given to the best officers who implement the Hindi.

TROPICAL FOREST RESEARCH INSTITUTE JABALPUR

Tropical Forest Research Institute (TFRI), Jabalpur is one of the institutions under Indian Council of Forestry Research & Education (ICFRE). It caters to the forestry research needs of four states of central India, viz. Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa. Thrust areas of research in the Institute relate to non-wood forest produce, rehabilitation of mined areas and other stress sites, development of and demonstration in agroforestry models, planting stock improvement, sustainable forest management, biodiversity conservation and control of forest diseases and pests. TFRI has established constant liaison with state forest departments, NGOs working in the field of forestry and allied areas, universities imparting education in forestry, and forest based industries. A number of scientists, officers and staff of the institute participated in various national and international scientific seminars and symposia. They were actively involved in extension activities through its Van Vigyan Kendras. This has helped the institute not only in imbibing in its research programme ideas and concepts but also extending technologies developed by the institute.

An abstract of projects run by the Institute is as follows:

		No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
TFRI, Jabalpur	Plan Projects	6	11	5
	Externally Aided Projects	10	14	02
CFRHRD, Chhindwara	Plan Projects	Nil	04	Nil
	Externally Aided Projects	Nil	01	02
	Total	**16**	**30**	**09**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Documentation of (traditional knowledge) ethno-medicinal information from traditional herbal healers (Vaidyas, Ojhas and Guniyas) in central Madhya Pradesh [Project No. : TFRI-084/TFRI/2005/Biod-1(4)/2005-08]

Findings: The ethno-botanical study was conducted at Jabalpur, Seoni, Hoshangabad, Chhindwara, Sehor, Bhopal, Betul, Harda, Raisen and Vidisha of Madhya Pradesh to document the traditional knowledge on ethno-medicine prevailing in the tribal communities over the years. The tribal pockets and traditional herbal healers were identified for each district for documentation work. The tribal villages were selected from tribal blocks by random sampling method.

Traditional herbal healer of Seoni district of Madhya Pradesh

A questionnaire/schedule was developed to document the information prevailing in the community by periodical visits.

For documentation work, local guide, villagers, traditional herbal healer (Vaidyas, Ojhas and Guniyas), tribal heads and tribal persons were contacted and enquired to gather related information. Identification of plants has been made through the local name of plant with the help of existing literature. Total 563 herbal plants from 103 traditional herbal healers were documented.

Herbal plant parts for sale at Van Mela

Project 2: Impact of pollutants on growth of plants [ICFRE- 115/TFRI-2007/Ecol-1(8)]

Findings: Seventy two sponge iron factories have come up at and around Raigarh, Chhattisgarh, India during the last 20 years. A huge amount of SO_2 and NO_x along with CO, CO_2, Volatile Organic Compounds (VOC) and Suspended Particulate Matters (SPM) are emitted into the atmosphere during the extraction of iron from hematite that relies on burning of inferior quality coal. SO_2 and NO_x are the primary causes of acid rain. The other most dangerous pollutant is SPM (<1mm in diameter). Study was conducted at Raigarh to determine the detrimental effects of severe pollution on the vegetation there.

The trees at the polluted sites at Raigarh, were found to be poorly grown with reduced collar girth, stem and branches deformed, leaves being chlorotic and/or necrotic with black patches. The levels of pH and organic carbon were lower in all the polluted rhizospheric soils while the EC was found to be higher in comparison to the control samples. In the present study, the levels of exchangeable Ca^{++} and Mg^{++} were found to be much higher in the rhizospheric soils of the polluted samples, which strongly support the hypothesis that in acidic environment, Ca^{++} and Mg^{++} leach out from the roots in exchange with Fe^{+++} and Al^{+++} from the soil leading to deformed and retarded growth of the trees. Interestingly, except for few species, the seeds never germinated in soil mix with SPM in nursery. SPM and slag were dumped on roadside vegetation areas. Unlike other byproduct dykes like that of fly ash or aluminium extraction wastes or different mine overburden areas, where atleast some herbs or shrubs were found to be growing naturally, no vegetation came up in the sponge iron waste slag dumps and all the tree species died shortly. This indicates that perhaps the dispersion of the SPM from the sponge iron factories would slowly render the areas unfertile turning them into deserted waste lands.

Project 3: Studies on forest dwelling Braconids (Hymenoptera : Braconidae) from central India and their role in biological control of important forest insect pests [081/TFRI/2005/ Ento-2(10)/2005-08]

Findings: A total of 1587 samples of Braconid parasitoids collected from eleven ecological/ agro-climatic zones of Madhya Pradesh, of the total 37 Braconid species viz. *Apanteles tachardiae, Apanteles machaeralis, Apanteles hyblaeae, Apanteles leptothecus, Apanteles antipoda, Apanteles cajani, Apanteles caniae, Apanteles colemani, Apanteles hasorae, Apanteles bambusae, Apanteles agilis, Apanteles attevae, Parahormius stom, Parahormius* nr. *jason, Parahormius deiphobus, Parahormius absonus, Parahormius zonus, Parahormius rameshi, Hormius lamidae, Hormius vitabilis, Hormius longiventris, Eutropobracon granulatus, Cassidibracon sumodani, Cassidibracon indicus, Adialytus salicaphis, Adialyts arvicola, Trioxys* (Binodoxys) *rubicola, Trioxys* (Binodoxys) *indicus, Trioxys* (Trioxys) *soporensis, Diaeretiella rapae, Chelonus* (*Chelonus*) *deogiri, Chelonus*

(*Chelonus*) *narayani, Chelonus* (*Chelonus*) *gastrus, Chelonus* (Chelonus) *dwibindus, Chelonus* (Microchelonus) *chailini, Chelonus* (Microchelonus) *scutellatus* and *Chelonus* (Microchelonus) *shyamus*, were identified up to species level. Of them, six species were proposed as the species new to science. They were illustrated and described in detail. Complete host-record of all Indian Braconid species has been prepared after careful consultation of available literature on the subject.

Project 4: Studies on bacterial and viral diseases of teak, Gmelina and Albizia and their management [066/TFRI/2004/Patho-1(8)]

Findings: In all 245 bacterial wilt and collar rot disease samples of teak and *G. arborea* and 5 virus infected samples of *A. lebbek, A. procera, T. grandis* and *G. arborea* from 27 forest nurseries of MP, CG and MS were collected. 2–5% economic losses were recorded in different nurseries caused by bacteria and viruses. A total of 9 bacterial isolates were purified and sensitivity test carried out to assess suitability of antibiotics for their application in nursery. Experiment was conducted in nursery to control wilt and collar rot disease of teak, *A. procera*, *A. lebbek* and *Gmelina arborea*. Incidence of Xanthomonas leaf curl and stunting in young teak plantations at Raipura, south Panna division was recorded. Disease was successfully controlled with the application of streptocyclin 0.1% in combination with monocrotophos 0.036%. The cost of treatment was found to be Rs. 952 per acre.

Project 5: Evaluation, modification and value addition of starches of forest origin [TFRI-083/NWFP/2005-08]

Findings: Starch was isolated from *Careya arborea* seed and *Curcuma aromatica* rhizome and their physico-chemical properties were determined. Potential of starches for preparation of different value added products was evaluated. Seeds of *C. arborea* and rhizome of *C. aromatica* have an average of 34.08 and 25.3% starch respectively. Value added products like dextrin, syrup and pappad from starch of *Careya arborea* and pickles from carboxymethylated starch of *Curcuma aromatic* were prepared.

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

Findings: A field study was conducted for assessing plant density, regeneration, coppice growth, woody perennial species and ground flora by laying out quadrate in People Protected Area (PPA), Rehabilitation of Degraded Forest (RDF) and Unprotected Forest Area (UFA) at Udaipur forest village in Satna Forest Division and Narwar, Nipnia, Aintajhar, Singpur forest villages of south Shahdol Forest Division in Madhya Pradesh. Under PPA scheme 19 species with 1950 tree density were observed in the first year. After two years of implementation of scheme, there was 1.35% and 1.47% increase with respect to number of species and density of trees. After three years 1.53% and 1.68% increase was observed in respect of above parameters. Under RDF scheme, 19 species with 1605.3 tree density were observed. After three years of implementation of scheme, there were 1.11% and 1.36% increase with respect to number of species and density of trees. In unprotected site, 16 numbers of species with 1106.3 trees density was observed during the first year. After three years 1.11% and 1.36 % increase with respect to number of species and density of trees was noted.

As far as density of coppice of tree species was concerned, after three years of implementation of scheme, there were 9.84 times and 5.66 times more coppice production in PPA and RDF as compared to unprotected site. Density of regeneration of tree species after three years of implementation of scheme was noticed 3.58 times and 1.98 times more in PPA

and RDF as compared to that of unprotected site. In PPA, the ground flora was observed 1.25 times more in PPA than that of unprotected site. Due to RDF activities status of ground flora was found less as compared to PPA.

Plant density regeneration, coppice growth of woody perennials species and ground flora were better in the forests having Joint Forest Management programme as compared to the forest areas having no JFM programme.

Closure of biotic interference (including fire protection) through patrolling and CPT under PPA scheme resulted in increased biomass of upper, lower and middle storey trees, shrubs, herbs and ground flora by active involvement of local people.

Soil and moisture conservation model with emphasis on gully plugging and nala bunding etc., water table was found to increase and the water was available throughout the year. Consequently, litter thickness increased resulting in increased moisture and nutrient status of soil. Rate of soil erosion, water run-off and loss of nutrients reduced due to soil and moisture conservation activities under RDF schemes. Population of ground flora having medicinal plants were found to increase by controlling grazing, fire protection and with active involvement of local people. Implementation of JFM programme has positive impact on socio-economic condition of people.

EXTERNALLY AIDED PROJECTS

Project 1: Identification of species and ethno-botanical survey [ID No. 088/TFRI/2005/Bio-3(CGMFD) (6)]

Findings: Nine PPAs of 5 divisions were quantitatively and qualitatively analyzed as per resource survey methodology. About 50 sample plots of 0.1 ha with stratified systematic sampling design were laid out in 1000 ha area of each PPA. Four subplots of 5 x 5 m size were laid out inside the main plot. Each one of them was marked at a distance of 11.2 m from the centre of the plot on all four sides. Study of important medicinal plants and MFP species on each plot was done. Five subplots of 2m x 2m were laid out inside the main sample plot for the study of regeneration.

Phytosociological (qualitative and quantitative values for structure and composition) studies were undertaken in all the nine people protected area of 0.1 ha each site. All individuals of >10 cm CBH (Circumference at breast height at 1.37 m) were enumerated. Data were recorded in all fifty sample plots of each 9 PPA.

The vegetation data were quantitatively analysed for density, frequency and basal area. The relative values of frequency, density and dominance were also determined. These quantities were summed up for getting Importance Value Index (IVI) of individual species. On the basis of IVI, dominant, co-dominant and main associated species are recognized in different sites. The composition of forest and regeneration status along with other growth parameters such as girth was also enumerated.

Enumeration of vegetation in the Makadi range indicated the presence of 2347 trees of over 10 cm cbh/gbh in 0.1 ha sample plot. It is represented by 29 families, 49 genera and 62 species. Plant community was recognized accordingly as Shorea - Terminalia community. A density of 469.4 trees /ha was found. *Shorea robusta* was found dominant with 110.6 trees ha followed by *Terminalia tomentosa* and *Buchanania lanzan* and other species. Basal area of trees ranges from 7.769 m^2/ha to 0.02 m^2/ha. Total 62 tree species were enumerated. Forty one species of medicinal plants were recorded in Makadi PPA.

Antagarh PPA indicated the presence of 3671 trees of over 10 cm cbh/gbh in 0.1 ha sample plot. It is represented by 24 families, 37 genera and 62 species. On the basis of density the species, *Cleistenthus collinus* secured the highest value (146.4 trees/ha) fallowed by *Shorea robusta.* Plant community was recognized accordingly as Cleistenthus - Shorea community. Total basal area 11.44 m^2/ha was observed. Total 43 tree species were enumerated. Thirty seven species of important medicinal plants were inventorized.

In Dugli PPA of Dhamtari area 41 trees, 10 shrubs, 26 herbs, 14 climbers and 2 grass species have been observed. Forty one tree species belongs to 19 families and 37 genera. Plant community was recognized as Shorea–Terminalia community. Total 41 tree species were enumerated. Density under Dugli PPA was 501.8 trees/ha and basal area 7.01 m^2/ha was observed. Total 39 species of important medicinal plants were listed out.

Enumeration of vegetation in the PPA Sankra range indicated the presence of 3142 trees. It is represented by 25 families, 47 genera and 53 species. Plant community was recognized as Shorea - Cleistenthus community. A density of 628.4 trees /ha was found *Cleistenthus collinus* was found as dominant species with 115.4 trees/ ha. Basal area of trees ranged from 3.75 to 0.002m^2/ha. The highest basal area was shown by *Shorea robusta*. Total 53 tree species were enumerated and 26 no. of important medicinal plants were recorded.

The vegetation in the Karpawan PPA indicated the presence of 2445 trees. It was represented by 27 families, 51 generas and 60 species. Plant community was recognized as Shorea-Terminalia community. The total density was 489 trees /ha *Shorea robusta* was found as dominant with 110 trees/ ha. The highest basal area was shown by *Shorea robusta*. Total 60 tree species were quantitatively enumerated and 77 species listed as important medicinal plants.

Enumeration of vegetation in the Machkot PPA indicated the presence of 2232 trees. It is represented by 27 families 46 genera and 56 species. Plant community was recognized as Shorea- Pterocarpus community. Total density was 469.4 trees /ha. *Shorea robusta* was found dominant with 99.2 trees/ ha. Overall total basal area covered by the trees was 13.42 m^2/ha. Fifty four tree and 77 medicinal plants species were recorded.

The vegetation in the Guriya PPA indicated the presence of 2181 trees. It is represented by 28 families, 50 genera and 55 species. Plant community was recognized as Shorea- Pterocarpus community. Total density was 436.2 trees/ha and *Shorea robusta* was found dominant with 131 trees/ha. The total basal area of trees in the area was 25.1 m^2/ha. Total 55 trees and 59 medicinal plants species were recorded.

Vegetation in the Ataria PPA of Lamni range indicated the presence of 3236 trees. It is represented by 21 families, 38 genera and 42 species. Plant community was recognized as Shorea- Terminalia community. Total density was 647 trees/ha. It indicated high density and highly protected area. *Shorea robusta* was found as dominant with 181.6 trees/ha. The total basal area of trees in the area was 11.87 m^2/ha. *Shorea robusta* showed the highest basal area. Forty two tree species were enumerated and 41 species of medicinal plants recorded.

The vegetation in the Keonchi PPA, indicated the presence of 1172 trees. It is represented by 20 families, 33 genera and 37 species. Plant community was recognized accordingly as Shorea- Terminalia community. Total density was 468.4 trees /ha and *Shorea robusta* was found as dominant species. The total basal area of trees in the area was 34.23 m^2/ha. Total 37 tree species were enumerated and 72 species of medicinal plants were recorded.

In all, 1114 species of flora (trees, shrubs, herbs, grasses and climbers) in all PPAs including species observed in low intensity and under threat were also listed.

Project 2: Screening of indigenous species of Trichogramma Westwood Trichogrammatoidea Girault (Hymenoptera: Trichogrammatidae) from central India and their utilization against important forest insect pests [077/TFRI/2005/Ento-(1) 9]

Findings: Of the 2590 specimens collected from Madhya Pradesh, Chhattisgarh, Maharastra and Orissa, 37 species of *Trichogramma* viz. *T. achaeae, T. agriae, T. breviciliata, T. latipennis, T. kankerensis, T. chilotraeae, T. flandersi, T. fasciatum, T. hesperidis, T. higai, T. plasseyensis, T. raoi, T. sembeli, T. semblidis, T. pallidiventris, T. vargasi, T. thalense, T. sericini, T. julianoi, T. bezdenkovii, T. parkeri, T. brevicapillum, T. nomlaki, T. tshumakovae, T. fuentesi, T. ingricum, T. savalense, T. margianum, T. rossicum, T. ostriniae, T. artonae, T. clotho, T. lachesis, T. lenae, T. pretiosum, T. poliae, T. stampai* and 04 species of *Trichogrammatoidea* viz. *Trichogrammatoidea bactrae, T. fumata, T. armigera* and *T. ruficorpa* were recoded for the first time from central India.

Ten species of genus *Trichogramma* and two species of *Trichogrammatoidea* are proposed as the species new to science. Complete host-range has been prepared, after consulting the world literature for all available species of *Trichogramma* and *Trichogrammatoidea*. Live culture of 4 indigenous species viz., *Trichogramma raoi, T. plasseyensis, T. latipennis* and *T. breviciliata* are being maintained.

Project 3: Standardization of sustainable harvesting practices of Arjuna (*Terminalia arjuna)* Bark [ID No.: 078/TFRI/2005/NWFP-1(MPFED)/(12)]

Findings: Presently the bark of Arjuna is being extracted through unscientific and destructive harvesting practices. This is the first study on development of sustainable harvesting practices of Arjuna bark. *T. arjuna* has the ability to withstand bark removal as long as the vascular cambium is not destroyed.

The study revealed that the regeneration of bark in young trees was faster in comparison to old trees. The bark was regenerated in two years. The medium aged trees gave better quality of bark in terms of their major active ingredients. The best time to harvest bark was found between March and April. The study recommends that for sustainable harvest, only ¼ or ⅓ of the mature bark of total girth of the tree should be stripped by removing only outer and middle bark leaving the inner bark for regeneration from opposite quarters of the trunk. Thus sustainable bark harvesting can be done after every two years by removing opposing quarters of trunk bark rather than girdling the trees.

Project 4: Standardization of non-destructive harvesting practices of Aonla (*Phyllanthus emblica*), Baheda (*Termania bellerica*) and Baividang (*Embelia ribes*) fruits [097/TFRI/2005/NWFP-8 (CGMFD)/(20)]

Findings: The study revealed that harvesting time plays very important role in maintaining the sustainability because only mature fruits produce viable seeds. The fruits if harvested at right maturity in Aonla (December-January), Baheda (January-February) and Baividang (November-December), they produce viable seeds. Even small quantities of fruits (5-10%) were found sufficient for regeneration. The study also suggests that anthropogenic pressures other than harvest could be responsible for difference in regeneration between protected and unprotected areas, which are managed under similar harvest intensities. Grazing and fire is the major causes for poor regeneration. In protected areas, 10-20 % Aonla fruits were found sufficient for regeneration. However, in unprotected areas less regeneration was observed even if 20% fruits were left for regeneration. In Baividang, 5-10 % fruits were found enough for proper regeneration in protected areas of Dhamtari district in good fruiting year if harvested in December. In Baheda, even 5-10 % fruits were found suitable for its regeneration in protected

areas if harvested in the month of January. In Baheda, the seed dispersal is very poor. For proper dispersal and to maintain sustainability, mature seeds should be dispersed in the forest area. These practices may be helpful for the sustainable management of these important medicinal plants.

Project 5: Standardization of non-destructive harvesting practices of Arjuna (*Terminalia arjuna)* and Maida (*Litsea glutinosa*) Bark [096/TFRI/2005/NWFP-8 (CGMFD) (19)]

Findings: The study revealed that the regeneration of bark in young trees was faster in comparison to older trees. In Arjuna, the bark was regenerated in two years whereas in Maida it took only one year. In Arjuna, the quality of trunk bark was superior in comparison to the bark of other plant parts, whereas no significant difference was found in Maida. In Arjuna, the bark thickness at breast height varied from 8.12 to 20.96 mm and was found to be irrespective of the age/girth of tree. The tannin content in Arjuna bark ranged from 6.89 to 11.83 gm per 100 gm. Mature Maida trees had thick bark with less mucilage content in comparison to younger trees. The study also showed that the stage of bark recovery (regrowth) varied from tree to tree. Arjuna showed remarkable bark regrowth in moist sites. The medium aged trees gave better quality of bark. The best time to harvest bark was found between December and March. The study recommends that for sustainable harvest, only ¼ or ⅓ of the mature bark of total girth of the tree should be stripped by removing only outer and middle bark leaving the inner bark for regeneration from opposite quarters of the trunk. The length of blaze/strip can be upto 1.20 metre depending upon girth of the trees. A long strip of one quarter of the trunk may be removed with sharp thin edge tool designed for the harvest of bark.

Project-6 : Processing Techniques of NWFPs of Chhattisgarh TBOs–*Madhuca latifolia, Shorea robusta, Schleichera oleosa, Pongamia pinnata* and *Buchanania lanzan* [ID No.: 091/TFRI/2005/NWFP-3(CGMFD)-(14)]

Findings: Study conducted on processing of Tree Borne Oil Seeds (TBOS) i.e. Sal (*Shorea robusta*), Chironjee (*Buchanania lanzan),* Karanj (*Pongamia pinnata),* Mahua (*Madhuca latifolia*) (Mahua) and Kusum (*Schleichera oleosa*) indicates that method of drying and storage in containers affect the quality of oil seeds severely. Different methods of drying i.e. shade, sun drying, hot air drying at 40, 60 and 80ºC were used to dry the tree borne oil seeds. Hot air drying at 60ºC proved better in comparison to sun drying /shade drying methods to maintain quality of seeds. At 80ºC, the moisture of the seeds decreases rapidly and affects the quality of seeds. Hot air drying at 60°C for 8 hours was found to be most effective in minimizing moisture content to 7-9% without affecting oil quality and undesirable changes in lipids and its properties. The kernels obtained after processing of seeds should be dried properly before storing to avoid deterioration due to pests. This will ensure availability of good quality seed kernels for the extraction of oil with minimal deterioration.

Project 7: Quality assessment of NWFPs: *Asparagus racemosus, Buchanania lanzan, Andrographis paniculata, Phyllanthus emblica* and *Embelia ribes* from Chhattisgarh [ID No.: 092/TFRI/2005/NWFP-4(CGMFD)-(15)

Findings: The maximum weight of fresh Aonla fruits was recorded as 6.89 gm, pulp weight 6.44 gm and ascorbic acid was recorded as 197.2mg/100 gm fresh Aonla in samples collected from Ambikapur. In Jabbara Nagan, the maximum fresh weight of Aonla was recorded 6.447 gm and the pulp weight was 6.53 gm and ascorbic acid 143.5 mg /100 gm of fresh weight. Ascorbic acid contents was found to be significantly higher in Aonla samples collected from Kanker.

Maximum weight of fresh fruit was recorded 5.77 gm, pulp weight 4.99 gm and ascorbic acid 326.3 mg/100 gm of fresh fruit.

The fruit weight of Chironjee ranged from 0.552 to 0.802 gm with maximum fruit weight in Kapu, Dharamjaigarh samples. Samples collected from Kudur, Kawardha showed maximum kernel weight (1.20 gm) and oil (62.57%).

Out of 20 localities surveyed for the quality of Chironjee, the maximum fruit weight of 0.802 gm was recorded from Kapu and Dharamjaigarh samples. The maximum oil percentage 62.57% was observed from the samples collected from Kudur and Kawardha.

Roots of Satawer (*A. racemosus*) were collected from 22 localities of Chhattisgarh during April-May. Maximum average root length of 25.35 cm and dia 1.02 cm and saponin percentage of 2.5 % was observed in the samples of Dondi (Durg), which are significantly higher than other localities.

Kalmegh samples were collected from 19 localities. Andrographolide contents were observed to vary from 0.27 to 0.49%. Maximum andrographolide content was found in the samples collected from Jagdalpur (0.49%).

Physical and chemical parameters of fruits of *Emblia ribes* were studied in samples collected from 5 localities of Chhattisgarh. The moisture % and embelin contents were estimated. Embelin concentration was ranged from 1.98-2.94%. Maximum concentration of 2.94% was estimated in the sample collected from Jabbara, Dhamtari.

Project 8: Non-destructive harvesting practices for selective MFPs species–*Buchanania lanzan* (Chironjee) [ID No.: 093/TFRI/2005/NWFP-5 (CGMFD)-(16)]

Findings: Surveyed and selected nine different Chironjee growing areas of Chhattisgarh state. The fruits were harvested on the basis of occular/ visual observations, and number of branches per tree. Fruits were collected non destructively either by hand or with the help of long bamboo sticks. Sometimes beaten slowly to help fallen the fruits.

Annual recruitment of young seedlings varied from site to site. Harvesting 90% fruits at Kota, Bilaspur resulted 7.90, 9.04 and 8.20% seeding recruitment in Ist, IInd and IIIrd years, respectively. In non-harvested control sites, it was 5.80, 9.69 and 9.69% respectively. It indicates that the population is increasing both in controlled as well as in different levels of harvesting.

Project 9: Sustainable yield assessment/harvesting of Non-Wood Forest Produce (NWFP) in People's Protected Areas (PPAs) of Chhattisgarh [098/TFRI/2005/Silvi-3 (CGMFD-10)]

Findings: Sample plots of *Andrographic paniculata* (Kalmegh), *Aspargus racemosus* (Satawar) *Celastrus paniculata* (Malkangani) and *Aegle marmelos* (Bel) were laid out in three agroclimatic zones (Bastar, Raipur and Bilaspur) of Chhattisgarh.

Sustainability for *Andrographic paniculata* with maximum productivity was found to be at 80% harvesting level. As such 80% of entire plants of *Andrographic paniculata* may be harvested. Sustainability for *Aspargus racemosus* with maximum productivity was found to be at 60% harvesting level. Eight month old plants of *Aspargus racemosus* should only be harvested.

Sustainability for *Celastrus paniculata* with maximum productivity was found to be at 80% harvesting level. Similarly, sustainability for *Aegle marmelos* (Bel) with maximum productivity was found to be at 80% harvesting level. Regeneration through root suckers was found better than through seeds. Regeneration through root suckers by hoeing 10-15 cm deep is advisable around the trees.

Socio-economic status and living standard of people in JFM areas have been found to be better due to implementation of the scheme by way of employment and enhancement of production of medicinal plants.

Project 10: Nursery technologies for mass multiplication of superior seedlings of Vaividang, Sarpgandha, Chironjee Arjun, Aonla and Bel in Chhattisgarh [099/TFRI/2005/Silvi-4 (CGMFD-11)]

Findings: Nursery technologies for mass multiplication of superior seedlings of *Embelia ribes* (Vaividang), *Rauvolfia serpentina* (Sarpgandha), *Buchanania lanzan* (Chironjee), *Terminalia arjuna* (Arjun), *Emblica officinalis* (Aonla), *Aegle marmelos* (Bel) in Chhattisgarh were standardized.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Evaluation of medicinal plant based agroforestry (Silvi-Medicinal) system under existing teak plantations [105/TFRI/2006/Agro-1(14)]

Status: OSR and OFR field trials were conducted to standardize the silvi-medicinal system using *Curcuma longa, Costus speciosus* and *Gloriosa superba*. Observation on yield, growth and biomass of intercrops recorded. The data indicated that *C. longa* and *C. speciosus* performed well under the full canopy of teak. The maximum plant height of *Gloriosa superba* was observed in 50% pruned teak, whereas significant yield reduction with respect to sole crop was registered under closed tree canopy. Analysis of OSR and OFR trials indicates that macro nutrients (NPK) are decreased in the intercrop as compared to sole crop (medicinal plants).

Gloriosa superba under silvi-medicinal system

Project 2: Study on plant diversity in Sal–Teak ecotone zone as influenced by ecological and climatic changes [085/TFRI/2005/Biod-2(5)/2005–09]

Status: Periodical survey of two Sal–Teak ecotone zones at. 1. Umariya (M.P.) and 2. Jagadalpur (C.G.) were conducted for the study. Compartment history and maps of the area were collected. The climatic data from 1947 to 2008 were collected from local observatory. Ten quadrats of 20 x 20m size at both the sites were laid down for observation on number, occurrence and girth of tree species. Seven quadrats of 3 x 3m size for shrubs and herbs/grasses were laid out for phyto-sociological study. Quadrats were also laid out in sal dominated and teak dominated natural forests at the study sites for observation. The climatic data including temperature, humidity and solar radiation inside and outside of the forests were recorded from both the sites. The result showed that the diversity of tree, shrub and herb species were high in ectone sites as compared to sal and teak dominated compartments.

Fifty soil samples each were collected from both the sites to analyse pH and nutrient status of the area. The data showed that the soil of Teak forest had 7.12 to 7.30 pH and Sal forest had an acidic range of soil varying from 5.32 to 6.02 pH. The pH in ecotone zone, however, varied from 5.56 to 6.93.

Project 3: Screening of tropical forest tree species for their potential as carbon sink in Madhya Pradesh and Chhattisgarh [124/TFRI/2007/Ecol-2(9)]

Status: Established agroforestry systems with *Tectona grandis* and *Dalbergia sissoo* as tree species and *Triticum aestivum, Cicer arietinum* and *Withania somnifera* as agricultural crops. Carbon sequestered by tree species and agricultural crops was measured by Biomass Method. Carbon accumulated in coarse and fine litter and organic carbon in the soil was also taken into consideration. *Tectona grandis–Triticum aestivum* agroforestry system sequestered 23.84 tonne carbon/ha per years.

Carbon sequestration potential of different aged *Eucalyptus eurograndis – Triticum aestivum* agroforestry systems was measured by Biomass Method at village Majitha (Jabalpur). This system sequestered 36.65 tonne carbon/ha per year.

Carbon sequestered by *Tectona grandis* plantations raised at Bodla forest range under Kawardha division (Chhattisgarh) was measured by non-destructive Biomass Method by measuring GBH and putting their values in allometric equations. Similarly, carbon sequestered by *Shorea robusta* plantations at Motinala, Mandla forest division (Madhya Pradesh) was measured.

Soil samples from all the selected sites were collected and analysed in laboratory for organic carbon and other physio-chemical characteristics.

Project 4: Studies on the efficacy of toxins of soil actinomycetes against major forest insect pests [103/TFRI/2006/Ento-2(13); 2006-09]

Status: Collected 90 soil samples from forests of Madhya Pradesh, Maharashtra and Chhattisgarh and isolated 3 actinomycetes/bacteria on potato-dextrose agar medium following serial dilution technique and pour plate method. Extracted toxins (antibiotics and its fractions) of actinomycetes, *Streptomyces* sp. and tested against key insect pests of teak (*Hyblaea puera* and *Eutectona machaeralis*) Stress (*Spiroma retorta*) (*Atteva fabriciella*). Conducted toxicity tests of antibiotics and its fractions of isolated actinomycetes. Efficacy of a commercially available bioproduct (spinosad) of a soil actinomycete was tested against above target pests through leaf and larval treatment as well as field-cum-laboratory tests which proved to be significantly ($p<0.05$) effective.

Project 5: Evaluation of biopesticidal products for the management of teak defoliator and skeletonizer in forest nursery [104/TFRI/2006/Ento-3(14)]. Duration-3 years from June 2006 to May 2009.

Status: Biopesticides like neem formulation at/above 0.5% offer 90% antifeedant effect against teak skeletonizer and can also be used as a prophylactic treatment to inhibit over 80% egg laying of teak defoliator as a component of IPM module. Foliar spraying of biopesticides 0.05% of Spinosad (Actinomycete) 45% EC and 0.05% Agropest bt, is effective to manage teak defoliator and skeletonizer in forest nursery. EPNs *Heterorhatdites indica* and *Steinernema carpocapsae* were reared and their bioefficacies evaluated for the first time against teak skeletonizer. EPN, *H. indica* in laboratory bioassay (dose-range 3 to 30 ijs larva^{-1}) in 72 hrs post-exposure caused mortality up to 76.47% at 10ijs larva^{-1} and 100% at 30ijs larva^{-1}. Field spraying experiment indicated that 10000 infective juveniles/ litre kills 50% larvae of leaf skeletonizer. EPN if mixed with biopesticides like 0.05% of Agropest–b + derisome or conserve (spinosad) killed cent per cent larvae. First time, 3 native EPN populations (1 *Steinernema* spp. and 2 *Heterorhabditis* spp.) were isolated and being maintained successfully as no previous reports from the central Indian forest floor is available.

Project 6: Chemical control of insect pests and diseases of *Buchanania lanzan* [114/TFRI-2007/Ento 2(17)/2007-10]

Status: Survey was conducted at Laripara (Bilaspur), Batkakhapa / Karabhoh (Chhindwara), Padar (Betul) in Madhya Pradesh and Purkabodi (Bhandara) in Maharashtra state for monitoring the insect pests and diseases of *Buchanania lanzan.* Incidence of stem borer (60%), leaf gall forming insect (40%), defoliator (26%), inflorescence sap sucker thrips (50%) and wilt and leaf blight/curling/diseases (60%) were recorded in nurseries and natural stand. Three fungicides viz. dithane, bavistin and redomil in different concentrations were tested against Fusarium wilt disease of *B. lanzan* in forest nursery at Salibara, Chhindwara. Bavistin 0.29% proved best to prevent the seed associated fungi. Eight commercial pesticides viz. monocrotophos, endosulfan, cypermethrin, fenvalerate, deltamethrin, alphamethrin, biopro super and neem oil were tested against defoliator, *Lamida carbonifera* in Entomology nursery, TFRI, Jabalpur. Endosulfan 0.05% followed by monocrotophos 0.05% proved better than the remaining pesticides. Six insecticides viz; dichlorvos, paradichlorobenzene, endosulfan, dimethoate, monocrotophos and neem oil were tested against stem borer *Batocera rufomaculata*. Dichlorvos 0.03% proved better than remaining pesticides used. Similarly five pesticides viz. endosulfan, monocrotophos, neem oil, bavistin and alpha naphthyl acetic acid in different concentrations were tested against insect pests and diseases to enhance the quality and quantity of seeds in natural stand of *B. lanzan.* The result showed that endosulfan 0.07 % + Bavistin 0.2% + alpha naphthyl acetic acid 40 ppm proved best to enhance the quality and quantity of the fruit produced.

Project 7: Application of growth promoting microbes and soil amendments to produce improved seedlings of forest trees [118/TFRI-2007/Patho-1(12)/2007-10]

Status: Germplasm of growth promoting micro-organisms were collected from Seoni, Balaghat, Chhindwara, Tamia, Umariya, Matkuli, Jhirpa and Pachmarhi (Madhya Pradesh). A field experiment was laid out on sandal to test the effect of soil amendment and biofertilizers on its growth. After two months of planting, there was no mortality in biofertilizer applied seedlings along with soil amended with loam soil, Leucaena leaf and mixed organic matter as compared to 20% mortality in control and uninoculated seedlings. The growth of sandal was maximum in soil amended with Leucaena leaf and mixed organic matter along with biofertilizer application. Another experiment on *Dalbergia sissoo* was conducted in root trainer to study the effect of plant growth promoting organisms (two fungi, *Trichoderma* sp. and *Aspergillus* sp. and three bacteria, Azotobactor, Azospirillum and PSB) on its growth. After 3 months, maximum survival of seedlings was recorded in Trichoderma (local strain) amended soil with soil and sand (2:1) followed by application of Azospirillum along with soil amended Leucaena leaf. Maximum height (19cm) was recorded in Trichoderma + FYM, soil and sand in 1:2:1 ratio applied seedlings followed by Azospirillum + FYM as compared to control (5.7cm). Two others experiments on *Jatropha curcas* and *Gmelina arborea* are in progress. Culture of organisms are maintained in the laboratory.

Project 8: Genetic variation for *in-vitro* morphogenetic potential of *Dalbergia sissoo* Roxb. clones and evaluation of their field performance [ID No. : 117/TFRI-2007/Gen.-1(13) (ICFRE)/2007-12]

Status: Five promising trees of *D. sissoo* were selected from Raigarh, Chhattisgarh in 2009. Vegetative propagules were collected for stock build up of clonal materials for *in-vitro* propagation. Shoot multiplication of five clones (GBW, JB 1, FZB and FZK RB) was evaluated by conducting two experiments. In the first experiment, the effect of nature of culture medium

(liquid and semi solid) and different basal media (MS, WPM, Nitsch and Nitsch) was evaluated in five clones. The data obtained from three way analysis revealed that the highest average number of shoots per explants after six week of inoculation was obtained for FZK clone (3.23) followed by FZB clone (3.07) on MS liquid medium. In the second experiment, explant types (single and double nodal segment) inoculated in three basal media (MS, WPM, N&N) were tested in five clones (GBW, JB 1, FZB, FZK and RB). Significant effect of explant types, basal media and clones was observed on number of shoots after six weeks of inoculation. The double nodal explant was invariably found to be superior compared to single nodal explant. However, the interaction of explant types with clones and media had no significant effect on shoot multiplication. The highest average number of shoots per explant was obtained on a combination of FZB clone and WPM medium (2.42) followed by combination of FZK clone and WPM (2.36) and combination of FZB clone and Nitsch and Nitsch medium (2.17).

Project 9: Sustainable management of medicinal plants in JFM areas in different agro-climatic zones of Madhya Pradesh [079/TFRI/2005/Silva-1(8)/2005-10]

Status: Data have been collected from sample plots laid out for generating data on sustainable harvesting of Kalmegh, Chironji and Satawar as per following details:

- Kalmegh in Satnur Forests area, Sawari Range, Delakhadi Forest Range West Chhindwara Forest Division, and at Naunichhapar Village, Chhindwara Range in East Chhindwara Forest Division.
- Chironji in Sitadongri, Delakhadi Forest Range, West Chhindwara Forest Division and Khumbhadeo Forests, East Harrai Range and Ojhaldhana Village East Batkakhapa Range, East Chhindwara Forest Division.
- Satawar in Bandhi Circle, Umariya Forest Range, Katni Forest Division.

Project 10: Standardization of nursery techniques of *Strychnos nux-vomica* and *Strychnos potatorum* [080/TFRI/Silvi. 2-(9)/2005-08]

Status: Seed germination studies of *Strychnos nux-vomica* and *Strychnos potatorum* under different physical, chemical and hormonal treatment were conducted. Vegetative propagation study through branch and root cutting of *Strychnos nux-vomica* and *Strychnos potatorum* under different hormonal treatment was conducted. Seeds of *S. nux-vomica* and *S. potatorum* were sown in polythene bags to conduct fertilizer trial in order to accelerate the growth of seedlings. Data on germination, sprouting, rooting, survival and growth of both the species under different experiments were recorded.

Project 11: Seed physiology of the tropical forest species with special reference to their maturity and storage [076/TFRI-2004/Silvi-2(7)/2005-10]

Status: The viability of *Bassia latifolia* seed was assessed using different storage conditions. The seed of this species can best be stored at 25^0C with shedding moisture content. Seed maturation studies for determination of seed collection time had been completed on *Ablomoscus moscatus, Moringa oleifera, Holoptelea integrifolia* and *Sapindus laurifolia*. Best collection time for *Ablomoscus moscatus* was noted at 30 days after anthesis, when the color of the pod turned reddish brown before it opened. Best harvest time for *Moringa oleifera, Holoptelea integrifolia,* and *Sapindus laurifolia* were 77, 60 and 117 days after anthesis respectively with 65%, 4% and 10% moisture content respectively. Stored seeds of *Schleichera trijuga, Hardwickia binata, Sapindus laurifolia, Rauvolfia serpentine, Moringa oleifera, Terminalia chebula, Mimusops elengi, Holoptelea integrifolia* and *Emblica officinalis* were sampled for viability assessment at regular

intervals depending on the species. Best storability at 45^0C was found for *Hardwickia binata* seeds with 100% germination after one year of storage.

Project 12: Development of nursery techniques for *Terminalia chebula* Retx. (Harad) [107/TFRI/2006/Silvi-1(12)/2006-09]

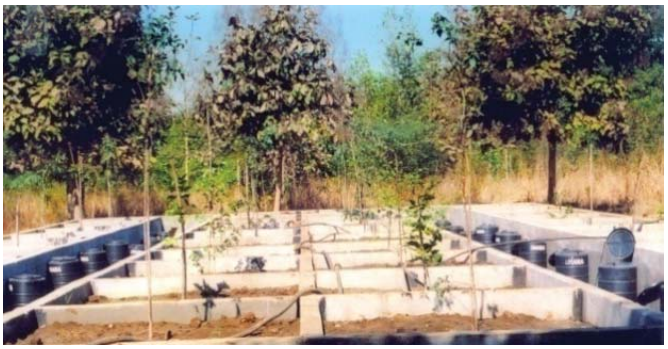
Status: Studies on seed germination of *Terminalia chebula* under different physical, chemical and hormonal treatment were conducted from the seeds and branch cuttings collected from Chandrapur (Maharashtra), Bhilaigarh (Chhattisgarh), Tamia (Madhya Pradesh) and Samplepur (Orissa). Vegetative propagation study through different size of branch cuttings under different concentration of hormonal treatment was conducted. Seeds of *Terminalia chebula* were sown in polythene bags and germination beds. Germination, sprouting, rooting, survival and growth of the desired species under different experiments were recorded and statistically analysed.

EXTERNALLY AIDED PROJECTS

Project 1: Identification of suitable tree species and other vegetation for biodrainage in Bargi command area (Jabalpur, M.P.) [087/TFRI/2005/Ecol-1(MOWR)(6)/2005-10]

Status: Dead seedlings were replaced by the healthy seedlings of the same age during rainy season in the plantation raised along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur. Seedlings of *Jatropha curcas* and *Agave americana* were planted surrounding the plantation area as biofencing.

Forty lysimetric tanks were constructed in the institute's campus to simulate the experiments being conducted along LBC. The experiments were set up in the lysimetric tanks with same tree species planted along the canal. The water levels maintained in the lysimetric tanks were : 0-0.25 m, 0.25 to 0.50 m, 0.50 to 0.75 m and irrigated (control). In another experiment, the tolerance of *Eucalyptus* hybrid with different salinity levels was tested.



Lysimetric Experiments

Growth data of planted seedlings were regularly collected along LBC of Bargi Command Area and lysimetric tanks. These data were collected at an interval of 3 months along LBC and at monthly interval in lysimetric tanks. Biomass studies were also conducted at regular interval.

Under ground water table below plantations of different tree species and control area was regularly measured with the help of observation wells. The effect of different tree species on water table was observed and compared with control.

Soil samples from different plantation sites were collected and analyzed for their physico-chemical characteristics including pH, EC, CEC, organic carbon, available N,P,K, exchangeable Na, K, Ca and Mg, mechanical analysis etc.

Training on 'Bio-drainage' was organized at village Dabhola along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur (M.P.) for farmers and tree growers. Field trip for the trainees was conducted to plantation area raised under the project.

Project 2: Lead institution for Achanakmar-Amarkantak Biosphere Reserve, Chhattisgarh [102/TFRI/2006/Ento-1/MoEF(12)/2006-09]

Status: Updated list of various flora consisting of fungi, lichens, ferns and angiosperm and fauna and the information disseminated to B.R. managers. Data on the population of different communities existing in Achanakmar-Amarkantak Biosphere Reserve also collected. Prepared saville strategy based on Madrid Action Plan and submitted to Ministry of Environment & Forests. UNESCO nomination form and supporting documents for designation of B.R. in World Network drafted and submitted to State Forest Department of Chhattisgarh for their suggestions.

Project 3: Development of integrated insect pest and disease control system for major economically important forest tree species [112/TFRI-2006/Ento–4 (MPFD)-15)/2006-09]

Status: Survey was conducted at 8 selected localities of Madhya Pradesh to monitor the insect pests and diseases of Aonla and Teak. Incidence of Teak leaf skeletonizer, *Eutectona machaeralis* and Aonla shoot gall forming insect, *Betousa stylophora,* leaf roller, *Garcillaria acidula*, fruit sucker *Scutellera nobilis* and wilt /root rot / foliar diseases, *Fusarium solani, Pseudomonos tectonae, Polyporus zonalis, Rigidoporous lineatus, Peniophora* species and *Olivea tectonae* were recorded in nurseries, plantations and natural forests. Experiments were laid out on IPM of skeletonizer *E. machaeralis* in teak plantations at Kanjai (Lamta Forest Project Division, Balaghat). Bio-insecticides / fungicides were used against *E. machaeralis.*

Project 4: Development of model for the management of white grubs in teak nursery, under the concept of Integrated Pest Management [ID No. : 113-2007/Ento–1(FDCM, MS)(16)/2007-09]

Status: Monitoring, observations and experimentations on *H. rustica, H. mucida* and *S. ruficollis* since the initiation of the emergence of beetles in the field revealed relationship of beetles emergence and rising relative humidity. Data indicated that in all years there was a marked increase in humidity (approx 40 – 60% increase over a few days) along with a noticeable decrease in temperature (approx. 5 ^{0}C over the same period, 6-9 days prior to the first emergence of beetles). Rainfall 2 - 3 weeks prior to the date of emergence did not induce beetle emergence, due possibly to the lower atmospheric relative humidity (< 50%). After the increase in RH, even moderate amount of rains induced the emergence of beetles.

Beetles attract preferably to *Z. jujuba* and *Z. mauritiana.* Foliar spraying of monocrotophos or dimethoate 0.05% kills the beetles resulting into less number of egg laying. Entomopathogenic nematode EPNs proved effective to kill the whitegrubs in laboratory. Phorate/ methyl folidol @ 300g/ bed (size 12 m X 1.25m) in combination and alternately with the cadavars of EPN *H. indica* and *S. carpocapsae* @ 250 – 300/bed in good watering conditions proved effective in reducing the incidence of seedling mortality caused by white grubs damaging teak seedlings. The juveniles of nematodes L. were recovered after 1 month of its release proving their survival in the field.

Project 5: Isolation, identification and evaluation of insecticidal phytochemicals from *Annona squamosa* L. (Annonaceae) against *Hyblaea puera* Cram and *Eutectona machaeralis* Walker, two major pests of teak (*Tectona grandis* Linn) [ID No.122-2007/Ento-3(CSIR)-(18)/2007-10]

Status: The seeds of *Annona squamosa,* were extracted in six solvents viz. petroleum ether, ethyl acetate, ethyl alcohol (ethanol), acetone, methanol and water, using Soxhlet's apparatus. Bioassays for antifeedant, growth inhibitory effects of the extracts were carried out against the larvae of teak defoliator, *Hyblaea puera* and teak skeletonizer, *Eutectona machaeralis* with preliminary testing of six crude extractives of *Annona* seeds, viz., petroleum ether, ethyl acetate,

ethyl alcohol (ethanol), acetone, methanol and water. For feeding inhibition property concentrations/ doses ranging from 25ppm to 3000ppm of each promising extractive tried. Probit analysis has been performed. Based on bioassay results, further bioassay-directed-separation of the active compounds is in progress. Extracts/ fractions were subjected to Ultra Violet (UV) and Infra Red (IR) Spectroscopy for further elucidating the compounds. Further fractions of petroleum ether and ethyl acetate crude extracts were obtained by subjecting the crude extracts to column chromatographic separation serially in different organic solvents. Chemical profiles of the fractions were frequently analyzed using Thin Layer Chromatography (TLC). The bioassays for evaluating efficacy of these chromatographic fractions and determination of EC_{50}, EC_{90} / LC_{50}, LC_{90} values of the promising fractions are in progress.

Project 6: Studies on taxonomy of Braconid parasitoids (Hymenoptera: Braconidae) from central India [123/TFRI/2007/Ento-4 (CSIR)(19); Funded by CSIR, New Delhi/2007-10]

Status: Taxonomic survey of important forest and agroforestry areas of Chhattisgarh (Rajnandgaon) and Maharashtra (Bhandara, Gondia, Chandrapur, Gadchiroli, Nagpur, Wardha, Amravati, Ahmadnagar, Pune, Raigad, Ratnagiri, Sindhu Durg, Kolhapur, Sangli, Satara, Yavatmal, Buldana, Jalgaon, Nandurbar, Dhule, Nashik, Thane, Aurangabad and Jalna) were carried out for Braconid collection. In all, twenty two species of Braconids viz. *Apanteles agilis, Apanteles detrectans, Apanteles creatonoti, Apanteles efferenus, Apanteles hyblaeae, Apanteles tachardiae, Apanteles bambusae, Apanteles cajani, Apanteles caniae, Apanteles platyedrae, Apanteles lamprosomae, Apanteles antipoda, Apanteles significans, Chelonus dwibindus, Chelonus narayani, Chelonus notauli, Chelonus indicus, Eutropobracon granulatus, Cassidobracon castrus, Habrobracon brevicornis* and *Homolobuospand spgalphus* sp. were identified.

Project 7: Studies on the natural enemies of teak pests, *Hyblaea puera* and *Eutectona machaeralis* and their role in suppressing the population of insects in Madhya Pradesh [127/TFRI/2008/Ento-1(MPCST)(20)/2008-09]

Status: Periodical surveys were conducted in teak forests of Madhya Pradesh for collection of natural enemies of major insect pests of teak, *Hyblaea puera* and *Eutectona machaeralis*. The natural enemies recorded include 6 species of parasitoids (*Apanteles machaeralis*, *Apanteles* sp., *Brachymeria* sp., *Sturmia* spp., *Trophocampa indubia* and *Xanthopimpla cera*), 5 species of predators (*Calleida splendidula*, *Canthecona furcellata*, *Corvus macrohynchos*, *Erthesina fullo* and unidentified spider) and 2 species of fungal pathogens (*Aspergillus flavus* and *A. niger*). Carried out laboratory rearing of a predator, *C. furcellata* and culture of 2 pathogens, *A. flavus* and *A. niger* for tests against target insect pests.

Project 8: Varietal improvement of *Rauvolfia serpentina* and *Tinospora cordifolia* through germplasm selection, evaluation and breeding [ID No.: 100/TFRI/2006/Gen-1 (MoHFW) (10)/2006-10]

Status: Data recorded after 24 months of planting from introduction trial of *R. serpentina*, laid out at TFRI, Jabalpur in December 2006, showed that CW-MP accession belonging to Chhindwara (M.P.) recorded maximum root diameter (1.62cm). The maximum root length (47.17cm) was recorded in JS-OR accession belonging to Jassipur, Orissa. The maximum number of root branches (12) and total biomass (266.54 gm) were recorded in NN-WB accession belonging to Nanungeria (WB) and root yield per plant (129.06gm) in ZR-CG accession belonging to Zora (C.G.).

The spectrophotometric method for estimation of total alkaloids was standardized for both species (*R. serpentina* and *T. cordifolia*). Total alkaloids (%) in 15 accessions of *R. serpentina*

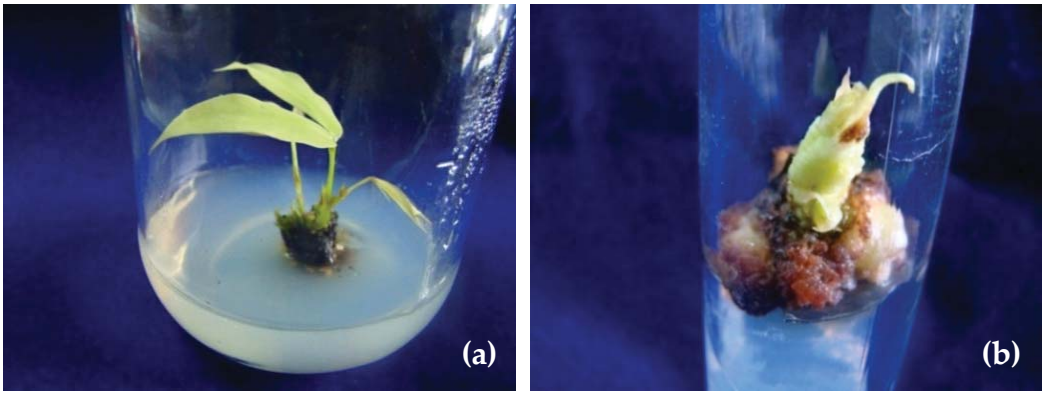
were estimated. The results on total alkaloids clearly exhibited some promising accessions of *R. serpentina* viz., KL-AJ (1.88%) belonging to Anjanakund, Kerala, ZR-CG (1.67%) belonging to Zora, (C.G.) and AG-OR (1.52%) belonging to Anugul, Orissa which contained higher amount of total alkaloid than JS-OR (1.00%) belonging to Jassipur, Orissa. Reserpine content in 15 accessions of *R. serpentina* was also estimated through HPLC method, data being analyzed.

The multi-location evaluation of germplasm of *R. serpentina* was established at Chandrapur (Maharashtra) in July, 2008 (Fig. a), Raigarh (Chhattisgarh) (Fig. b) and Jabalpur (M.P.) (Fig. c). These trials were established in randomized block design with three replications. Each accession was represented by nine plants per replication. Observations on the survival of the plants at Raigarh exhibited better survival than the remaining two localities.

Establishment of multi location field trial at (a) Chandrapur (M.S.), (b) Raigarh (Chhattisgarh) and (c) Jabalpur (M.P.)

Project 9: Studies on *in-vitro* regeneration of plantlets and their genetic (molecular) fidelity in *Saraca indica* Linn., a vulnerable medicinal tree [ID No.: 111/TFRI-2006/Gen.-2(CSIR)(12)/2006-09]

Status: Seeds were collected from mature trees from Jabalpur and Pipariya. They were germinated under *in-vitro* conditions on MS basal semisolid medium. In all, 60-70% germination was obtained. Shoots were further multiplied on MS semisolid medium supplemented with 10 µM BA (Fig.a). The effect of different seasons and sterilizing agents on aseptic culture establishment were studied taking nodal explants from 2-3 years old seedlings and terminal buds from 20 years old tree. Highly significant effect of seasons was observed on sprouting of buds with maximum sprouting (35.18 %) obtained in summer season in 2-3 years old plants. Sterilizing treatments also had significant effect on sprouting of buds with 0.2 % $HgCl_2$ treatment resulting in maximum sprouting (38.89 %). During surface sterilization of terminal buds from 20 years old mature tree, 0.2 % $HgCl_2$ treatment resulted in maximum alive bud during autumn and winter season. Shoot formation from embryonic axis of immature seeds was obtained on B_5 medium supplemented with 2.5 µM BA. Zeatin doses and interaction between zeatin and BA did not significantly affect number of shoots. Maximum callus formation (64%) on embryonic axis was obtained on B_5 medium supplemented with 2.5 µM BA. In another experiment with embryonic axis, the interaction between 2, 4-D and TDZ had a significant effect on number of shoots with 3.56 shoots obtained on 2 µM 2, 4-D and 10.0 µM TDZ. On medium containing 2 µM 2, 4-D + 10 µM TDZ + 10 µM zeatin, well formed shoots were obtained on embryonic axis along with callus (Fig. b). Leaf pieces were tried for organogenesis. Significant effect of various auxins was observed for callus formation on leaf pieces with picloram resulting in maximum (62.50 %) callus formation. Zeatin doses and their interactions with auxins did not have any significant effect on callus formation on leaf pieces. On B_5 medium supplemented with 13 µM NAA, 6 % rooting of shoots was obtained.



(a) Multiple shoots obtained on 10 μM BA from cotyledonary nodes in *Saraca indica*; (b) Formation of shoots from embryonic axis on B_5 medium supplemented with 2 μM 2, 4-D, 10 μM Zeatin and 10 μM TDZ in *Saraca indica*

Project 10: Evaluation and prediction of oil bearing capacity of Sandal (*Santalum album* L.) germplasm using physio-morpho–molecular marker [ID No.: 120/TFRI/2007/Gen-3/ DSAE (15)/2007-10]

Status: In all 47 mature sandal trees were selected at IWST, Bangaluru, marked and their GBH, heartwood ratio and percentage of oil content were estimated. A lot of variation with respect to growth and oil content of selected sandal trees was recorded. Tree IW 53 had the highest GBH of 97 cm and Tree IW 23 exhibited the lowest value for GBH of 32 cm. The heartwood/ sapwood ratio was maximum in Tree IW 24 (0.75) and minimum in Tree IW23 (0.14). Tree IW 57 had the highest oil content of 3.25% and Tree IW3 had the minimum oil content of 0.19%. The oil content did not show significant correlations with GBH or heartwood/sapwood ratio.

Genomic DNA from leaves of the selected sandal trees of IWST, Bangaluru was extracted following the modified method of Doyle and Doyle (1990). Tree IW 36 yielded maximum genomic DNA of 651 μg/500 mg fresh leaf, whereas Tree IW 20 had minimum genomic DNA of 18.86 μg/500 mg fresh leaf. The quality (A260/A280) of genomic DNA ranged from 1.41 to 2.0, which was adequately purified for setting PCR-ISSR assay.

Genomic DNA in three replicates was extracted from thirty trees each of TP and TO following the modified method of Doyle and Doyle (1990). Tree TP- 27 yielded maximum genomic DNA of 323 μg/100 mg fresh leaf, whereas tree TP-7 had minimum genomic DNA of 6.47 μg/100 mg fresh leaf. The quality (A260/A280) of genomic DNA ranged from 1.08 to 1.98, which was adequately purified for setting PCR-ISSR assay.

Nitrate reductase activity in the second and third quarter was determined in leaves of selected 30 trees each from TP and TO plantation area. In the second quarter, Trees from TP selection exhibited more enzyme activity than those from TO selection. Tree TP-15 and Tree TO-16 had maximum enzyme activity. On the other hand, the lowest enzymatic activity was recorded in Tree TP-3 and Tree TO-22 among their respective selections. In the third quarter, Tree TP-8 and TO-9 had maximum enzyme activity but Tree TP-28 and Tree TO-21 recorded the lowest enzymatic activity among trees of their respective selections.

Twenty seven Sandal trees of TP and three trees of TO were sampled at 50-150 cm above ground for collection of eight wood core samples per tree. The wood core samples are being analyzed for oil content. Genomic DNA of 24 IWST Sandal trees graded on the basis of oil content was amplified using 26 selected ISSR primers.

Project 11: Molecular characterization of *ex-situ* conserved germplasm and identification of molecular associated with wood quality traits in *Tectona grandis* L.f. [ID No: 125/TFRI/2007/Gen-4(DBT)(16)/2007-10]

Status: Field visits were conducted to collect branches from three ramets each of 97 plus trees of *Tectona grandis* maintained at National Teak Germplasm Bank, Chandrapur (Fig. 1a). The trees represented 12 teak growing states of the country. The collected branches (Fig. 1b) were cut into small shoot cuttings of around 8 inch length and treated for 5 minutes with 0.1 % $HgCl_2$. The surface sterilized cuttings were administered 200 ppm IAA and 200 ppm thiamine solution for 4 hours at their base, followed by sealing of top cut end with wax. The auxin treated five cuttings each of three ramets per plus tree were planted in polybags filled with potting mixture (Fig. 1c). After 1 month of the planting, the cuttings produced sprouts to the tune of 40% (Fig. 1d). Young leaves of sprouts were harvested for the extraction of genomic DNA.

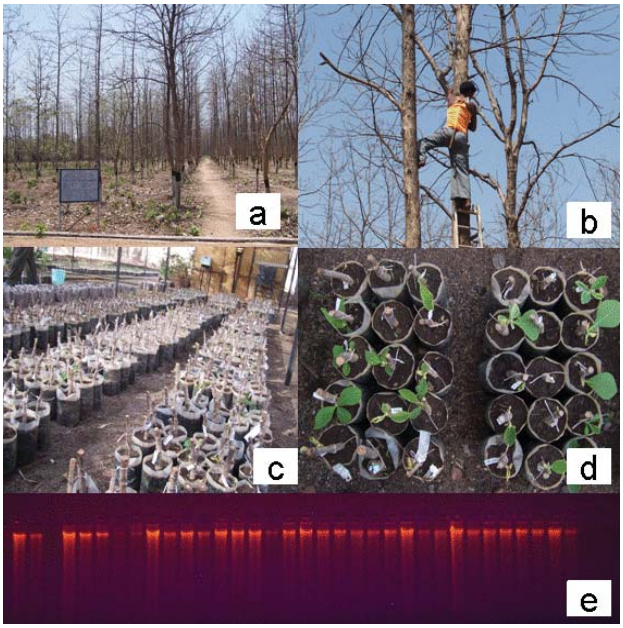


Fig. 1: Plus trees of teak (*Tectona grandis*):
(a) A view of germplasm bank at Chandrapur;
(b) Collection of branches from plus trees;
(c) Planting of branch cuttings; (d) Emergence of sprouts for genomic DNA extraction and
(e) Visualization of genomic DNA of plus trees on 0.8% agarose gel.

Field visit was also undertaken to collect ten branches with dormant buds from 15-31 progenies (half sib families) of nine plus trees (A-5,A-4,A-3,A-7, A-16,A-17,A-10,A-21,A-35), which were raised in a trial comprising three replicates each of 16 trees at National Germplasm Bank Lohara, Chandrapur, Maharastra (Fig. 2a,b).

Genomic DNA of leaves of plus trees and apical bud of progenies was extracted taking 100 mg fresh leaves using modified method of Doyle & Doyle (1990). To avoid RNA contamination, 20µg/ml RNAse was used.

Fig. 2: Progenies of plus trees of teak (*Tectona grandis*):
(a), (b) Collection of apical bud of plus tree progenies from the trials and
(c) Visualization of genomic DNA of progenies on 0.8% agarose gel.

Integrity and quantity of the extracted DNA were estimated spectrophotometrically and visualized on 0.8 % agarose gel (Fig. 1e). The average yield of genomic DNA of plus trees was 70 µg ± 57.61 µg / 100 mg fresh wt (Range: 14.0 µg - 250.0 µg), whereas the quality of DNA (A260 / A280) was 1.74 ± 0.15 (Range: 1.40 – 1.95). The quantity of genomic DNA of progenies ranged from 27.12 µg to 71.34 µg and visualized on 0.8 % agarose gel (Fig. 2c) and the quality (A260/A280) of genomic DNA extracted from apical bud of progenies, from 1.09 to 1.81. STMS primers were designed and tested for amplification and STMS assay for genomic DNA, standardized.

Project 12: National Network on Integrated Development of Jatropha and Karanj [73/TFRI-2004/NWFP-3(NOVOD)(11)/2007-09]

Status: ***Jatropha curcas*** (Jatropha): Multilocational trials in the form of national, zonal, progeny and package of practices established at the institute campus, experimental area at Barah, Jabalpur and in Chhindwara are being maintained. Third national trial of *Jatropha curcas* comprising of 14 accessions received from various network institutes/centres has been established at TFRI campus, Jabalpur. The observations on growth attributes like height, collar diameter, number of branches etc. are recorded on regular intervals. The trials are performing well and the survival is more than 90%. In national trial, accessions TNMC-5 and TFRI-2 performed best among all other accessions, whereas in zonal trial, IGAU-1 performed well among all other accessions received from different member institutions with respect to growth attributes. Maximum fruiting was observed in TNMC-5 (national trial) followed by TFRI-2 (zonal trial). Pruning operations in Jatropha induced more number of branches which lead to more production/fruits. The findings of package of practices trial shows that the seedlings planted on ridges in the last week of July 2005 performed better than the seedlings planted in pits.

Pongamia pinnata (Karanj): Ten CPTs of Karanj were selected in Dindori and Jabalpur district of Madhya Pradesh. Experimental trial in the form of national, zonal and progeny trials established in institute campus, Barah experimental area and Bhandamuri, Balaghat are being maintained. The observations on growth attributes like height, collar diameter, number of branches etc. are recorded on regular intervals. In national trial, accession number TNMP-6 received from TNAU, Mettupalayam, Tamil Nadu performed best among all other provenances, whereas in zonal trial, TFRI-2 performed best with respect to growth attributes. Progeny collected from Jhinjhari, Katni-1 (height 241.71 cm; collar diameter 3.61 cm; number of branches 14) performed well among all other progenies in respect of growth attributes. Significant variation was observed in the growth attributes among different progenies.

Project 13: Integrated development of bamboos for economic upliftment in central India [126/TFRI/2007/Agro-1(NBM)/2007-10]

Sub project-I: Sustainable development of new bamboo agroforestry techniques for increased income generation in the central Indian states

Status: Established Bamboo – Wheat Agroforestry trial as an On Station Research (OSR) trial at the Agroforestry Experimental Plot, TFRI, Jabalpur. The wheat crop had ripened fully and is ready for harvesting during April, 2009.

Seventeen progressive farmers in Chhindwara district of Madhya Pradesh and sixteen in Devipur Sub-division under the Raipur district of Chhattisgarh were identified using Participatory Rural Appraisal (PRA) tools during May and June 2008 and training on the benefits of adopting bamboo based agroforestry systems was imparted to them. Seedlings of *Dendrocalamus strictus* were provided to them for planting around their agricultural fields.

Sub-project II: Bamboo species suitability for different degraded non-forest areas in Madhya Pradesh

Status: Geoenvironmental survey and study of degraded lands at Dhuma, Damoh, Hoshangabad (Bagra), Bhopal (Ratapani), Katni (Kymore, SVIL Mines, Khitola) and Rewa (Sirmore) were conducted. The degraded lands are on Basalt and Sand stone as well as on Limestone. The water table is deep around 350′ to 450′. The drainage is seasonal along shallow channels. The geomorphology varies from place to place, some areas belongs to rocky terrain with moderate slope, whereas other areas belongs to plateau. The soil is generally shallow with dry to low moisture and nutrient content. To know the performance of bamboo on these degraded lands, the bamboo plantations of 2005-06, wherever located nearby to these degraded lands, have been studied.

Sub-project III: Insect and diseases of bamboo occurring in central India and their management

Status:

A. Identification of Diseases and Insect Pests

Seeds of *Bambusa nutans* and *Dendrocalamus strictus* were observed to be attacked by a bug, *Ochrophara montana*. The mature of seeds were examined for the fungi and insects. The seeds of *D. strictus* were damaged by an unidentified seed borer. The work on its identification is in progress.

Seeds of *Bambusa nutans* and *Dendrocalmus strictus* were sown in nursery beds and rhizomes planted at TFRI, Jabalpur and bamboos grown by forest departments at selected localities of M. P. and Chhattisgarh were screened for different diseases and insect pests. It was observed that bamboo culms are attacked by 14 fungal pathogens. *Poria rhizomorpha* and *Cyathus* sp. infested clumps of *B. nutans* and *Curvularia lunata* is recorded to infest the leaves of bamboos in nursery stage. Dead standing bamboo culm in plantations were observed to be infested with 4 species of fungi.

In nursery and plantation seedlings of *Bambusa nutans* and *D. strictus* were recorded to be damaged by various insect pests. Rats observed to cause a great menace to the rhizomes of *B. nutans* and *D. strictus* in nursery beds, whereas hares observed to feed on leading soft branches of culms of bamboos in plantations.

B. Field Trials Against Various Diseases and Insect Pests

A field trial was laid out at Kosabadi (Korba) in Chhattisgarh for the control of rhizome rot and fungal diseases attacking culms in bamboo, *Dendrocalamus strictus.* In all, 6 treatments combinations including one untreated control were taken. Each treatment was replicated five times. The second dose of above pesticides were given in September 2008. The observations on number of dead culms and numbers of new culms arise will be taken in last quarter of the year. The work is in progress.

Seven field trials were laid out to investigate the lowest effective concentration of 10 moderns insecticides. The different insecticidal concentrations were formulated. Each treatment was uniformly sprayed on entire bamboo seedling bed having larvae bearing rolled leaves. Each treatment was replicated thrice. The observations on percentage of larvae died after 72 hrs of spray recorded. Data showed that foliar spraying of chlorpyriphos 0.05% is best followed by endosulfan 0.05%.

To investigate the efficacy of synthetic pyrethroids, two field trials were conducted. In all, 7 insecticidal concentrations and an untreated control were taken. Each treatment was replicated thrice. The data on the percentage of larvae died after 72 hrs of spray were enumerated. It was observed that foliar spraying of fenvalerate 0.01 % is best causing 94.83 to 95.37% killing of the larvae within 3 days of the spray.

Sub-project IV: Nutritive value and value addition of some bamboo species of central India

Status: Surveys were conducted to various bamboo growing regions of Madhya Pradesh, Maharastra and Chhattisgarh for collection of shoots of *Dendocalamus strictus, D. asper, Bambusa bambos* and *B. tulda. D. strictus* is the major bamboo species of central India followed by *B. bambos. D. asper* and *B. tulda* was found growing only in nurseries and private plantations. The collected bamboo shoots were processed for estimation of various nutrients (proteins, carbohydrates, vitamins, minerals, fibre, tannins and total phenols) and anti-nutrients (cynogenic glycosides). Maximum edible portion (77.12% of its fresh weight) was found in *D. asper* shoots whereas highest anti-nutrient (cynogens 41.82 mg/100 g fresh weight) was found in shoots of *D. strictus*. Bamboo shoots were processed, dried and stored for chemical analysis and product development. Fresh bamboo shoots were treated with cold and hot water, saline and sodium bicarbonate solutions to study their effect on nutrients and anti-nutrients. one percent saline solution treatment was found best among all the treatments as it significantly reduces anti-nutrients like cynogens and retains all nutrients. The amount of nutrients in preserved bamboo shoots (1% sodium benzoate) and fresh bamboo shoots was found at par. Bamboo shoots can be preserved in 1% sodium benzoate solution as it did not have any adverse effect on their nutritional status. Two products namely bamboo pickle and bamboo vinegar have been prepared from fresh bamboo shoots.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1 : Evaluation of productivity of maize in *Dalbergia sissoo* (Shisham) and *Zea mays* (Maize) Agroforestry system [133/TFRI-2008/Agro-I (15)/2008-11].

Status: One year old *Dalbergia sissoo* seedlings were planted in 21 plots of size 10 x 10m each at 3 different spacings of 4 x 4m, 5 x 5m and 6 x 6m. Hybrid maize seeds were sown at a spacing of 60 x 20cm with tree to crop line spacing of 60 and 120cm following Randomized Block Design. The maize crop was harvested and yield data were recorded, tabulated and analysed statistically. Tree distance 5 x 5 m with 60 cm tree to crop line spacing proved best for maximum yield of maize crop. Growth parameter i.e. collar diameter and height of each *Dalbergia sissoo* plant was recorded at the time of planting and harvesting of maize crop and soil samples were collected from each block at the time of planting and harvesting of maize crop and pH, EC, organic carbon, available N,P,K, and Ca++, Mg++ were determined.

An overview of *Dalbergia sissoo - Zea mays* agroforestry system

Project 2: Studies on diseases of important medicinal plants and their bio-control [129/TFRI-2008/Patho-1(13)/2008-11]

Status: Periodical survey of Seoni, Chhindwara, Dhar, Bilaspur, Raipur, Bhopal, Neemach and Pachmarhi were conducted and diseases infesting *Rauvolfia serpentina*, *Withania somnifera* and *Chlorophytum borivillianum* were recorded and identified. Disease causing organism of *R. serpentina* were identified as *Lasiodiplodia theobromae*, *Phoma jolyana*, *Colletotrichum dematium* and *Cladosporium* sp. Leaves and roots of *W. somnifera* were observed to be infested by *Pseudocercospora withanae* and *Fusarium oxysporum*, whereas *C. borivillianum* was recorded to be infested by *Colletotrichum dematium*, *Phoma* sp. and *F. oxysporum*. Comparative studies of systemic fungicide Bavisitin, a non-systemic fungicide, Thirum, a biopesticide (cow urine + leaves of *Azadirachta indica* + *Ailanthus excelsa* + *Calotropis procera*) and antagonistic organisms (*Streptomyces* sp.) and *Bacilus firmus* were performed in the laboratory against pathogenic fungi, *L. theobromae* and *F. oxysporum*.

Project 3: Studies on wood decay and its control in stored tropical timber [130/TFRI-2008/Patho-2(14)/2008-12]

Status: In all 30 wood depots of Madhya Pradesh and Chhattisgarh (Dhuma, Narsinghpur, Jabalpur, Gadasarai, Karanjia, Rasaiyadona, Mandla, Sizora, Chilpi, Kalpi, Sohagpur, Taku, Budni, Timarni, and Kherkia, Ralamandal, Chandrakesar, Sanavat, Katghora, Nagri, Kota, Dhamtari, Chilpi, Pithora, Gariaband, Kaker, Sargipal, Kondagaon, Bhanupratapur, Korar, and Ballod) were surveyed and 650 samples of wood decaying fungi collected. Twenty five cultures of wood decaying fungi were prepared from collected samples and maintained in the laboratory. A total of 20 genera and 34 species of wood decaying fungi were identified. Out of these, 4 genera viz. Hapalopilus, Ceriporiopsis (Fig. 1), Schizopora, and Postia) and 7 species viz. (*Hapalopilus nidulans*, *Ceriporiopsis merulinus*, *Trametes ochraceae*, *Postia placenta*, *Schizopora paradoxa*, *Pycnoporus coccineus* and *Pycnoporus cinnabarinus* (Fig. 2) recorded for the first time. All the collected samples of wood decaying fungi are maintained in the herbarium.

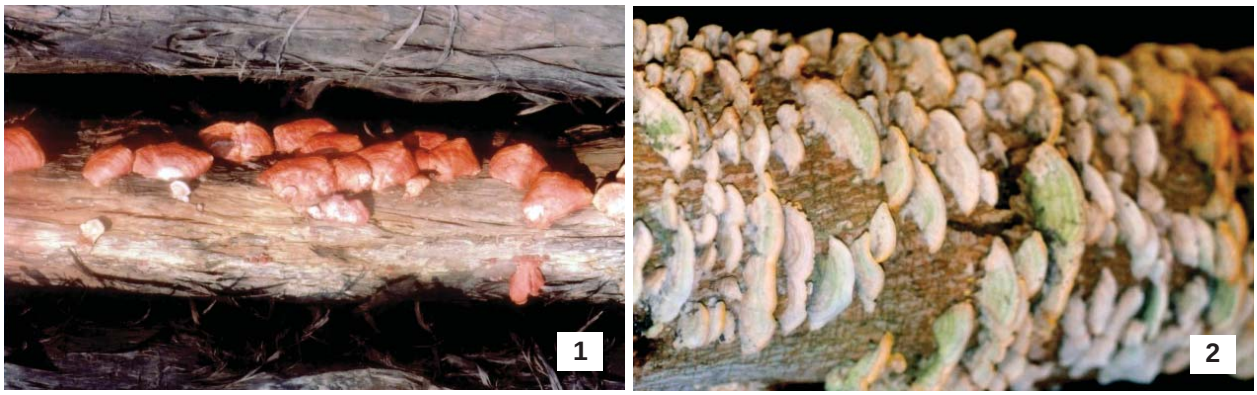


Fig. 1: Wood decay fungus, *Pycnoporus cinnabarinus* fruit bodies on sal, from Gariyaband, Raipur (CG) and Fig. 2: *Ceriporopsis unicolor* fruit bodies on *Peltophorum*, from Sargipal, Jagdalpur (CG).

Project 4: Studies on endogenous auxin level and its relationship with adventitious rooting potential in *Dalbergia latifolia* Roxb. [131/TFRI-2008/Gen-1(17)/2008-11]

Status: Ten phenotypically superior trees of *Dalbergia latifolia* were selected. Seeds were collected from the selected trees and seedlings raised. Sixty four seedlings from each tree were planted in separate blocks in field and maintained. Spectrophotometric method for estimation of IAA in *Dalbergia latifolia* was standardized (Stoessel and Venis, 1970). Further work is in progress.

Project 5: Development of an information system for forest tree species associated insect and their management [ID No.: 132/TFRI-2008/IT Cell-1(1)/2008-11]

Status: Data on distribution, host range, nature of damage, period of occurrence and management techniques of two tree species viz. Sal and Sissoo were collected. The photographs of different insects and the nature of damage caused by them were taken. Work is in progress.

EXTERNALLY AIDED PROJECTS

Project 1: Studies on developing alternative methods of sustainable harvesting of medicinal plants [ID No.: 134/TFRI/2008/NWFP-1(NMPB) (22)/2008-11]

Status: Surveys were conducted to various agroclimatic regions of Madhya Pradesh, Chhattisgarh and Orissa for selection of targeted species i.e. *Terminalia arjuna* (Arjuna), *Bauhinia veriegata* (Kachnar), *Holarrhena antidysenterica* (Kutaj), *Oroxylum indicum* (Sheonak) and *Saraca asoka* (Ashoka) growing areas. Experiments were laid out for standardization of sustainable harvest of plant parts of targeted species in forest areas of Jabalpur, Rewa, Satna and Balaghat (M.P.); Harishankar and Bolangir (Orissa); Dhamtari (Chhattisgarh). *Terminalia arjuna*, *Bauhinia veriegata* and *Holarrhena antidysenterica* are available in the forests of central India. However, *Oroxylum indicum* and *Saraca asoka* populations were found out only in Orissa. Harvested plant parts like bark, leaves and twigs etc. were collected and brought to laboratory for chemical and biological analysis. The collected plant samples were processed and analyzed for their active chemical constituents e.g. tannins, alkaloids, phenols and flavanoids. Samples were also sent to Central Institute for Medicinal and Aromatic Plants, Lucknow for detailed chemical and biological analysis.

Project 2: Establishment of multilocational trial of superior accession of *Jatropha curcas* under the network programme of DBT [ID No.: 135/TFRI/2008/NWFP-2 (DBT)(23)/2008-11]

Status: A multilocational trial of *Jatropha curcas* comprising of seven accession received from different participating institutes has been laid out at institute campus. These accessions include three from HNBU Garhwal, three from NBRI Lucknow and one from Biotech Park Lucknow. The experimental field was divided into 28 equal size blocks and nine plants were planted in each block at the distance of 3 x 3 metre. The trial is performing well and the survival is more than 90%. Observation on growth attributes like height, collar diameter, number of branches and flowerings has been recorded on monthly basis and sent to Biotech Park, Lucknow for detailed analysis. Seeds of seventeen accessions were received from different participating institutes for establishment of half sib progeny trial.

EDUCATION AND TRAINING

Trainings

Conducted

1. Training on Bio-drainage was organized on 20th February 2009 at village Dabhola along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur for farmers, tree growers and forest officials.
2. Training programme on Insect pests and diseases of Aonla, *Emblica officinalis* and their control measures to the SFD officials of North-South Panna Forest Divisions at Panna, M.P. on 20th January 2009.

3. Training programme on Insect pests and diseases of Teak, *Tectona grandis* and their control measures to the SFD officials of Jabalpur region of Forest Development Corporation of Madhya Pradesh at Kanchangaon Mohagaon Forest Project Division, Mandla on 19th February 2009.

Attended

1. Training programme on Bamboo Technology & Trade Development held from 29th September to 5th October 2008 at State Forest Research Institute, Jabalpur.
2. Training to farmers and tree growers on agroforestry and climate change held on 23rd December 2009 at village Majitha, Jabalpur.
3. Research Methodology from 26th December 2008 to 07th January 2009 held at Indian Agriculture Statistical Research Institute, New Delhi.
4. Farmer training on Bio-drainage held on 28th February 2009 at village Dabora district Jabalpur.
5. Forest certification programme for sustainable forest management held from 25th to 27th July 2008 at Indian Institute of Forest Management, Bhopal.
6. K.K. Soni delivered a lecture on Forest diseases and their management to the trainees from SFD of M.P. at SFRI, Jabalpur.

LINKAGES AND COLLABORATION

1. One collaborative research project titled "Development of integrated insect pest and disease control system for major economically important forest tree species" is being implemented with State Forest Research Institute, Jabalpur for developing integrated insect pest and diseases control system.
2. An inter-institutional project titled "Isolation, identification and evaluation of insecticidal phyto-chemicals from *Annona squamosa* L. (Annonaceae) against *Hyblea puera* Cram and *Eutectona machaeralis* walk two major insect pests of teak (*Tectona grandis* Linn.)" funded by CSIR, New Delhi is being implemented with Govt. Autonomous Science College and North Maharashtra University, Jalgaon.
3. An inter-institutional project "Studies on developing alternative methods of sustainable harvesting of medicinal plants" funded by NMPB is being implemented in collabortion with CIMAP, Lucknow.
4. A project titled "Molecular characterization of *ex-situ* conserved germplasm and identification of molecular markers associated with wood quality traits in *Tectona grandis* L.f." funded by DBT, New Delhi is being implemented in collaboration with TERI, New Delhi.

PUBLICATIONS

Books

1. Forest Biotechnology in India, Satish Serial Publishing House, Delhi.
2. Bamboo Management, Conservation, Value Addition and Promotion. Proc. of National Conference. Tropical Forest Rsearch Institute, Jabalpur.
3. Forest Fungi of Central India. International Book Distributing Co., Lucknow.

Brochure

Arjun (*Terminalia arjuna*) Chal Ka Vinashvihin Vidohun. Tropical Forest Research Institute, Jabalpur (Hindi).

Technical Bulletin

वन रोपवाटिका आणि रोपवनांमध्ये होणारे किड़ आणि रोगांचे प्रादूर्भाव व त्यावर व्यवस्थापन कार्यपुस्तिका. Technical Bulletin in Marathi, 51 p.

CONSULTANCIES

The following consultancies received and executed:

1. Evaluation of preservation plots of Maharashtra, State Forest Department, Chandrapur, Maharashtra.
2. Evaluation of FDA plantations of Madhya Pradesh, State Forest Department, Bhopal, Madhya Pradesh.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

Attended

The representatives from Tropical Forest Research Institute (TFRI), Jabalpur attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

International

1. International Conference on Molecular Biology and Biotechnology organized by Banasthali University, Rajasthan during 19th to 21st October 2008
2. VI World Congress on Medicinal and Aromatic Plants (WOCMAP) at Cape Town, South Africa from 9th to 14th November 2008.
3. International Conference on Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood at New Delhi from 15th to 17th April 2008.
4. International conference on Tribal Health held from 27th February to 1st March 2009 at Regional Medical Research Centre for Tribals (ICMR), Jabalpur.
5. Asia and the Pacific Forest Health Workshop on Forest Health in a Changing World at Kuala Lumpur, Malaysia held from 1st to 3rd December 2008.

National

1. National Conference on "Biofules: Problems and Potentials" held on 25th and 26th February 2009 at TFRI, Jabalpur.
2. National Conference on Pest Management Strategies for Food Security held on 2nd and 3rd May 2008 at College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur.
3. National Conference on Bamboos: Management, Conservation, value addition and promotion from 12th to 14th March 2008 at Tropical Forest Research Institute, Jabalpur.
4. National Conference on Impact of Climatic Factors on Insect Abundance: Changing Scenario and Future Research Thrusts at Department of Zoology, Madras Christian College, Tambaram, Chennai, on 25th October 2008.

5. Regional Conference on Madhya Kshetriya Vigyan Sammelan at Govt. M.H. Home Science College, Jabalpur held on 21st and 22nd February 2009.
6. ISPP Golden Jubilee Conference on Challenges and Emerging Strategies for Improving Plant Productivity from 12th to 14th November 2008 at IARI, New Delhi.
7. National Workshop on Integration of MADPs/NTFPs in National Working Plan Code at India International Centre, New Delhi on 20th August 2008.
8. Workshop on Sustainable forestry development and forest certification held on 26th and 27th February 2009 organized by Indian Institute of Forest Management, Bhopal at Van Vigyan Bhawan, New Delhi.
9. National Symposium on Agroforestry held from 15th to 17th December 2008 at NRC Agroforestry, Jhansi.
10. National Symposium on Bamboo held from 17th to 19th March 2009 at Arid Forest Research Institute, Jodhpur (Rajasthan).
11. National Symposium on Non-Chemical Insect Pest Management held on 5th and 6th February 2009 at Entomology Research Institute, Loyola College, Chennai.
12. National Symposium on IPM Strategies to Combat Emerging Pests in the Current Scenario of Climate Change from 28th to 30th January 2009 at College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh.
13. National Symposium on Biotechnology in Plant Disease Management for Sustainable Crop Protection on 17th and 18th September 2008 at MACS, Agharkar Research Institute, Pune.
14. National Seminar on Reclamation of mined lands of coalfields held on 5th and 6th August 2008 at SFRI, Jabalpur.
15. National Seminar on Socio-economic development of ethnic population in Chhattisgarh with integrated approach to natural resources held on 4th and 5th March 2009 at Jagdalpur (Bastar).
16. National Seminar on Intellectual Property & Innovation Management in Knowledge Era jointly organized by MPCST, Bhopal & NRDC, New Delhi on 24th and 25th June 2008 at Bhopal.

Organized

- A two - days National Conference on Biofuels: Potential and Challenges was organized on 25th and 26th February 2009 at Tropical Forest Research Institute, Jabalpur, Madhya Pradesh.

AWARDS

1. Brandis Award for best research paper in Silviculture for the year 2006 has been awarded to Dr. V. Nath, Scientist–F on 15th September 2008 by the society of The Indian Forester.
2. Dr. Nitin Kulkarni was awarded "Best Paper Award" by the Entomological Society of India, Indian Agricultural Research Institute, New Delhi.

DISTINGUISHED VISITORS

1. Dr. S.K. Dhyani, Director, National Research Centre on Agroforestry, Jhansi.
2. Dr. P.B. Gangopadhyay, Principal Chief Conservator of Forests, Bhopal, M.P.
3. Dr. S.M. Paul Khurana, Vice-Chancellor, R.D. University, Jabalpur.

MISCELLANEOUS

The institute observed and celebrated the following:

- International Biodiversity Day on 22nd May 2008.
- World Environment Day on 5th June 2008.
- World Day to Combat Desertification on 17th June 2008.
- Van Mahotsav on 30th July 2008.
- Hindi Week from 7th to 14th September 2008.
- Vigilance Awareness Week from 12th to 16th November 2008.
- Annual sports from 16th to 26th January 2009.

CENTRE FOR FORESTRY RESEARCH AND HUMAN RESOURCE DEVELOPMENT, CHHINDWARA

Centre for Forestry Research & Human Resource Development, Chhindwara came into existence on 30th March 1995. But from 3rd January 1996 it has been declared as Satellite Centre of Tropical Forest Research Institute, Jabalpur under the Indian Council of Forestry Research & Education, Dehradun. The mandate of the centre is to take up the forestry research in the specialized areas like biodiversity conservation, non-wood forest products, silviculture and tree improvement. In addition to this the centre has also been assigned to develop the human resource in forestry sector by imparting vocational training leading to poverty alleviation through self employment.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Standardization of nursery technology and evaluation of various planting stocks of *Pterocarpus marsupium* [Project ID No.: 109/CFRHRD/2006-2(9)]

Status: Seeds of *Pterocarpus marsupium* collected from Gondia (Maharashtra) region. The seeds were treated with cold water for 24 hours showed promising results as compared to hot water treatment. The bigger size seeds gave higher germination percentage and germination value as compared to the small size seeds. The studies showed higher germination percentage in the month of July and minimum in the month of January. Potting mixture in the ratio of 80% organic compost + 20% soil was found to be best combination, whereas the 250cc size gave better results with respect to root and shoot biomass. Experiments to study the effect of different dosages i.e. 2,4 and 6 gm. of inorganic fertilizers on growth and development of 4 months old seedlings has been conducted. Urea, Di ammonium Phosphate and Murate of Potash per plant was applied but initially no effect of inorganic fertilizers on growth and development of seedlings was observed. Branch cutting from *Pterocarpus marsupium* (Bijasal) is kept in mist chamber by treating the cuttings with different concentration of IBA 500,1000,1500 and 2000 ppm for 24 hours. Shoot formation was recorded after 14 days but no root formation was observed. A field trial of different types of seedlings (seedlings raised in polybags, root-trainers & root-shoot cuttings) has been established at CFRHRD campus with three replications and spacing of 5x5 metre in randomized block design for evaluating the planting stocks of *Pterocarpus marsupium.*

Project 2: Studies on the seasonal variation in active chemical constituents of Hadjor, *Cissus quadrangularis* Linn. [108/CFRHRD/2006-1(8)]

Status: *Cissus quadrangularis* (Hadjor) plant samples were collected from the following places depending on the availability viz. Chhindwara, Bhopal, TFRI, Jabalpur (Madhya Pradesh), Nagarjuna Botanical Garden, Akola, Nagpur (Maharashtra), Janjgir, Raigarh (Chhattisgarh) and National Research Centre for Agroforestry (NRCAF) Jhansi and planted in the nursery beds of the centre. Established *Cissus quadrangularis* nursery beds are being maintained. *Cissus quadrangularis* fresh stem samples were collected on monthly basis from Medicinal and Aromatic Plants (MAPs) nursery of the centre for estimation of active chemical constituents viz. total phytosterols, ascorbic acid, macroelements and trace elements content. Method was standardized for estimation of total phytosterol content. The samples were analyzed from January 2007 to March 2009. Ascorbic acid (Vitamin–C) contents were analysed in the samples from November 2006 to March 2009. Macroelements viz. calcium, magnesium, potassium were analyzed from July 2006 to March 2009. Trace elements viz. zinc, copper, manganese, iron and selenium content were estimated. Analysis of active constituents viz. total phytosterols and ascorbic acid in *Cissus quadrangularis* fresh stem samples collected from Bhopal, Jabalpur, Chhindwara(M.P.), Janjgir, Raigarh (Chhattisgarh), Akola and Nagpur (M.S.) and Jhansi were also analysed simultaneously. Survey was conducted in some places of Chhattisgarh and Madhya Pradesh viz. Rajnandgaon, Khairagarh, Kapsi, Tamia and Betul District for collecting information from the tribals and traditional herbal healers regarding their knowledge on best harvesting time of *C. quadrangularis.*

Project 3: Standardization of cultivation protocol for *Asparagus racemosus* (Satawar) [No.119/CFRHRD/2007-2(12)]

Status: *Asparagus racemosus* (Satawar) seeds were sown in nursery beds at 1.5x1.5 cm spacing. Farmyard manure and compost was applied. 70% germination response was observed at the depth of 1 to 2 inches. Experiment was laid out to study the effect of different spacing viz. 45x45 cm, 60x45 cm, 60x60 cm and 45x30 cm and harvesting age of *Asparagus racemosus* on farmers field at Jabalpur, Poama and Chhindwara. The experiment was also laid out to study the effect of above spacings in combination with different types of organic fertilizers (F.Y.M., Vermicompost and VAM) with three replications in a randomized block design at CFRHRD nursery. The experiment was also laid out to study the effect of irrigation on growth of *Asparagus racemosus.* Half of the experimental plot was irrigated at 5 days interval and other half was left under stress condition. The tuber of stress condition crop is slightly bigger than the irrigated one. Soil testing of CFR & HRD nursery, Chhindwara and farmers field was done. 5% mortality of *Asparagus racemosus* plants was observed in farmer's field. Maintenance of experimental plots is being done. Samples of tubers have been taken for records. Seed collection from CFR & HRD nursery has been done to raise nursery for laying out other experiment in June. Chemical analysis of *Asparagus racemosus* (Satawar) tubers was done for saponin component at an interval of 45 days for 4 sites.

Project 4: Genetic improvement of *Buchnania lanzan* [No.116/CFRHRD/2007-1(11)]

Status: Extensive survey has been conducted at Amarwada and Delakhari block of Chhindwara Forest division and selected 13 phenotypically superior candidate plus trees. Also 12 phenotypically superior candidate plus trees of *B. lanzan* were selected from Gondia and Shahada forest division of Maharashtra and 8 candidate plus trees from Raigarh Forest Division of Chhattisgarh. Seeds have been collected from 25 candidate plus trees of *B. lanzan.*

Collected seeds were dried in the shade. After drying, seeds were placed in polybags for germination. Germination percentage and growth data (height and collar diameter) has been

recorded. Forty one to Ninty seven per cent germination was recorded. Progeny trial of *B. lanzan* has been established in the Centre for Forestry Research and Human Development campus by planting 25 progenies. Nine trees/family/replication with three replications in a randomized block design has been laid out. Progeny trial is being maintained. Data has been recorded on height and collar diameter of *B. lanzan.*

EXTERNALLY AIDED PROJECT

Project 1: Field trial on agroforestry model in farmers field with medicinal trees and herbs in Satpura plateau of Madhya Pradesh [P.ID No. 110/CFRHRD/2006-3(NMPB)(10)]

Status: During entire year from time to time monitoring work of all the twelve farmers field has been carried out in which all the details of protection and monitoring has been suggested. In the different training programmes conducted by our centre, the farmers were invited and trained. For casualty replacement, sufficient number of plants of different selected species under the project has been distributed. They have been motivated by giving directions of NMPB time to time.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

EXTERNALLY AIDED PROJECT

Project 1: Developing methodology and parameters for selection of CPTs of NTFP species [P. ID No.: 128/CFRHRD/2008-(MSFD)(13)]

Status: For selection of site of targeted species, tour has been conducted to Gondia Forest Division, Chandrapur Forest Division and Nagpur Forest Division, Under Gondia Forest Division. Site for *Terminalia chebula* has been selected in Jambhdi Forest Range. Also selected site for *Acacia catechu* in compartment no. 504. Under Chandrapur Forest Division, site for *Pongamia pinnata* has been selected in Chinchpalli Forest Range. Survey has been carried out in Palasgaon forest range. Under Nagpur Forest Division, site has been selected for *Acacia catecheu* in Khapa Forest Range. Survey has been conducted in Chhindwara Forest Division and selected site for *Terminalia chebula* in Chhindi Forest Range. Survey has also been conducted in Batka Forest Range. Selection of site of targeted species has been carried out after extensive survey in Paratwada and Jarida Forest Range of Amravati Forest Division of Maharashtra and selected site of *Terminalia chebula, Terminalia belerica* and *Pongamia pinnata*. Data recorded on important characters. Survey in Sawalmend and Chicholi Forest Range in Betul Forest Division of Madhya Pradesh and Mandla Forest Division has been carried out and selected site for *Terminalia chebula, Terminalia belerica* and *Pongamia pinnata*.

EDUCATION AND TRAINING

Centre has organized and conducted 14 training programmes during the financial year 2008-09. Five hundred sixty trainees participated in various training programmes. The target groups were SFD's, Villagers, Farmers, NGO's and herbal healers.

LINKAGES AND COLLABORATION

Linkages were developed with State Forest Departments, Forest Development Corporation, Agriculture Research Station, Chhindwara for conducting research / training and Forest Survey of India, Nagpur for analysis of forest floor and soil samples.

CONFERENCES/MEETINGS/WORKSHOPS/SYMPOSIA/ EXHIBITIONS

- Attended workshop on Ayurvedic medical practitioner at Parasia on 11th June 2008.

AWARDS

Shri Harishankar Awasthi, Forester of the Centre was Awarded District level Award on 26th January, 2009 for his contribution in Cultivation, Conservation & Uses of Valuable Medicinal plants by district administration.

MISCELLANEOUS

- Environment day was celebrated by organizing panel discussion of environmentalist, forest officers and staff of CFRHRD on 5th June 2008.
- Wild Life Week was celebrated by State Forest Dept., Chhindwara from 1st to 7th October 2008 & Nature Awareness camp was conducted under Wild Life Week for school children on 4th and 5th October 2008 at CFRHRD, Chhindwara.

RAIN FOREST RESEARCH INSTITUTE JORHAT

The Rain Forest Research Institute (RFRI), Jorhat, Assam, a constituent Institute of Indian Council of Forestry Research and Education (ICFRE), Dehradun (An autonomous Council) under Ministry of Environment and Forests, Govt. of India mandated to cater the forestry research related needs of North-Eastern India has been pursuing research in the areas of shifting cultivation, ecology and biodiversity, propagation, cultivation and performance trial of important forest species, integrated management of pests and diseases, bio-prospecting of bio-resources, genetic improvement and biotechnology.

An abstract of projects run by the Institute is as follows:

	No. of project completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
Plan Projects	11	10	07
Externally Aided Projects	01	08	01
Total	**12**	**18**	**08**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Evaluation of different existing land use systems for development of viable economic models in North-East India [RFRI/SC/06/2003-08]

Findings: The benefit cost ratio of Land Use Systems (LUSs) identified at different jhum areas in Assam, Nagaland and Meghalaya revealed that in Assam *Trichosanthes dioca* with B: C (3.75) followed by *Anona comosus* (3.23) were potential LUSs among other in the list, whereas in Meghalaya *Citrus* sp. (6.09) followed by *A. comosus* were practiced as well accepted LUSs because of its prospective characteristics. The data collected from various LUSs in Nagaland revealed that the *Areca catechu* (11.4) followed by *Musa paradisiaca* (10.78) were established as highly sustainable LUSs among other in the list.

Project 2: Management of *Bambusa nutans* for enhancing the productivity of marketable culm through silvicultural practices [RFRI/TI/13/2005-08]

Findings: Trial on thinning and soil mounding revealed that proper thinning and soil mounding of the clumps helps to enhance the productivity. Treatment combination of 20% thinning 30 cm soil mounding resulted in highest collar diameter and plant height. Application of fertilizer (DAP) was also found to be helpful in increasing the production with respect to plant height and collar diameter.

Project 3: Development of nursery for production of quality planting stock of bamboos in North-East [RFRI/SM/06/2005-08]

Findings: In nursery, the sand, soil, FYM and vermicasting (cultured) was found to be the best media for production of bamboo planting stock in polybags. The bamboo seedlings raised in polybags were evaluated for field performance. Seedling raised in soil and vermicasting (wild) seedlings gave best performance in the field.

Project 4: Standardization of nursery technique of *Bambusa pallida* [RFRI/SM/07/2007-08]

Findings: Soil, sand and FYM (1:1:1) was found suitable media for propagation of *B. pallida* through culm cuttings. Culm cuttings treated with IBA 300ppm gave maximum production of new shoots with 20-25% survival. Further proliferation of plantlets gave 75-85% survival. A total of 1200 seedling production was made through macro proliferation technique.

Project 5: The potential bamboo species with reference to carbon sequestration in Assam & Mizoram [RFRI/EE/07/2005-08]

Findings: Carbon sequestration potential of two bamboo species (i.e *Bambusa tulda* from Hudamuagaon, Bhakatgaon and Bosepather Borgurigaon of Jorhat district, Assam and Lawipu Ram & Turial Aizawl, Mizoram and *Dendrocalamus hamiltonii* from New Sonowal, Jorhat district of Assam and Lawipu Ram & Zembouk Dai of Aizawl, Mizoram) each of 1st, 2nd & 3rd years age groups was studied through biomass estimation. Above ground biomass of *D. hamiltonii* was 50% in most of the samples. In *D. hamiltonii* dry biomass ranged from 46 to 54% in 1st year, 50 to 56% in 2nd year and 48 to 57% in 3rd years culms. Whereas in *B. tulda* it ranged from 43.5 to 56.3% in 1st year, 49.5 to 56% 2nd year and 53.7 to 68.7 % in 3rd years culms.

Project 6: Diversity and dynamics of Arbuscular Mycorrhizal fungi and their influence on biomass production of some medicinal and aromatic plants of Assam [RFRI/FP/10/2005-08]

Findings: Diversity studies of Arbuscular Mycorrhizal fungi associated with medicinal and aromatic plants were completed in fifteen districts of Assam. These districts are Dibrugarh, Sivasagar, Jorhat (including Majuli Sub-Division), Golaghat, Karbi Anglong, Nagaon, Marigaon, Kamrup (Rural), Kamrup Metro, Nalbari, Barpeta, Sonitpur, North Lakhimpur, Dhemaji and Baska. Mycorrhizal spores were isolated from the collected samples and their quantification was done. Root infection percentage was also calculated and it was found that AM fungi infect the plants with varying degree.

Project 7: Studies on structural formation of vegetation for the conservation of biodiversity in Gibbon Wildlife Sanctuary Assam [RFRI/SC/08/2005-2008]

Findings: A total of 225 plant species were enumerated from the forest (91 species of tree, 18 species of shrub, 74 species of herb and 36 species of climber). The canopy height of most of the trees (about 50%) in the study area ranged between 20-35m. The feeding height of gibbons in this study was found to be between 25 to 30 m. Identified 3 vegetation communities and other associate species. Most preferred food plants by Hoolock Gibbons were found to be 45 in number. Their phenological observations were recorded. Quantitatively all these trees are quite abundant in the study area except degraded sites.

Project 8: Development of Patchouli based viable agroforestry models for North-Eastern region of India [RFRI/CFE/04/2005-08]

Findings: Organized farmer visits to the on-farm trials for demonstration of the Patchouli agroforestry practices. Training was imparted through lectures and practical sessions during field visits. The local entrepreneurs were also invited in the program to facilitate liaisoning with the farmers. The farmers were assured 30 % higher price by these entrepreneurs for the raw material (dry leaves) to be supplied to their industries with a purchase guarantee. Under the technical guidance of RFRI, the farmers have already started growing Patchouli in their tree gardens. Primary observations reveal that the practice will be highly beneficial on sustainable basis.

Project 9: Comparative studies on natural resistance of bamboos to biodegradation in Assam [RFRI/FP/08/2005-08]

Findings: Evaluation trial of eleven bamboo species was conducted for their natural resistance against the biodegrading agents under the natural conditions of Assam. Test yards were laid at three sites viz, at Jorhat, Nagaon and Burnihat and were observed for the period of 18 months. The final results revealed that *Bambusa pallida* and *Melocanna baccifera* as the most and least resistant bamboo species respectively based on biomass loss during the period.

Project 10: Investigations on the formation of Agar wood in *Aquilaria malaccensis* Lamk. [RFRI/FP/11/2006-07]

Findings: Symptoms of infected Agar trees have been identified. *Zeuzera conferta* (Walker), a stem borer larva along with the fungi viz., *Fusarium* spp., *Penicillium* spp., Mucor, *Rhizopus* spp., *Aspergillus* spp. and *Cladosporium* spp. were found to be associated with Agar wood formation in Agar tree. Artificial inoculation with dominant fungi isolated from diseased wood was found to be the best method for Agar wood inducement in Agar tree as compared to other artificial methods.

Infection in Agar (*Aquilaria malaccensis*) TS

Infection in Agar (*Aquilaria malaccensis*) LS

Project 11: Appraisal of tree-crop association pattern in selected Jhum areas of North-East region for efficient land use under agroforestry [RFRI/SC/12/2008-09]

Findings: Keeping in view the objective to explore information on intercropping pattern and their socio-economic impacts, required for formulation of comprehensive agroforestry project

with an aim of efficient utilization of land, studies were carried out in specific areas of Meghalaya (selected Jhum practicing villages of West Garo Hills and East Garo Hills districts) and Mizoram (Aizawl district). Information on marketing channel and market data of raw and value added products were collected. New LUSs have also been observed in practice with some newly introduced crops under different programs of Govt. and Non-Govt. agencies.

EXTERNALLY AIDED PROJECT

Project 1: Establishment of a network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry parameters in India [RFRI/EP/16/2006-08]

Findings: Project concluded on 31st December 2008. Required information was submitted to the Directorate of Extension, Division of Statistics, ICFRE Dehradun. The revised format received from ICFRE was communicated to all State Forest Departments of North-East states for submission of forestry statistics information.

PROJECTS ONGOING DURING THE YEAR 2008–2009

PLAN PROJECTS

Project 1: Investigation on propagation and cultivation of selected Rattan species [RFRI/EE/10/2006-09]

Status: An area of 0.25 ha of *Calamus flagellum* and 2.0 ha of *Calamus tenuis* were planted and growth data recorded.

Project 2: Improvement of Degraded Shifting Cultivation lands through introduction of *Thysanolaena maxima* (Broom Grass) along with *Cajanas cajan* as N_2 fixing plant [RFRI/SC/09/2006-09]

Status: The experimental plots situated at Deohari Rongpi Village (Silonjan) and Raising Rongpi village (Kohora) Karbi Anglong, Assam were maintained. Growth (Plant height, basal diameter, No. of culms/tussock, No. of panicles and length of panicles) and yield data of *Thysanolaena maxima* (Broom Grass) were recorded. No significant difference in growth was observed between 2m and 2.5m spacing trial and least growth was recorded in 1m spacing. The yield obtained from selected individuals planted with *Cajanas cajan* in a spacing of 2m was recorded maximum. Soil samples collected at different stages of growth showed high NPK content in planting stage in comparison to harvesting stage. Significantly high value was recorded in plots where *Thysanolaena maxima* were planted along with *Cajanas cajan*.

Project 3: Improvement of Agar/Agar wood production in *Aquilaria malaccensis* [RFRI/BG/20/2007-10]

Sub-project-I: *In-vitro* induction of essential oil components of *Aquilaria malaccensis* [RFRI/BG-20-I]

Status: Friable callus developed under *in-vitro* condition were transferred to liquid medium for suspension culture. Various elicitor molecules are being used in order to induce essential oil components in the medium.

Sub-project II: Survey and Selection of Desirable Genotypes of *Aquilaria malaccensis* and Establishment of their Field Gene Bank [RFRI/BG/20-II]

Status: Air layering was done in agar trees (*Aquilaria malaccensis*) of approximately 10-14 years old plantation at Nahorani Experimental Station, Nahorani, Golaghat district. The maximum number of roots recorded with treatment of IBA after 45 days.

Air layering in Agar
(*Aquilaria malaccensis*)

Rooting in air layered branches of Agar
(*Aquilaria malaccensis*)

Sub-project III: Clonal multiplication of *Aquilaria malaccensis* through *in-vitro* culture including hardening and out planting [RFRI/BG/20-III]

Status: Optimum shoots regeneration media has been standardized. Five fold multiplications achieved from regenerated shoots of auxillary bud explants.

Sub-project IV: Evaluation of insectidal properties of some plant extracts against *Heortia vitessoides* Moore (Lep. Pyralidae), a major pest of *Aquilaria malaccensis* Lamk. [RFRI/ BG/ 20-IV]

Status: Population dynamics studies of the defoliator *Heortia vitessoides* was carried out at three different districts of upper Assam (Golaghat, Jorhat and Sivasagar district). The extracts from five botanicals (*Azadirachta indica, Acorus calamus, Melia azedirach, Adhatoda vesica, Clerodendron viscosum*) were bioassayed against the *H. vitessoides* in laboratory and the maximum 97% antifeedant activity was shown by the extracts of *Azadirachta indica,* followed by 94% in case of *Acorus calamus*.

Project 4: Documentation of baseline information and restoration of selected stress sites under shifting cultivation through agroforestry in North-East India [RFRI/SC/11/2007-10]

Sub-project I : Documentation of baseline information on shifting cultivation in North-East India.

Sub-project II : Restoration of Jhum land through intercropping Rhizobium inoculated legume trees with agricultural crops in Assam.

Status:

Sub-project I : The analysis of data revealed that area under shifting cultivation has reduced from 73410 sq km in the year 1975 to 5476 sq km in 2001-2003 in North-East region. Major transformations observed in shifting cultivation is changes in land use pattern like establishment of cashewnut, arecanut, bamboo, orange, gamari, teak, tea plantations on fallow lands. Analysis of field data collected on shifting cultivation practices from eleven sites shows that shifting cultivation practices varies mainly with altitudinal gradient and social, cultural and economic status of Jhumia tribes.

Sub-project II : Experimental field trials were laid out in shifting cultivation land at Bey Killing and Phumen Ingti villages, Karbi Anglong, Assam through participatory approach. Control and Rhizobium inoculated seedlings of *Albizzia lucida* and *Indigofera zollingeriana* planted at 10m x 10m spacing with 3 replications in RBD design were intercropped with hill paddy, maize and mixed crops. Composite soil samples were collected randomly at the time of sowing of crops and after harvesting.

Project 5: Establishment of GIS laboratory for systematic creation, management and up-gradation of GIS based forest database of North-East India [RFRI/EE/13/2007-10]

Status: Geometric corrections of 135 nos. of SOI Topographic Sheets (1:50,000 scale) done. Edge matching of the geo-referenced SOI topographic sheets done using proper projection parameters. Digitization of vector layers of reserve forest boundaries from the SOI topographic sheets completed for Assam. Geometric correction of geological zone map, agro ecological zone map and physiographic map of Assam done. Digitization of vector layer of geological zones, agro ecological zones and physiographic zones for Assam has been completed. Hyper linking of the created vector layers and geo-referenced SOI Topographic sheets done with the respective states. Forest cover data of North-East India (digital format) has been procured from Forest Survey of India, Dehradun. Bringing all this spatial and non spatial information in an integrated common GIS platform was done successfully.

Project 6: Genetic improvement of *Acacia mangium* for growth characteristics, pulp and timber quality [RFRI/BG-15/2007-10]

Status: Seeds collected from selected plus trees have been sown in nursery to raise the stock for assessment. A progeny-cum-demo trial of *Acacia mangium* has been laid out to study parent's offspring relation. Similarly a vegetative multiplication garden has been established to get explants for standardization of vegetative propagation technique for the species. In a rooting trial 10% success has been achieved.

Project 7: Development of an efficient technique for *in-vitro* clonal propagation of superior or clone of *Bambusa tulda* [RFRI/BG-17/2007-10]

Status: Multiple shoots developed in the shoot multiplication medium are transferred to various rooting medium for inducing roots *in-vitro*. For inducing roots, treatments with various root inducing hormones, polyamines, carbohydrates are being used.

Project 8: Macro and micro propagation of selected germplasm (clones) of *Dipterocarpus retusus* Bl. Syn *D. macrocarpus* [RFRI/BG/21/2007-10]

Status: Eighteen (18) selected genotypes of *Dipterocarpus retusus* have been established in the green house condition through rooting of shoot cuttings. Axillary bud and shoot tip regeneration was achieved *in-vitro*. Basal and optimal regeneration media has been standardized.

Project 9: Assessment of rattan diversity and conservation strategy with reference to Assam [RFRI/EE/12/2007-10]

Status: Survey was carried out at Dihing Patkai Wild Life Sanctuary (DPWLS), Kaziranga National Park (KNP) and Dibru-Saikhowa Biosphere Reserve (DSBR) and identified 6, 5 and 4 species respectively.

Calamus tenuis, C. floribundus and *C. flagellum* were found to be common species in all three study sites and *C. latifolius* was common in KNP and DPWLS only. *C. erectus* and *C. guruba*

are found in KNP and *C. leptospadix* in DPWLS. The species *Calamus tenuis* in Kaziranga National Park and *C. flagellum* in Dihing Patkai Wild Life Sanctuary were found to occur in clustered form. In Kaziranga National Park 940-1195 individuals of *C. tenuis* per hectare were recorded while in Dihing Patkai Wild Life Sanctuary, the total individuals were 490-600 per hectare.

Calamus flagellum in Dihing Patkai Wild Life Sanctuary

Project 10: Study of Reproductive Biology and Seed Production in Clonal Seed Orchard of *Gmelina arborea* [RFRI/BG-22/2007-10]

Status: Periodical observations were made on the recurring seasonal vegetative and reproductive events. The number of flowers per inflorescence and inflorescence per branch was counted from randomly selected branches. Maximum of 23 number of flower buds per inflorescence were recorded in the clone.

Pollen production was estimated. Diameter of fresh pollen grains was measured. Pollen fertility was assessed by staining them in 2% acetocarmine. The mode of pollination (wind and insect) was studied. Maximum activity of the active foragers like bumble bees (*Bombux haemorrhoidalis*) and *Apis dorsata* (Asian honey bee) and *Apis sarana* var. *indica* (Indian honey bee) was observed during the full light between 11.30 am and 2.00 pm. During the foraging activity, a large number of pollen grains were transferred to the body parts of the bees.

Flowering and fruit initiation in *Gmelina arborea*

Bumble bee (*Bombux haemorrhoidalis*) foraging nectar from Gamari flower

EXTERNALLY AIDED PROJECTS

Project 1: Validation, testing and locational trial of micro/macropropagated planting stock of selected bamboo species in North-East India [RFRI/EP/08/2004-07 extended up to 2009]

Status: Technical guidance to FIAs in Plantation management, observation recording at eight locational trials of North East states was given. Replacement of dead seedlings at locational trial sites has been done. Monitoring of growth and performance of plantations and tabulation of recorded data has been done by RFRI and TERI collaboratively.

Project 2: Sustained capacity enhancement of economically backward scheduled tribes of North-East region through composite R&D technologies [RFRI/EP/11/2006-09]

Status: Ginger and Turmeric rhizomes (2 quintals each) were planted in 2 ha mixed plantation area in participation with the villagers of the adopted village. Fertilizer dosages were applied

in the plantation area. Fish fingerlings were released in the fish pond that produced about 150 kgs fish and sols in the local market. Honey was also extracted by the villagers and sold in the local market. The amount received from sale of fish and honey was deposited in the bank account of the society formed by the villagers. Three-fourth of the earnings was distributed among the villagers and remaining one fourth was kept for purchase of fish fingerlings and feed for fish.

Project 3: Biological control of *Mimosa invisa*, a destructive alien weed threatening Kaziranga National Park (Grassland) [RFRI/EP/12/2006-09]

Status: Survey was conducted for association of bio-agent in the Mimosa infested areas. One insect larva was found to feed upon young leaves and twigs. Few fungal samples were also collected and further laboratory studies were done using pot planted Mimosa plants. However, fungal species failed to produce any disease on the Mimosa plants when applied artificially.

Project 4: Genetic improvement and conservation of genetic resources of some economically more important bamboo species of North-Eastern India [RFRI/EP/13/2006-09]

Status: Survey continued for selection of CPCs of bamboo, collection of clonal materials from selected CPCs. These clones have been multiplied and conserved in gene bank at RFRI, Jorhat. Yearly observations on survival, growth and performance of species-cum-clonal trial plantations established at all six sites in different North-East states have been recorded. The performance trial is better in Tripura (Teliamura) as compared to that in Nagaland (Jalukie), Assam (Kamrup and Hailakandi) and Mizorum (Aizawl and Virengte). Among species, *Bambusa balcooa* has been found to be performing better in terms of survival and growth attributes. Staggering plantation trial of *Melocana baccifera* has been established on permanent plot in RFRI campus. A new block has also been prepared and plantation of seed collected in year, 2008 has been established. Bamboo nursery has been regularly monitored for incidence of disease and pests. No such incidence has been observed in Muli trial and clonal trial sites.

Project 5: Biodiversity studies of orthoptera in Kaziranga National Park, Assam [RFRI/EP/14/2006-09]

Status: A total of 36 species of Orthoptera belonging to 30 genera and 4 families were recorded in different habitats viz., forest lands, savannahs and grass lands of Kaziranga National Park, Assam. The number of species found to be the highest (19 no.) in case of Acrididae family, followed by Tettigoniidae (9 species) and Mantidae (5 species); and the grasslands harbours greater number of Orthoptera species followed by savannahs and forestlands in Kaziranga National Park, Assam.

Project 6: Mapping and Quantitative Assessment of Geographic Distribution and Population Status of Plant Resources of Eastern Himalayan Region (Upper Assam unit) [RFRI/EP/15/2006-09]

Status: Survey and sampling of 87 belt transects of 80 sampling grid (6.5 kmX6.5 km of size approximately) of upper Assam have been completed so far. Information on tree, shrub and herb species of sampled area has been documented. Collection of specimens for preparation of herbarium has been done. About 60 herbarium were prepared. Photographs of all the species available have been taken. Data feeding for 53 belt-transect is completed so far. Data feeding is in progress for rest of the transects and will be completed soon. Periodic updating of the database is in progress. Creation of a GIS based dynamic data-base for upper Assam is under process.

Project 7: On-farm innovation in macro proliferation technique and promotion for commercial plantations of edible bamboo species [RFRI/EP/18/2008-10]

Status: The site was selected after extensive survey of nearby area of Edible Bamboo Shoot Processing Unit at Rongbonhat, Karbi Anglon district, Assam. Being potential species for edible bamboo shoot production, *Bambusa balcooa,* was selected for study. The Kisan nursery was established after imparting systematic training on raising planting stock using macroproliferation technique. Bamboo was planted at four different spacings i.e. 3mx3m 3mx4m, 4mx4m & 5mx5m in RBD design with three replications. Weeding operation done in every three months interval. Survival percentage, growth parameter and number of culms produced per clump were recorded after every six months. The SHGs were motivated to participate in the activity through capacity building approach.

Project 8: Sustainable development of quality bamboo resource for employment generation and socio-economic development in North-East India [RFRI/EP/19/2008-11]

Sub-project I: Development of suitable agroforestry models for promoting bamboo cultivation outside forests in North-East region

Status: Conducted field survey in the four North-Eastern states namely Arunachal Pradesh, Assam, Nagaland and Tripura as proposed in the project and finalized 3 sites of 1 ha each in each of the states. Participatory appraisals have been conducted in the villages where the selected sites are located. Based on the appraisals, designs of agroforestry field trials for different locations have been prepared.

A Bamboo nursery of 10000 plantlet capacity has been established at Sotai village, Jorhat. Propagules of different bamboo species viz, *Bambusa balcooa, B. nutans, B. tulda* and *Dendrocalamus hamiltonii* collected from the Bamboo Germplasm Bank of RFRI have been used for multiplication and production of required planting stock.

The first phase of Farmers' Training on Bamboo Propagation, Cultivation and Management was organised from 12-14 May 2008 for the participating farmers from different sites selected under the project.

Sub-project II: Development of Clump Management practices for economically important bamboo species for enhanced production of quality culms and edible shoots

Status: Collected soil samples from three experimental sites from Agchia (Palasbari), Kamrup, Madhapur, (Titabor), Jorhat and Sotai to determine the initial nutrient content. Thirty clumps of 3 species in three sites finalized on the basis of uniform clump diameter in the farmers field to lay out experimental trial.

NEW PROJECTS INITIATED DURING THE YEAR 2008–2009

PLAN PROJECTS

Project 1: A study on the biodiversity of the plant resources of the patch vegetations around rural homestead in Jorhat district, Assam and its role in socio-economy of the villagers [RFRI/EE/15/2008-11]

Status: Study sites were selected and data on socio-economic status and their dependency on homestead forest of the villagers of Pokamua, Lahing, Boloma, Selenghat, Kakojan and Tamulisiga were collected. Phyto-sociological studies were done in patch vegetation at the above sites. Analysis of collected data of vegetation as frequency, density, dominance is in process. Composite soil samples were collected from above sites for analysis.

Project 2: Ecological assessment of medicinal plants in Nambor Reserve Forest and their socio-economic impact on fringe villagers [RFRI/EE/14/2008-11]

Status: Literature on medicinal flora of Nambor Reserved Forest was consulted & collected. Data collection format for Phyto-sociological studies were developed and tested in the field. Sampling for the enumeration of medicinal plants is under process. Socio-economic survey of one village namely Tegaani has been completed. Market survey for availability of medicinal plants & their source was done at Shillonijan, Karbi Anglong.

Project 3: Development of commercially viable dye products from selected plants of North-East Region [RFRI/BIK/02/2008-11]

Status: Survey was carried out in the nearby areas of Jorhat district and Nambor Reserve Forest for collection of *Baccaurea sapida*, *Aporusa dioica* and *Biscofia javanica*. Plants were identified with the help of BSI, Shillong and herbarium was maintained. The plant material was extracted and material to liquor ratio and time for isolation of dye has been optimized with the help of analytical facilities in Chemistry Division of FRI, Dehradun.

Project 4: Exploration and documentation of indigenous knowledge of Phyto-resources among Mishing tribe of Assam [RFRI/BIK/03/2008-10]

Status: Field visits were made to Mishing villages (viz. Bahfola, Lalitimukh, Neul gaon, Kumolia, Hatisal and Jopong. Sonari, Sundarpur, Bojalkota, Bheloguri in Jorhat District and Agoratoli, Dhaboati, Mohkhuti, Dhanbari Bamungaon, Palas bari, Dhansirimukh, Moriahola, Nikorighat, Amtenga, Alisinga, Ouguri, Nahorkhana Mishing gaon, Nikori under Golaghat District of Assam). Information on plant applications for Pneumonia-6, Worm problem-2, Ring worm-2, Stomach pain-4, Post natal pain-7, Nail infection-1, Urinary problem-8, Stop bleeding-1, Skin diseases-2, Fever-3, Dysentary-6, Nasal bleeding-2, Blood pressure-1, Easy delivery-1, Jaudice-2, Stomach pain-2, Cattle stomach pain-1, Blood dysentery-3, Cattle eye infection-1, Indigestion and lever trouble-1, Intestinal ulcer-1, Cuts-1, Cattle larval infection-1, Snake bite-1, Headache-1 was collected.

Project 5: Impact of climate change on litter microbial dynamics in Dipterocarp forest [RFRI/FP/13/2008-11]

Status: The leaf and litter samples were collected from two sites viz. Deomali (Arunachal Pradesh) and Moreh Town (Manipur) during winter season. Experimental site was selected at Deomali, Arunachal Pradesh to study the decomposition rate of leaf litter under natural conditions. Five fungal genera viz., Aspergillus, Fusarium, Curvularia, Mucor, and Alternaria, were observed to be noticeably dominant over others. Three genera viz. Aspergillus,, Fusarium, and Rhizopus were found to be thermo tolerant under laboratory tests.

Project 6: Seed production potential, seed and seedling quality of planting stock in seedling seed orchards of *Dipterocarpus retusus* (Syn *D. macrocarpus*) [RFRI/G/23/2007-10]

Status: Seedling seed orchard of *Dipterocarpus retusus* (Holong) at Deovan, Naharoni and Joypur has been assessed for seed production potential. Data on flowering and fruiting parameters collected. Seed were collected from Deovan. Seeds sown in nursery for assessment of germination behavior and quality of planting stock of different progenies of plus trees.

Project 7: Appraisal of tree-crop association pattern in selected Jhum areas of North-East region for efficient land use under agroforestry [RFRI/SC/12/2008-09]

Status: Different existing land use systems have been identified out of which most of them are traditional with transforming trends. New LUS have also been in practice with some newly introduced crops under different programs of Govt. and Non-govt. agencies. Site survey was also conducted to identify the suitable sites for field research trials.

EXTERNALLY AIDED PROJECT

Project 1: Assessment of Land Use pattern on Jhum land and Investigation of Production Related Parameters [RFRI/EP/20/2009-11]

Status: The project was initiated in January 2009. Site survey was conducted for identification of parameters to prepare data cataloguing sheets. Planning for execution of future course of action has been prepared during the workshop in consultation with the Coordinating Agency and DST officials.

EDUCATION AND TRAINING

Trainings

Conducted

1. Farmers' Training on Bamboo Cultivation for Sivasagar Forest Development Agency on 19th September 2008 at RFRI, Jorhat (Assam).
2. Propagation, Cultivation Technology and Value addition of Bamboo for Eco-development Committees of Kaziranga National Park and adjoining areas on 9th November 2008 at RFRI, Jorhat.
3. Bamboo Cultivation under NBM for Farmers and JFMC member of Sivasagar FDA, Sivasagar (Assam) at RFRI, Jorhat on 27th March 2009.
4. Organized the visit of school students of different districts of Assam under Assam Chief Minister's Gyanjyoti Scheme on 24th and 25th October 2008.
5. On-site awareness programme under Technology Transfer Programme on Capacity building of SHGs for sustainable livelihood through forestry activities from 5th to 9th February 2009 at Gibbon Wild Life Sanctuary, Jorhat, Assam.
6. Technology transfer programme for sustainable livelihood of Jhumias through plantation of cash crop (Broom grass) at Deohari Rongpi Village, Silonijan and Raising Rongpi Village, Kohora (Karbi Anglong), Assam on 16th February and 3rd March 2009.
7. One week (16th to 21st February 2009) training on Capacity Building/Extension of Forestry for JFMC Members/Stakeholders under Van Vigyan Kendra Hathipara, Gandhigram, Agartala, Tripura to JFMC members, farmers and field staff.
8. Participatory Rural Appraisal for Preparation of Micro plan for Demo Village, Melang Grant organized at Melang Grant village from 6th to 9th February 2009.

Attended

1. Training on 'Mainstreaming Biodiversity in Impact Assessment' held at WII, Dehradun from 18th to 22nd August 2008.
2. Workshop on 'Recent Advances in Microbial Biotechnology and Molecular Biology' from 6th to 10th October 2008 at NERIST, Nirjuli, Arunachal Pradesh.
3. Training on Recent Advances in Agroforsetry w. e. f. 24th November to 5th December 2008 held at National Research Centre for Agroforestry, Jhansi, UP.
4. National Seminar on Bio-resources of North-East India: Industrial potential and Intellectual property Rights Issues on 2nd and 3rd January 2009 at Nowgong College, Nagaon (Assam).
5. National Workshop on Extension Strategies in Forestry Research and presented detailed account of VVK and Demo Village of RFRI on 15th and 16th January 2009 at ICFRE, Dehradun.
6. National Seminar on Exploitation, Utilization and Strategies Action Plan for Sustainable Management of Plant Resources on 27th and 28th February 2009 at Gauhati University, Guwahati (Assam) and presented paper.
7. National Seminar on Bio-piracy: Imminent threat to the conservation of Biodiversity and Bioprospecting of flora and vegetation of NER, held at DKD College, Dergaon, Golaghat (Assam).
8. Training on Bioreactor operation and scale up studies of plant cell culture (1st to 13th December 2008) at Institute of Himalayan Bioresources, Palampur (HP).
9. Training on Biotechnological tools & techniques for plant biodiversity and conservation study from 19th to 31st January 2009 at North-East Institute of Science & Technology (NEIST), Jorhat.
10. Advanced training on non-timber forest produce at Dr. Y. S. Parmar University of Horticulture & Forestry at Solan, during 16th February to 8th March 2009.
11. Meeting on Climate Change adaptations at Assam Secretariat, Guwahati, Assam on 4th March 2008 with German Development Bank.

VAN VIGYAN KENDRA PROGRAMME

RFRI, Jorhat established five Van Vigyan Kendras in the states of Assam, Arunachal Pradesh, Tripura, Mizoram and Nagaland.

Five two-day trainings each in Assam (Jalukbari, Makum, Silchar, Tezpur), Nagaland (Dimapur, Mokakchaung, Peren, Wokha and Kohima), Mizoram (Forest Training School, Aizawl) and two one week trainings at Arunachal Pradesh (Itanagar and Zero), Tripura (Hathipara Research Station, Agartala) were imparted to frontline officials of State Forest Departments, JFMC members, NGOs, farmers during 2008-09.

Vermicompost unit at Hathipara, under VVK Tripura

Trainees were trained in wide range of subjects of stakeholders need like agroforestry practices; bamboo propagation, cultivation, preservation and value addition; nursery practices of rattans; NTFPs marketing; medicinal plants cultivation; Panchakarma uses of medicinal

plants; plantation technology; pest and disease management; vermicomoposting; and biofertilizers.

Modern nurseries were created in all the five VVKs for training and demonstration purposes. The VVKs were supplied with literature in different subjects. Audio-visual CDs were prepared for distribution to the VVKs. These were also equipped with extension equipment such as LCD projector, camera, PA system, exhibition display system, furniture, almirah, computer, bouchery machines for bamboo preservation.

RFRI Demo Village – The Meleng Grant

Selection of Demo Village: The Meleng Grant village adjacent to the Gibbon Wild Life Sanctuary in Jorhat District was selected as the RFRI Demo Village. This single village comprises of three hamlets viz. Bhogpur, Madhupur and Govindpur with a total of 220 households.

Training for Capacity Building: Training on Participatory Rural Appraisal (PRA) and Microplanning was organized during 05th to 09th February 2009. Other trainings on different aspects viz. Bamboo Nursery, Vermicomposting have already been conducted during the current financial year.

Participatory Implementation: A local TTMC (Technology Transfer Monitoring Committee viz. Trinayan Unnayanmukhi Committee) has been constituted by the villagers. The committee visits the sites as per schedule and maintains the records of feed backs and advice besides recording the field data. It has also been agreed by the individuals and groups to contribute 5% of the income to the Committee's Account. The committee has already opened their Bank Accounts with State Bank of India and Union Bank.

Two Patchouli Nurseries of about 3 lakhs plantlet production capacity has already been established. Two Bamboo Treatment Tanks have been installed and brought under operation. The bamboo culms will be treated with the techniques developed by RFRI. Treated bamboos will be fetching income to the farmers by selling it with at least 10 % more income. Twenty two number of Vermicompost Units have been constructed.

LINKAGE AND COLLABORATION

The linkage were established with State Forest Departments of all North-Eastern states, Central/State Universities, other research organizations, NMBA, MoEF, NBM, NABARD, DBT, NEC and NGOs working in the field of forestry and forestry research. Multi-locational trials of three bamboo species and clonal trials of six bamboo species are being conducted in association with SFDs. Bamboo based agroforestry demonstration plots have been established in Assam, Arunachal Pradesh, Nagaland and Tripura states.

CONSULTANCIES

- Consultancy awarded by Principal Chief Conservator of Forests, Department of Forests, Ecology, Environment & Wild Life, Government of Nagaland, Kohima for preparation of project proposals for funding under Central Sector Scheme for Conservation, Development and Sustainable Management of Medicinal Plants Scheme of National Medicinal Plants Board, GoI, New Delhi.
- Successfully completed the consultancy on first concurrent monitoring and evaluation of the projects of North-East States except Tripura and internal monitoring and evaluation of the projects under Golaghat Forest Development Agency (FDA) sponsored by National Afforestation and Eco-development Board (NAEB), Ministry of Environment & Forests (Govt. of India).

PUBLICATIONS

Newsletter/ Technical Bulletins/ Manuals/ Reports/ Chapter in Books

- RFRI (2009), RFRI Newsletter (VVK Issue). Vol. 1 (No. 1), January to March 2009: 8p
- Bamboo Cultivation: An Opportunity for Livelihood Needs, RFRI Publication.
- Rattan Nursery & Plantation: Techniques & Practices, RFRI Publication.
- *Mimosa invisa*- Alien Invasive Species, Pamphlet, Rain Forest Research Institute, Jorhat, Assam: 6pp (English & Assamese version).

Brochures

1. Vermicompost Production Technology and its Role in Increasing Soil Productivity, RFRI/BR-18/2009.
2. Self Employment through Scientific Patchouli Cultivation, RFRI/BR-19/2009.
3. Compost- Methods of Preparation and its Importance, RFRI/BR-20/2009.
4. Bamboo nursery by Scientific Method: A Way of Self Employment, RFRI/BR-21/2009.
5. Bamboo Preservative Techniques, RFRI/BR-22/2009.
6. The Bamboo Flowers: Its Problems and Remedies, RFRI/BR-23/2009.
7. Hollong Nursery Techniques: Theory and Practices, RFRI/BR-24/2009.
8. *Michelia champaca* Linn. (Titachapa).
9. *Gmelina arborea* (Gamari).
10. *Anthocephalus sinensis* Linn. (Kadam).
11. Bamboo Nursery Techniques: Theory and Practices.
12. Rattan Nursery Techniques: Theory and Practices.
13. *Acacia mangium* - A Prospect Tree Species for North-East.
14. *Aquilaria malaccensis* Lamk. (Sachi).
15. Mimosa- An Alien Invasive Species.
16. Sarpagandha (*Rauvolfia serpentina*).

Book/Training Manual

1. Bamboo in North-East India: A Management Guide, Vol. II.
2. *Dipterocarpus retusus* Syn. *D. macrocarpus*.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

Attended

The representatives from The Rain Forest Research Institute (RFRI), Jorhat, Assam attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

1. National Seminar on Exploitation, utilization and strategies action plan for sustainable management of plant resources on 27th and 28th February 2009 at Guwahati University, Guwahati (Assam).

2. National Seminar on Bio-piracy: Imminent threat to the conservation of Biodiversity and Bioprospecting of flora and vegetation of NER, held at DKD College, Dergaon, Golaghat (Assam).
3. National Seminar on Exploration, Utilization and Strategy Action Plan for Sustainable Management of Plant Resources, organized by Department of Botany, Guwahati University, Assam on 27th to 28th February 2009 Abstracts of Papers: 93p.
4. Symposium on Forest Insect – Pest and disease management in Himalaya organized by Himalayan Forest research Institute, Panthghati, Shimla, H.P. held on 10th and 11th January 2008, pp20 (Abstract).

Organized

RFRI, Jorhat, organized a "National Conference on All India Co-ordinated Project on Bamboo" at Indian Institute of Entrepreneurship, Guwahati, Assam on 23rd May 2008.

Hon'able Chief Minister of Assam Sri Tarun Gogoi in inaugural session of National Conference on All India Co-ordinated Project on Bamboo at IIE, Guwahati, Assam

Exhibition/Fairs/Kissan Mela

1. Participated in the Exhibition at DCB College, Jorhat (Assam) in commemoration of its Golden Jubilee Celebration on 9th and 10th January 2009.
2. Participated in the Exhibition on the occasion of 7th Kaziranga Elephant Festival at Kohora, Kaziranga, Golaghat (Assam) from 9th to 12th February 2009.
3. Participated in the Science Exhibition on the occasion of 16th National Children Science Congress-2008, State Level, Jorhat (Assam) from 23rd to 26th October 2008.
4. Participated in the Regional Agricultural Fair 2008 to be held at Saramsha Exhibition Center, Ranipool, Gangtok, Sikkim from 1st to 3rd December 2008.

RFRI participation in 7th Kaziranga Elephant Festival, Kohora

RFRI participation in Regional Agriculture Fair in Gangtok, Sikkim

DISTINGUISHED VISITOR

Thailand Embassy dignitaries visited RFRI, Campus on 7th January 2009.

MISCELLANEOUS

Sri Mridul Saikia, TA Grade–IV of this Institute who represented ICFRE in the XVII All India Forest Sports Meet held at Chandigarh, Punjab bagged the BRONZE MEDAL in Weight Lifting 77 kg category competition.

Sri Mridul Saikia
with Bronze Medal

ADVANCED RESEARCH CENTRE FOR BAMBOO AND RATTANS, AIZAWL

Advanced Research Centre for Bamboo and Rattan (ARCBR), Aizawl (Mizoram) is one among the network of eight Institutes and four centres under aegis of the Indian Council of Forestry Research and Education, Dehradun, an autonomous body under Ministry of Environment and Forest, Govt. of India. The Centre is first of its kind in India for socio-economic upliftment of North-Eastern people that revolve around Bamboos and Rattans. The Centre is aimed to cater the bamboo and rattan related research needs of all the eight North-Eastern states viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. In addition, the Centre is entrusted to support various research activities of RFRI in Mizoram, Tripura and Barak Valley of Assam states. The Centre is mandated to conduct advance research on Bamboo & Rattan with regard to management and sustainable utilization, standardization of nursery technology including cultivation practices, macro and micro propagation, diversity enrichment, genetic improvement and conservation of promising genetic resources, certification, technology development for value addition, edible shoot processing, product development including bamboo composites, Bamboo based tools/machines for bamboo working, extension of bamboo based knowledge and technologies to stakeholders. The Centre is presently in establishment stage and is equipping and aligning itself to fulfill the mandate.

PROJECT ONGOING DURING THE YEAR 2008–2009

PLAN PROJECT

Appraisal of tree-crop association pattern in selected Jhum areas of North-East Region for efficient land use under agroforestry (RFRI/SC/12/2008-09) of RFRI in Mizoram.

EXTERNALLY AIDED PROJECT

Project 1: Validation, testing and locational trial of micro/macro propagated planting stock of selected bamboo species in North-East India [RFRI/EP/08/2004-09].

Project 2:Genetic improvement and conservation of genetic resources of some economically more important bamboo species of North-Eastern India [RFRI/EP/13/2006-09].

LINKAGES AND COLLABORATION

1. Technical Meeting with Forest Officers/Officials of Aizawl Forest Division at Aizawl (Mizoram) on 17th May 2008 related to management of Bamboo Species-cum-Clonal Trial.

2. Technical Meeting with Forest Officers/Officials of Kolasib Forest Division at Kharjawl (Mizoram) on 6th June 2008 related to management of Bamboo Species cum Clonal Trial.
3. Visited Model Nursery of Mamit Forest Division, Mizorm on 30th January 2009 and extended technical advice to the forest official regarding management of nursery, proper upkeep of the bamboo planting stock, installation of essential nursery components and measures to overcome the mortality problems in nursery stocks.
4. Extended technical advice to the Nodal Officer-VVK, E & F Deptt., Mizoram in designing the training programmes, finalizing topics and preparing the course material.

PUBLICATIONS

Brochures

1. Bamboo Cultivation: Choice of Species, ARCBR/BR/01
2. Propagating Bamboo, ARCBR/BR/02
3. Bamboo Plantation Management (for better productivity), ARCBR/BR/03
4. Propagating Rattans, ARCBR/BR/04

CONFERENCES/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

Attended

The representatives from Advanced Research Centre for Bamboo and Rattan (ARCBR), Aizawl (Mizoram) attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

1. Fifth Meeting of Scientific Advisory Committee – Consortium on Micropropagation Research and Technology Development (SAC-CMRTD) held on 11th April 2008 at DBT, New Delhi.
2. First Meeting of the Working Group of National Bamboo Mission on R&D held on 14th and 15th October 2008 at Krishi Bhawan, New Dehli.
3. Tenth Central Monitoring Committee Meeting of MoEF held on 14th January 2009 at Agartala (Tripura).

Organized

1. Two days Farmers Awareness Programme organized on 20th and 21st November 2008.
2. Awareness Campaigns conducted in remote areas of southern Mizoram including Phawngpui, Cheural, Rawlbuk, Lungpher, Siachangkawn, Kawlchaw, New Lataw, Saisih, Khawmawi, Hmunnuam and Bualpui villages from 27th January to 2nd February 2009.

Awareness Campaign at Kawlchaw village

Training programme on "Cultivation and sustainable use of Bamboo and Rattans" organized at Sangau-II village in Saiha District on 29th January 2009 and at Phura village under Mara Autonomous District Council of Mizoram on 31st January 2009.

ARID FOREST RESEARCH INSTITUTE JODHPUR

Arid Forest Research Institute, Jodhpur (Rajasthan), is one of the eight Institutes under the Indian Council of Forestry Research & Education (ICFRE), an autonomous body of the Ministry of Environment & Forests, Govt. of India. The objectives of the Institute are to carry out scientific research in forestry & allied fields to enhance the productivity & vegetative cover, to conserve the biodiversity and to develop the technologies for the end-users, especially in the hot arid and semi-arid region of Rajasthan, Gujarat and Dadra & Nagar Havelli.

An abstract of projects run by the Institute is as follows:

	No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
Plan Projects	05	16	03
Externally Aided Projects	03	07	00
Total	**08**	**23**	**03**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Assessment of International Neem Provenance Trial [AFRI-78/FGTB/2006-09]

Findings: Provenance trials of Neem were established by AFRI as a collaborating institute in International Neem Network with an aim to improve the genetic quality and adaptability of Neem and to improve its utilization. The materials for the present investigation come from one of these provenance trials located at Jaipur. This trial was initially established with 18 provenances including 8 international and 10 Indian provenances in the year 1996. At the time of initiation of the project, only12 provenances were present and the other provenances were succumbed to extreme biotic factors like frost and heat. Three of the 12 provenances are from Yezin (Myanmar), Geta, Dhangadhai (Nepal) and Chamnion (Tanzania), and the rest of the 9 provenances are from India. The statistical analysis showed no significant difference between the provenances in terms of growth traits i.e. height and diameter at breast height (dbh). Among the international provenances, the provenance from Nepal (Geta, Dhangadhai) showed good growth in height which was above the mean height during the years 2006 and 2008, except in the year 2007. The mean growth of this Nepal provenance (5.37 m) was the best among all other provenancs. Other two introduced provenances showed less height growth than the mean. Most of the Indian provenances, which performed better in growth, did not show stability in the assessment years. Only two provenances viz. Kalyani, Mandore and local seed source (Jaipur) maintained consistency in their growth during the assessment years. The Yezin (Myanmar) and Chamnion (Tanzania) provenances and Ramannaguda and Sagar provenances from India continuously performing poor. The Geta (Dhangadhai) provenance from Nepal showed more growth in both height and dbh than the mean. Except the Ramannaguda provenance, all other provenances from India had higher growth in dbh than the mean.

There is sufficient synchronization in flowering of both the Indian and introduced provenances. The seeds obtained from the provenances showed variation in length and diameter which was ranging from 10.1 mm to 12.5 mm and 6 to 7.5 mm respectively. Among the introduced provenances, the seed size of the Yezin (Myanmar) provenances was almost equal to the size of the Indian provenances. The oil content was ranging from 36.34% to 43.24% in kernel. The variation in oil content amongst the provenances was statistically significant. The provenances from Ramannaguda and local seed source (control) had higher oil content (<43%) and which was followed by the Tanzanian provenance (41.13). The other introduced provenances had oil content on par with other Indian provenances (36% and above).

In the present study, all the introduced provenances had synchronization in flowering and produced seeds. Hence, these provenances can further be best utilized for further improvement programme by introducing more provenances and individual superior trees from tested ecological zone.

Neem tree (Kalyani prov.) in Peak flowering

Close view of flowering branch

Tertiary branch with fruits

Project 2: Relative resistance of neem provenances to insect pests and mites and their Bio-management in arid areas [AFRI-73/FPD/2006-09]

Findings:

Relative resistance of neem provenances to neem weevil, *M. tenuicornis*: An experiment has been conducted to study the resistance of 39 neem provenances to neem weevil, *Myllocerus tenuicornis*.The provenance from Palanpur and Jhansi exhibited the least preference for the larvae (0.65 and 0.69 cm sq.), wheras the provenance from Mulag was found to be the most favoured or susceptible host as the leaf area consumed by larvae was 3.11 sq cm.

Microbial control agent of neem weevil: Infection of an entomopathogenic fungus, *Beauveria bassiana* has been observed in the adult population of neem weevil, *M. Tenuicorins.* Efficacy of this entomopathogenic fungus has been studied.

Bioecology of neem defoliator: A complete lifecycle under different generations took an average period of 39.75 days which ranges from 29 to 47 days under different conditions of temperature and relative humidity.The population dynamics of *Myllocerus tenuicornis* on 39 neem provenances is in progress. Periodical data are being collected and being analyzed. Seasonal variation of economically important insect pests i.e. sap suckers and defoliators has been studied.The mortality data on pest incidence have been recorded.

Project 3: Developing strategies and methodologies for extension of forestry research technologies in semi-arid and arid areas [AFRI-71/AFE/2005-09]

Findings: Dissemination of research information was ensured by participation in farmers fair held at CAZRI, Jodhpur on 12th September 2008 and Hast Shilp Utsav held from 2nd to 11th January 2009 at Rawan Ka Chabutra, Jodhpur. Designed the material and got 80 bilingual (Hindi-English) research display material prepared for the VVK AFRI, Bichhwal, Bikaner, Rajasthan and the Interpretation Centre, AFRI. Similarly 16 research bilingual display boards were prepared in English & Gujarati for the VVK site at Rajkot, Gujarat. Strengthened Library and Information System resource data base by addition of books related to agroforestry & Extension. Prepared report on the Bamboo training programme under NMB and forestry training held for field functionaries of State Forest Department and farmers of Gujarat held at Rajpipla and Rajkot, Gujarat respectively.

Project 4: Screening of Exotic and indigenous plant species for their performance potential on arid salt affected soils with different level of management [AFRI-49/NWFP/1997-09]

Findings: A total of eight experimental trials were laid out on lithic, calcid, coarse sandy to loamy sand salt affected area of Gangani in Jodhpur district in different years (from 1997 to 2003). An experimental trial was laid in August 2003 with two fodder species namely *Zizyphus mauritiana* (ber) and *Colophospermum mopane*. The trial was laid with two levels of gypsum (0 and 100% soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form of urea) on two modes of planting (control and circular dished mound). *Colophospermum mopane* registered 92.0% survival on CDM and 86.5 % in control after five years of planting. There was no change in survival for mopane for 36 - 60 months period while Ber (*Z. mauritiana*) recorded 17 to 48% survival on thus failing to survive the experimental conditions. Two Factors Analysis showed that there is no effect of planting technique on survival and growth. However, in case of above ground biomass, CDM was significantly superior to control. Application of Gypsum with 9g N recorded higher biomass compared to all other treatments. Root biomass by excavation showed that root penetrated the kankar pan up to the depth of more than one metre.

Other Major findings

- Exotic shrubs of genus Atriplex perform well on arid saline alkali lands with FYM and nitrogen. They produce nitrogen rich fodder used for sheep and goat. High salt content necessitate mixing with cereal residue.
- *Salvadora persica*, was the best performed indigenous tree with highest survival. It is a slow growing species, application of gypsum and nitrogen gave increase in growth and biomass production.
- *Acacia ampliceps* (exotic) tree perform very well on alkali soils with good soil depth (60 cm to 75 cm minimum) and respond well to FYM, gypsum and phosphorus application. It is a very good fodder for all the animals.
- Large pit size is necessary to mix amendments to create less salty environment during seedling establishment. Double ridged and Circular dish mounds enhanced survival of all the plant species. by providing protection from waterlogging and less salty environment. Crescent shaped drainage trenches served dual purpose helped in leaching of salts and harvested water.
- Plantation activities helped in improving the site conditions, promoting growth of natural flora (glycophytes as well as halophytes) and natural germination of *S. persica* is also observed.

- **Distribution of seeds collected from experimental site:** One kg seed *C. mopane* and half kg seed of *Acacia ampliceps* were given to Gujarat SFD during 2008.

Project 5: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time [AFRI-50/NWFP/2002-09]

Findings: Variation of secondary metabolites in *Tribulus rajasthanensis, Pluchea lanceolata* and C*assia angustifolia* in different developmental stages was studied for determining the optimum harvesting time in these pecies. Analysis of total saponin content in the aerial parts of *Tribulus rajasthanensis* showed that the saponin content high in the vegetative stage (5.45 %), decreases in the flowering stage (4.1%) and then, rises again (5.40 %). Total saponin content in fruits was found to be much less (1.5%) as compared to that present in aerial parts. The secondary metabolite (Plucheoside) content in leaves of *Pluchea lanceolata* was found to be maximum in the flowering stage (7.3%). It was found to increase from vegetative stage to the flowering stage and, then, decrease again. The sennoside content in leaves of *Cassia angustifolia* was found to be maximum in flowering stage (1.98%).

EXTERNALLY AIDED PROJECTS

Project 1: Productive propagation of remunerative medicinal plants for establishment of silva-ayurveda demonstrative models in the arid and semi-arid areas, their preservation for further improvement, research, extension, development and diversification [AFRI-70/AFE/NMPB/2006-09]

Findings: Plants of some species like *A. indica* (neem), *Cordia mixa* (gunda), *Ziziphus jujuba* (ber), *P. cineraria* (khejeri), *T. undulata* (rohida) *Moringa oleifera* (sahjan), *Caraissa carandas* (karoda) and *Commiphora wightii* (guggal) were raised at AFRI nursery. Plants of some medicinal plant species like Aloe vera, Brahmi and Ashwagandha etc., were procured from outside sources.

Two sites at Tibna and Jadan of Jodhpur and Pali districts respectively were planted & maintained. Fifteen field beneficiaries were selected at Tibna village, two of one hectare and thirteen of one bigha area. Total area planted is 5.75 ha. at village Tibna. The species of *A. indica* (neem), *Cordia mixa* (gunda), *Ziziphus jujuba* (ber), *P. cineraria* (khejeri), *T. undulata* (rohida) *Moringa oleifera* (sahjan), *Caraissa carandas* (karoda) and *Commiphora wightii* (guggal) were maintained at farmers fields.

Some of the farmers have shown their interest to plant *Aloe vera* (guwarpatha), and *Withania somnifera* (ashwagandha). Total area planted is 5.75 ha. at village Tibna. At Jadan, species *T. undulata* (rohida), *P. cineraria* (khejeri), *Cordia mixa* (gunda), *Ziziphus jujuba* (ber), *Emblica officinalis* (aonla)*Commiphora wightii* (guggal) and Citrus (nimbu) were maintained over 1.25 ha. The survival percentage in the field ranged 70% to 90%.

At AFRI, Jodhpur nursery 4,20,000 nos. of Aloe vera plants were transplanted in thirty five nursery beds, which were procured from SKN College, Rajasthan Agriculture University, Jobner. These are being maintained by providing proper shelter and irrigation. Field nursery at Tibna was maintained by providing watch and ward. It contains about 45,000 seedlings.

An experiment on "Production Study of Medicinal Plants Integrated with tree and shrubs in the Indian Desert" was established at experimental fields of AFRI, Jodhpur with two shrub speices i.e. Nimbu and Guggal and tree species Gunda and Khejri in Randomized Block Design.

Project 2: Establishment of a network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry parameters in India [AFRI-86/Silvi/ITTO/2007-09]

Findings: Data regarding forestry statistics collected from Rajasthan, Gujarat and Dadra & Nagar Havelli were compiled in various formats and sent to the ADG (Stat.), ICFRE. The revised formats developed in consultation with the ITTO consultant were field tested and comments given by the Forests Departments were forwarded to the ADG (Stat.), ICFRE. Draft manual was finalized and report prepared.

Project 3: Assessment of soil carbon stock and dynamics in forest soils of India (All India coordinated project, funded by MoEF, GoI) [AFRI-91/FED/NATCOM-II, MoEF/2009]

Findings: From July 2008 to January 2009, a total of 111 soil samples (98 from forest areas and 13 from agriculture land) in 0-30 cm soil layer were collected from 26 forest subgroup types identified covering 6 districts of Gujarat and 16 districts of Rajasthan.

Soil Organic Carbon (SOC) was lowest ($P<0.05$) in Desert dune forests (0.04%) and highest in Northern dry mixed deciduous forest (1.16%). But soil carbon density was highest ($P<0.05$) in Dry tropical riverain forest (38.92Mg ha^{-1}) and lowest in Tropical Euphorbia scrub (1.46 Mg ha^{-1}). Thus, carbon density depended upon soil conditions as well as gravel content and rock outcrop in particular type of forests. SOC and carbon density were in reverse order in *A. leucoploea* based and *Salvadora oleoides* based *Cassia auriculata* scrub. Boswellia forests (5/E2) occupied highest altitude, whereas Rann Saline thorn scrub (6/E3) occupied lowest altitude. Carbon density was relatively greater in Rajasthan than in Gujarat forests. Lesser carbon density in most of the forest types than in the agriculture land indicates varying degree of degradation resulting in less carbon storage. However, dry tropical riverain forest, dry teak forest, northern dry mixed deciduous forest and desert thorn forests showed highest carbon density than in agriculture land reflecting better soil health in these forest types by maintaining greater soil carbon stock. Wide variability in carbon density between forests and agriculture land indicated scope of carbon stock improvement in forests.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Development of economically viable and integrated agroforestry models for arid region [AFRI-55/Silvi/2003-09]

Status: Agroforestry model is being maintained at farmer's field at village Harsh, Bilara. Survival, growth and crop production data were recorded and compiled. Performance of *Ziziphus auritiana* (grafted ber), *Cordia mixa*, was found best as horticultural species and *Prosopis cineraria* and *Ailanthus excelsa* was best as silvicultural species.

Prosopis cineraria plants obtained average maximum height 155 cm and followed by *Cordia mixa* (150 cm), *Colophospermum mopane* (149 cm), *Ailanthus excelsa* (142 cm) and *Ziziphus mauritiana* (130 cm). Similarly, collar diameter was highest in *A. excelsa* (5.09 cm) and followed by *Cordia mixa* (4.79 cm), *Colophospermum mopane* (3.34 cm) and *P. cineraria* (3.27 cm). The plant growth was higher in agroforestry compared to the control (without crop). The highest survival was observed in *P. cineraria* (98%) followed by *Z. mauritiana* (86%), *C. mopane* (85%) and *Cordia mixa* (77%) and the lowest survival was *Emblica officinalis* (7%) species. Wheat crop production was recorded 19.55 quintal/ha.

Project 2: Market survey on selected species in selected markets [AFRI-24/FRME-1/1994-Continue 1994 to till date]

Status: The data regarding prices of various forest produces viz., timber, fuelwood, bamboo were collected from the markets of Jaipur and Ahmedabad on quarterly basis. Data collected were compiled and submitted to the ADG (Stat.), ICFRE, Dehradun on prescribed format for publication of Timber and Bamboo Trade Bulletin.

Project 3: Survey, selection, performance trial and estimation of yield potential of *Jatropha curcas* in Rajasthan and Gujarat [AFRI/JU/Silvi/2006-07/RPC 25th-26th February 2007/ 2007-12]

Status: Carried out measurement in the two sample plots of *J. curcas* laid out at Motiya Research Farm, Rajpipla (Gujarat). Total height, crown width and collar diameter varied from 1.3m to 2.6m, 0.4m to 2.5m and 5.7 cm to 13.2 cm, respectively. Seed yield was varied from 4.6 gm to 189 gm. Similarly, height and seed yield/plant at Lekawada nursery varied from 0.92 m to 1.29 m and 14.75 gm to 138.00 gm. Seeds were collected from 14 CPPs planted in Lekhawada nursery, Gandhinagar. Total seed weight, seeds per 10g, kernel and oil content were estimated. Number of seeds per 10g varied from 17 to 23 percent oil from 27.6 to 41.1 percent. Progeny of 20 CPTs from Rajasthan and 10 CPTs from Gujarat have been raised for establishing progeny trial.

Two progeny trials, one with 5 replications having single plant per replication at AFRI, Jodhpur and another with 15 replications in RBD at Haldughati, Udaipur were established in July 2008. Initial survival varied from 95-100 percent. Rodent infestation was observed at Udaipur site and a total of 30 plants were damaged by rodents. Mechanical treatment by protecting collar with wire mesh was found superior than chemical treatment. Plants have been raised for mortality replacement. Growth data have been taken and analyzed. Initial plant mean height (28-70.60 cm), mean number of branches (1.0-2.40) and collar diameter (0.80-2.20 cm) were observed at AFRI, Jodhpur and 37-52.3 cm, 1.0-1.20 and 1.30-1.76 cm respectively at Haldughati, Udaipur. Preliminary seed yield equation developed, SY=4.0752-1.096*CD, where, SY= seed yield, CD= crown diameter.

Project 4: Studies on seed traits of seeds collected from seed stands/SPAs/SSOs/CSOs of important species of Gujarat state [AFRI/JU/Silvi/2006-07 RPC 25th-26th February, 2007]

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

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

Project 5: Characterization and classification of forest soils of Rajasthan [AFRI-85/FED/2007-12]

Status: The project has been initiated in September 2007 with the objective to characterize and classify the forest soils of Rajasthan following the USDA classification system. Soil profiles have been studied at 55 places in Jodhpur, Banswara, Pratapgarh, Dungarpur and Pali districts covering 25 vegetation/forest sub-types in the major forest types of tropical dry deciduous and tropical thorn forests.

Physicochemical characterization of the soils has been done in the field as well as in laboratory. Soil structure, consistency, colour, pH, electrical conductivity, organic carbon, NO_3-N and NH_4-N and phosphorus have been estimated for 171 samples. Ecological study in an area of 0.1 ha near each of the soil profile pit has been completed.

Shallow, well drain soil with pebbles & stones in *Boswellia serrata* forest at Khed tala, Udaipur

Shallow soil in Heteropogon - *A. Leucophloea* grassland at Sindarli ghas Jod, Desuri (Pali)

Stony shallow soil

A. pendula forest, Sabla

In general, forest soils are found to be very shallow to shallow as most of the forests are located on hilly terrain. Presence of calcium carbonate layer at shallow depth was observed in grassland soils. Deep soils are present along narrow strip of valley. Soils on the hilly area of Banswara, Pali, Dungarpur and Pratapgarh are neutral to acidic in nature with low electrical conductivity, whereas, on grasslands in Pali and Jodhpur District, they are basic with high electrical conductivity.

Project 6: Genetic Improvement of *Tecomella undulata* [AFRI-33/FGTB-7/(2002-09]

Status: Progenies of selected CPTs of *Tecomella undulata* were maintained in the Nurseries of AFRI, Jodhpur and Beechwal, Bikaner. Two progeny trials using 40 progenies were established in the experimental area of AFRI and in the SFD land at Bikaner. These progenies were established in randomized incomplete block design, with a spacing of 3 x 3 m and having 9 plants per plot. The trials were established in the month of August 2008 and fencing was provided to the trial in Bikaner. Regular watering is done for the plants.

A view of the plants in the trial

7 months old healthy progeny

Project 7: Screening of high oil and Azadirachtin in Neem [AFRI-34/FGTB-8/2002-09]

Status: The progeny trial of neem established in Govindpura, Jaipur to study the heritability pattern of selected CPTs for their oil and Azadirachtin content had not produced flowers and fruits. This was due to frost and other climatic factors. The trials were maintained and the periodical flowering observations taken. The observations in the month of March 2009 showed flower bud initiations in most of the progenies of the selected CPTs.

Project 8: Multilocational trial of *E. camaldulensis* and *D. sissoo* clones in Gujarat state [AFRI-41/FGTB/2002-09]

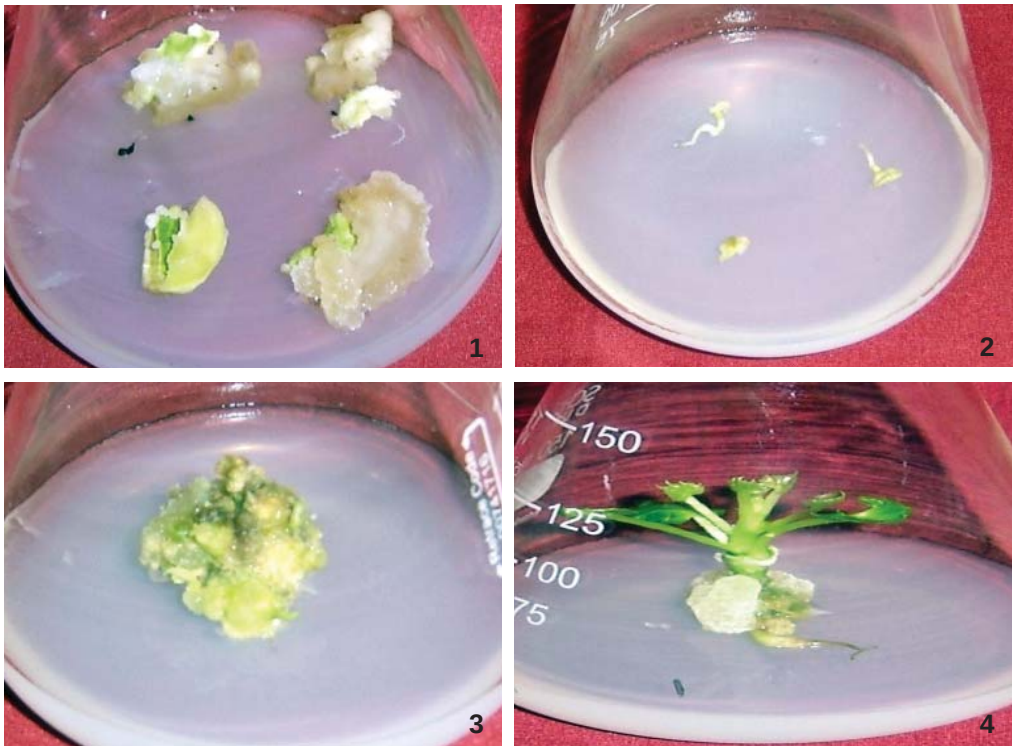
Status: Analysis of variance revealed significant to very highly significant variation between the clones of both the species for most of the traits across the locations. Estimation of genetic parameters showed that the growth traits of *Eucalyptus camaldulensis* are strongly inherited and under the influence of both additive and non additive gene action. Detailed genetic analysis of *D. sissoo* trials is being carried out. As far as the performance of the clones at different sites is concerned, ranking of the clones varies in different sites, however, few *Eucalyptus camaldulensis* clones like G2 and clone No. 15 and 35 showed stable performance across the sites as demonstrated by their better growth. These clones were amongst the top 10 clones in all the sites. Similarly *D. sissoo* clone Nos. A3, 10 and 105 were found suitable in all the four test sites.

Project 9: Demonstration trial of male and female *Ailanthus excelsa* plants raised through grafting and tissue culture [AFRI-79/FGTB/2006-09]

Status: Demonstration trial is established with grafted seedlings raised through male and female scions collected from marked trees. Trail is laid in Randomized Block Design in July 2008 in AFRI experimental area. Trial is irrigated and is being maintained well. Survival percentage is about 85%. Data have been recorded on growth parameters as per schedule.

Project 10: *In-vitro* mass propagation of *Jatropha curcas* L. and optimization of low cost options for Economizing the technology [AFRI-83/FGTB/2007-10]

Status: Embryogenic callus cultures have been obtained. Embryogenic callus cultures were multiplied further by repeated subculturings. Part of the embryogenic callus cultures with somatic embryoformation zones was diverted to South-East germination medium where somatic embryogermination has been achieved.



Photoplate: *Jatropha curcas*: 1. Somatic embryo (SE) formation from callus; 2. Germination of SE; 3. Callus showing formation of multiple shoot buds and 4. Multiple shoot formation

Apical bud explants when cultured on different combination of BAP & IAA supplemented MS medium resulted shoot formation (organogenesis). Cultures with bud break response and shoot morphohenesis were further multiplied and the microshoots were transferred to rooting media.

Project 11: Management of potential insect pests and diseases of important medicinal plants grown in arid and semiarid regions [AFRI-72/FPD/2006-09]

Status: Isabgol (*Plantago ovata*) crop was found severely attacked by downy mildew disease at Sojat (Pali). The incidence of the disease was noticed about 35-40%. The fungus was identified as *Peranospora* sp. The treatment 8 comprising Rattan (1.5%)+Monocrotophos (0.05%) was

found very effective against downy mildew disease, whereas, treatment 7 Bavistin (1.5%) + Monocrotophos (0.05%) was found the best against aphid attack on Isabgol at Sojat. The combination of Bavistin (1.5%) + Monocrotophos (0.05%) reduced pest incidence from 3.0% to 3.5% after the treatment.

Combination of Rattan (1.15%) and Monocrotophos (0.05%) reduced disease incidence from 43 to 13% after the treatment.

- The lifecycle of *Achaea janata,* defoliator of Mehndi crop has been completed.
- In Mehndi crop, incidence of one species of semilooper, one species of whitefly, mite and blister beetles were recorded. Termite damage caused maximum injury to the plants. A few other symptoms like yellowing and shedding of leaves were also recorded but were due to early sprouting of lower leaves which can be explained as physiological disorder.
- An Aphid species (*Aphis gossypii*) *i*s the major insect pests attacking Isabgol.

A field experiment was laid out on Mehndi for the managment of economic important pest (semilooper larvae) and charcoal root rot/leaf spot/blight disease. The experiment was laid out in randomized block design and four treatments by using biopesticides viz., T-1: Soil treatment (Trichoderma + Vermicompost + Phorate) foliar spray Pratirodh; T-2: Neem ban+ Bavistin + Wonderlife; T-3: Terminator + Wonderlife; T-4: Control (untreated). The replication were three with the block size of 5mx5m soil treatment (Trichoderma + Vermicompost + Phorate) was found the best amongst other three treatments, wherein, Mehndi yield was increased from 1.5 to 2.1 kg per sq metre in treated plots.

Project 12: Mycorrhizal dependency and productivity of economically important medicinal plants (Mehndi & Ashwagandha) of arid zones [AFRI-84/FP/2007-10]

Status:

- AMF genera like Glomus, Scutellospora, Sclerocystis and Acaulospora and Seven species of Glomus viz., *G. fasciculatum, G. aggregatum, G. mosseae, G. macrocarpum, G. intraradices, G. reticulatum* and *G. constrictum* were isolated and identified.
- The distribution of different VAM species viz., *Glomus aggregatum* (35%); *G. mosseae* (15%); *Glomus fasciculatum* (20%); *G. macrocarpum* (10%); *Glomus* sp. (15%); Scutellospora (3%) and Acaulospora (2%) were recorded.
- The AM spore population of Rhizosphere soil collected from Ashwagandha plants under the *Albizia lebbeck* and Khejri trees from Nagour and Jharali The spore population was recorded 320 spores per 100 gm of soil from Nagour and 270 spores per 100 gm of soil from Jharali.
- Both the species Mehndi and Ashwagandha were found highly mycorrhizal in nature. The root infection was found in the form of intercellular, intracellular hyphae, vesicles and arbuscular structures in the roots.
- A field experiment on Mehndi & Ashwagandha was laid down in Randomised Block Design (RBD) with six treatments including control. The treatments were, T-1= *G. intraradices*, T-2 = *G. reticulata*, T-3 = *G. fasciculatum*, T-4 = *G. mosseae*, T-5 = *G. constrictum*, T-6= Control (untreated). About 90 percent survival percentage was recorded in Mehndi, whereas, in Ashwagandha it was only 35%. Initial observations have been taken.

Project 13: Development of web portal for forestry research extension [AFRI-82/ITCELL/ 2007-11]

All the required softwares namely MS-Visual Studio 2008 and MS-SQL Server 2008 have been procured during this year. The first activity of the purchase of the software has been completed.

Out of the three scheduled trainings, two trainings on "Web Designing" and "Programming in C Language" has been completed and the third and final training is undergoing and likely to be completed soon.

The selection of the fields for the database has been finalized and the structure of the underlying database has been finalized. The Database could not be created physically as the MS-SQL Server 2008 software has been supplied during March 2009.

The collection of data for 50 important tree species has been started according to the fields finalized and fed into the excel sheet for further entry into the database.

EXTENSION ACTIVITIES

Establishment of Van Vigyan Kendra

MOU was signed between by AFRI and RFD on 18th March 2009 at VVK, Bichhwal, Bikaner, Rajasthan. Training programme was organized for farmers and field functionaries under VVK from 16-18 March 2009 at Bikaner. Extension/display material like photographs, display boards, printed material in Hindi & English were displayed at VVK Bikaner. A progeny trial of *T. undulata* (2.3 hec, 1440 nos of seedlings) has been planted at the site for demonstration.

MOU was signed by AFRI and GFD on 26th February 2009 at VVK, Chhipardi Beedi, Rajkot, Gujarat. Traning was organized for farmers and field functionaries under VVK from 26th to 28th February 2009 at Rajkot. Extension/display material like photographs, display boards, printed material in Gujarati and English were displayed at VVK Rajkot.

SFD, Dadra & Nagar Havelli FD has provided the VVK site at Rudana Nursery, Khanwel. The site had been visited by the DCF/ Director & staff. Director AFRI recently has discussed MOU with FD of Dadra & Nagar Havelli.

Development of Agro-hort-silvi demonstration Models in Demo village, Bilara

Two Demo village plantation sites on farmer's field namely Mrs. Sita Chaudhary, Bijwadia and Mr. Rajendra Singh Chaudhary, Harsh were maintained. Mortality replaced. Growth data recorded six monthly. Crop production estimated on both the sites. *Cordia mixa* attained maximum height (102 cm) followed by *Zizyphus mauritina* and *Prosopis cineraria*. Survival of *Prosopis cineraria* is the highest (68% and 71%, respectively, Mr. Rajendra Singh Chaudhary and Mrs. Sita Chaudhary).

EXTERNALLY AIDED PROJECTS

Project 1: Establishment of multilocational clonal trial and seedling seed orchard of *Jatropha curcas* [AFRI/JU/Silvi/2006-07/RPC 25th-26th February 2007/DBT/2007-10]

Status: Two multilocational clonal field trials have been established at Haldughati, Udaipur. The first trial was established in the month of November 2007 with 12 accessions and the second

clonal trial was established with 8 accessions in the month of September 2008 in RBD with four replications.

The initial growth parameters were recorded for both the trials. Percent survival varied from 87% in TERI/DBT-Jat/06/16 to 100 percent in PDKV-DBT-12 in clonal trial-I. Mean above ground plant height varied from 37.75cm in TERI/DBT-Jat/06/10 to 51.78cm in SDHQ4N1. Similarly, Mean number of branches and collar diameter varied in different accessions.

In clonal trial-II, percent survival varied from 55.50 to 97.20, plant height from 16.37cm to 35.46cm, mean number of branches from 1.0-1.12 and collar diameter from 0.98 to 1.24cm.

For raising seedling seed orchard of *Jatropha curcas*, seeds from 116 CPTs selected earlier by various micro-mission linked partner Institutes have been received and their percent oil content on seed basis as tested by TERI, New Delhi. Percent oil varied from 33.07 to 42.08 in all collected accessions.

Randomized Block Design (RBD) with 5 replications at Arid Forest Research Institute, Jodhpur and 15 replications at Haldughati, Udaipur was used for plantation. Trial was established in July 2008 from 116 CPTs having single plant per replication at a distance of 3x3m.

Whereas maximum mean height of 60.0cm in J-83 of Hisar was observed initially, mean number of branches was maximum in J-80 and maximum collar diameter of 2.20cm was of TERI/DBT-JATROPHA/05/06 planted at AFRI, Jodhpur. However, J-127 showed initial maximum plant growth of 57.67cm and collar diameter of 2.07cm. Mean number of branches was highest (1.27) in TERI/DBT/JATROPHA/01/12 at Udaipur.

Project 2: Genetic improvement of *Jatropha curcas* for adaptability and oil yield [AFRI/JU/Silvi/No.5/258/39/2004/CSIR, New Delhi/2005-10]

Status: Performance Trial of Jatropha Accessions: A total of 185 accessions (24 elite and 161 native) were collected/exchanged with participating Institutes and planted in September 2005 and 2006 showed variation in plant mean height, mean collar diameter and mean number of branches.The maximum mean height (177.0cm) was of CRIDA-JJ-06, mean number of branches (4.44) of CSMCRI-GUJ-Banas-1205-C1.

A total of 161 native accessions (now accessions) have been exchanged. All accessions have been planted in August 2006 in RBD design with three replications having single plant per replication at 2.5 x 2.5m spacing. Causalities were replaced in July 2007. At present, 161 accessions were surviving. Percent survival varied from 66 to 100.

Spacing Trial: Spacing trial was initiated from the seedlings raised from seeds received from Bhav Nagar. Plants were planted in RBD design with 16 plants per treatment and in five replications in July 2007. Except height, none of the parameters were affected by spacing.

Irrigation and Fertilizer Trial: The experiment was laid out in split plot design with four replications at four levels of irrigation treatments and five levels of fertilizer treatments. Plants were spaced at a square spacing of 2.5 x 2.5 m.

Observations have been recorded on above ground height, number of branches and collar diameter after 18 months of planting. The irrigation treatments were imposed in February 2008. Initially, application of fertilizer has no significant effect on plant growth. Number of branches and collar diameter was also unaffected by the treatments at present. However, Irrigation at 15 days interval has significantly affected height and collar diameter of the plants.

Pollarding trial: Trial was established in July 2007 in RBD design with five replications and four treatments (T_0: No Pruning; T_1: Pruning Height 30cm; T_2: Pruning Height 45cm and T_3: Pruning Height 60cm. The number of plants per treatment was 10.

The treatments were imposed in February 2008. The initial survival is 100 percent and average height in T_0 was 167.1±28.68cm, mean number of branches 7.82±1.62 and collar diameter 5.862±0.95. Analysis of variance suggested that there is insignificant effect of pruning on average plant height. However, T_0 and T_2 varied significantly for mean number of branches only. Collar diameter was unaffected by the treatments.

Project 3: Source variation, extraction and cultivation practices for *Commiphora wightii* Arn. Bhandari [AFRI-76/Silvi/NMPB/2006-09]

Status: Trial was maintained in Kumatia enclosure, Kailana Forest Area, Jodhpur. Percent moisture in thinner branches was ranging from 36.6-39.4% in various treatments in the month of April 2008. Growth data (Height, crown diameter) was recorded in September 2008. Height increment was maximum (4 - 32 cm) in trees treated with FYM and I_1 (irrigation after 20 days) and minimum in trees with no FYM and no irrigation (2-15 cm). Crown diameter was maximum in FI_1 (207-287cm) while all other treatments were in similar range F_0I_0 (207-226 cm), FI_0 (172-226 cm) and FI_2 (183-210 cm).

Visit of DG, ICFRE

All the trees, where tapping was undertaken in February 2008 were healthy up to August 2008, even those branches did not dry where cuts were given. Gum exudation completed till 15th April 2008. Casualties started in September end and total nine trees out of total 48 trees died till December 2008, after ten months of gum extraction. Protection measures were applied in January 2009 and no further casualty observed after that. Casualties were maximum (77.78%) in C_3 (450 mg ethephone) followed by in C_2 (22.22%) treatment with or without irrigation. There was no casualty in C_1 dose (150 mg of ethephone) and control.

Leafing occurs in 70-80 % plants in April –May due to rain but plants were completely leafless in June 2008. Plants were lush green after rains in monsoon (July to September 2008). Association of *Asparagus racemosus* was with all the plants. Leaf started yellowing in late October and all the plants were completely leafless in November 2008. Flowering was noticed in January 2009 in all the plants with leaf initiation in some plants of I_1 treatment. Fruit setting was observed in February 2009.

Twigs (Pre & post ethephone treatment in 2007-08) were pulverized and soxhlet extracted with petroleum ether and ethyl acetate. The petroleum ether contents was 1.7 to 1.9 % in the pre ethephone treated plants. It was ranging from 2.12 to 2.78 % in various treatments in post ethephone treated trees.

Organic manure (2 kg/plant) was applied in September 2008 in experimental trees as per the treatment. Treatment wise irrigation schedule (at an interval of 20 & 30 days) was imposed from November 2008 to January 2009. Tapping experiments were initiated in third week of March 2009. Ethephone doses were modified (0, 100, 200 & 300 mg in place of 0, 150, 300 and 450 mg) and injected at two to three places in a tree and cuts were given simultaneously.

Gum was collected after six days; yield is low probably due to tapping in March end. So far, all the trees are healthy.

DG, ICFRE visited the experimental site in July 2008.

Project 4: Study of Characteristic Features Pertaining to Bio-drainage Potential of Some Selected Tree Species [AFRI-38/FED/MOWR/2004-09]

Status: This project is funded by the Ministry of Water Resources (MoWR), New Delhi. It was initiated in 2004 with two field experiments in Indira Gandhi Nahar Pariyojana (IGNP) and one in in-filled non-weighing type of lysimeters (2 x 2 x 2 m^3) at Jodhpur.

Among the tree species (*Eucalyptus camaldulensis*, *E. fastigata*, *E. rudis*, and *C. tessellaris*) tried in the field, performance of *E. rudis* has been found to be the best with respect to growth, biomass, transpiration rate and overall bio-drainage potential. Soil working at the site resulted in heavy regeneration of *Eucalyptus camaldulensis*. The regenerated plants were mostly concentrated between 6 and10 m from the tree trunk of the mother trees situated at the edge of the experimental site. Number of seedlings varied between 13 and 36 per m^2 area.

Ground water table has receded from 25 cm to 145 cm depth as recorded in the observation pit resulted by transpiration pull (bio-draining) of the growing vegetation. Apart from the planted ones, some species like *P. juliflora*, *Tamarix dioca*, *Saccharum munja* and *Arundo donax* also have come up in the area. The number of *A. donax* has reduced gradually with recession of ground water table in the experimental plot. With the lowering of ground water level, other species started growing in the area as natural succession. Population of *S. munja* was highest followed by *P. juliflora* and *Tamarix dioca*. Total biomass per tree in *P. juliflora* was recorded as 110 kg. Contribution of root to the total biomass was 25%. *S. munja* and *T. dioca* accumulated total biomass of 76.5 and 73.25 kg per tree.

In lysimeter experiment, water use by *E. camaldulensis*, *Acacia nilotica* and *Tamarix aphylla* and their growth has been affected by water logging and salinity treatments. Height and collar girth was highest in *E. camaldulensis* whereas, crown growth was highest in *A. nilotica*.

Tree growth has been highest in waterlogged treatments than the control where surface irrigation was done. Trees were taller water logging ranged between 1-1.25 m soil depth in comparison to 0.5-.75 cm. Water logging at shallow depth may have restricted root growth resulting in less growth.

Water use per day per tree was significantly affected by salinity level and depth of water logging. Water use of *E. camaldulensis* was 32 ltr. day^{-1} $tree^{-1}$ in the month of October and November, however, it was at par with *A. nolotica* (29 ltr. day^{-1} $tree^{-1}$) and *T. aphylla* (28 ltr. day^{-1} $tree^{-1}$).

Layout and plantation of different species in lysimeter experiment (left), mineral deficiency in *E. camaldulensis* leaf due to salinity and water-logging stresses

Project 5: Enhancing productivity of saline wastelands in Kachchh, through improved tree planting techniques (Patan) and silvipastoral study (Bhuj) [AFRI-77/NWFP/SFD/ 2006-09]

Status: The experimental area is located in Kordha, Sami Range in Patan (23.83° N latitude 72.12°E longitude) of Gujarat, India. After 20 months, *Acacia bivenosa* and *A. ampliceps* recorded 86.0 and 72.6 % as mean survival and there is almost negligible change in mean survival from August 2008 to March 2009. There is no effect of treatments on percent survival for *A. bivenosa*, however, in case of *A. ampliceps*, treatments influenced the survival and T_2 and T_3 treatments recorded significantly higher survival compared to other treatments. Survival of *Atriplex* spp. was poor as they were planted on very shallow and waterlogged soil. Maximum survival was for *A. amnicola* (39.5 %) followed by *A. lentiformis* (18%) in March 2009.

At 18 months of age mean height of *A. ampliceps* is 161.3 cm (55.5% more) and crown diameter 169.5 cm (38.9% more). While, in case of *A. bivenosa*, the mean height is 97.9 (60.7% more) and crown diameter 182.2 (65.3% more). T_2 (FYM) and T_3 (Wheat husk) treatments recorded significant higher growth compared to other treatments for both the plant species. Overall *S. persica* recorded maximum mean percent survival (92.8) at 18 months. Plants record appreciably high growth between 12-18 months. Mean increment in height and crown diameter was (40.4%) & (38.6%) respectively ranging from 26.2-49.5% and 26.2 – 51.5%. So far T_5 was the best treatment attaining maximum height 112.6 cm and crown diameter (154.1 cm).

Soil Properties: There was no significant change in pH values recorded between winter and summer months. However, summer EC values are significantly higher compared to winter values in all the treatments in 0-25 and 25-50 cm soil layer in plant pit for both *A. bivenosa* and *A. ampliceps.* EC values of interrow spaces were generally higher compared to plant pit in summer season.

Weed Biomass: Green weedmass was dominated by halophytes and other salt tolerant species. *Chloris virgata* was the most dominant species followed by *Sueada fruticosa*. Overall 431 gm^2 yield was recorded, however, species wise variation was observed and it was 693.0 gm^2 (*A. bivenosa*), 375.5 gm^2 (*S. persica*) and 224.1 gm^2 (*A. ampliceps*).

Sub project B: Trials with four tree species namely *Cordia gharaf, Prosopis cineraria, Ziziphus. mauritiana* and *Colophospermum mopane* and three grass species, namely, *Cenchus ciliaris, C. cetigerus* and *Dicanthium annulatum* were laid in RBD in three replication at Mochirai, Bhuj in July 2006. Experiment one with *D. annulatum* grass is abandoned due to destruction of one and half replication due to passing of Narmada pipeline in June 2008.

Survival: Plant species maintained more than 90% survival in both the experiments. Overall periodic percent survival recorded after 30 months of age was in similar range, *Cenchrus setigerus* 95.6%, and *Cenchrus ciliaris* 95.4% (almost no change between 24-30 months growth period). However, survival with grass was higher in case of *C. ciliaris* (98.1%) compared to *C. setigerus* (92.0%). Species wise maximum survival was with *Prosopis cineraria* 94.9%, *Cordia gharaf* 99.5%, and *Zizyphus mauritiana* 93.5%.

Height & Crown Diameter: At the age of 26 months, tree species recorded 15.2 to 17.5 % and 12.2 to 28.7% mean height increment under control and with grass treatment for *C. ciliaris* and *C. setigerus*, respectively compared to height at 14 months. Mean height and crown diameter of control trees was significantly more (p-0.45) than trees grown with grass in case of *C. setigerus*. However, difference was insignificant for *C. ciliaris*. Within species, height

difference was highly significant (p-0.00), due to less height growth of *P. cineraria* compared to *Z. mauritiana* and *C. gharaf* which almost attained similar height with *C. setigerus* and *C. ciliaris*. Incremental growth for crown diameter was 7.7 to 5.7 and 11.9 to 25.7 % respectively for various tree species with *C. ciliaris* and *C. setigerus*, respectively, between the growth periods (14-26 months). Low rainfall (287 mm) is the reason for less growth. Effect of grass growth significantly influenced the overall crown diameter only with *C. setigerus* (p-0.00) at 14 and 26 months where it was 39 & 37.4 % more in control.

Grass yield: The year 2008 received very scarce rain and yield was one third of the year 2007. It was 0.66 & 0.17 kg ha^{-1} and 0.47 & 0.16 ka ha^{-1} as green and dry grass yield for *C. ciliaris* and *C. setigerus*. The reduction in mean green grass yield was 2.9 fold for *C. cilaris* and 3.2 fold for *C. setigerus.* Conclusions so far are *C. ciliaris* is the best grass species very closely followed by *C. setigerus*. Establishment of *D. annulatum* was poor. *Cordia gharaf* maintained nearly 100 % survival and appreciable growth followed by *Z. mauritiana* with all the grass species.

Project 6: Multiplication and field trial of bamboos through tissue culture in Rajasthan & Gujarat [AFRI-68/FGTB/DBT/2005-09]

Status: Experiment conducted with four fertilizer treatments namely, T1 – No Fertilizer, T2 – FYM (10kg), T3 – NPK (50g N + 50g P + 25g K) and T4 – FYM + NPK (5kg FYM + 50g N + 50g P + 25g K). Effect of fertilizer treatment on height is clearly visible irrespective of the site. At Kushalgarh, Banswara *D. strictus* average height in control was 3.36 m. and it was more than 4.1 m in all other three fertilizer treatments. Similar trends were recorded at Chakhalia, but here average height was more in all the treatments as compared to Kushalgarh. In case of *B. bambos*, average height was 1.59 m in control and in treatments average height was more than 2.0 m at Kushalgarh. In this species also trend in fertilizer experiment was same but the performance was better at Chakhalia. Data were also analyzed with number of culm per clump and clump girth.

Project 7: New Biocontrol opportunities for prickly Acacia: exploration in India [AFRI/FPD/2008-11]

Status:

- Contract agreement has been signed and sent to AFRS, Australia.
- Selection of 4 experimental locations i.e., Jodhpur Pali (Selibandh Forest Nursery), Bharatpur (Keoladeo National Park) and Hanumangarh (Kohla Forest Nursery) in Rajasthan and Gandhinagar, Junagarh and Bhuj in Gujarat.
- Extensive field survey were made covering Rajasthan State and samples of entomo-herbivores and disease infected plant parts were collected.
- A severe primary attack of *Ganoderma lucidum* was noticed in 2005. *A. nilotica* plantation at Sadri (Desuri) in Pali Forest Division followed by a secondary infestation of a termite species *Odontotermes* sp.
- Heart rot of *Acacia nilotica* tree caused by *Fomes* sp. collected from Keoladeo National Park, Bharatpur.
- Charcoal root rot was recorded in young plantation of *A. nilotica* collected from Desuri (Pali).

- Twenty to Twenty five percent seedlings (12 weeks old) were found attacked by two species of Myllocerus (Curculionidae : Coleoptera) at Sadri - Desuri (Pali) during the month of August 2008.
- Active larvae of one species of bagworm, *Pteroma* sp. nr. *plagiophleps* (Psychidae: Lepidoptera) was noticed on 30 to 40% trees at Sadri Range, having *Acacia nilotica* plantation in an area of 25 ha.
- Plant height was maximum when the seedlings were kept under canopy whether treated or untreated while numbers of shoots were maximum when the seedlings were exposed to sun. Similarly, maximum number of leaves were recorded in the seedlings which were exposed to sun.
- In nursery, Fusariam root rot, leaf blight, leaf spots were recorded on Acacia seedlings. Among insects whitefly, myllocerus, lac insects were recorded.
- Among pathogens powdery mildew fungus and rust was found to be very promising and host specific for acacia seedlings.
- The infestation of gall insect belonging to the family Lepidoptera was recorded for the first time in Desa Forest Range. The samples have been sent to Australia for identification.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges [AFRI-39/EED/2005-09]

Status: Experiment was started in July 2005 with the financial assistance from Rajasthan Forest Department. A total 75 plots of about 700 m^2 area were laid in 0-10, 10-20% and >20% with control, contour trench, gradonie, Box trench and V-ditch rainwater harvesting treatments.

Growth data recorded in July and December 2008 indicated plants were taller and thicker in <10% slope area and decreased with increase in slope. But *Holoptelia integrifolia* indicated highest, whereas, *Dendrocalamus strictus* and *Acacia catechu* showed lowest growth in 10-20% slope area. Growth of *Dendrocalamus strictus*, *Azadirachta indica* and *Zyziphus mauritiana* was best in V-ditch area. *Embilca officinalis* and *Holoptelia integrifolia* performed best in contour trench areas, whereas, *G. arborea* and *Acacia catechu* performed better in Box trench areas.

Growth data of July 2008 indicated that seed sown seedling of *Acacia catechu* outperformed the planted seedlings of *E. officinalis*, *Syzigium comini* and *Zyziphus mauritiana*. In some of the cases, the difference is about 2 fold.

Soil water content increased downward but Soil Organic Carbon (SOC), NH_4-N and NO_3-N were highest at mid position in a plot. Soil water content and soil organic carbon were highest in <10%, whereas, NO_3-N and NH_4-N concentrations were highest in >20% slopes. In RWH treated area, SOC and PO_4-P were highest in CT plots; SWC and NO_3-N were highest in G plots, whereas NH_4-N concentration was highest in VD plots. Lowest availability of soil nutrients indicated greater diversity.

Species diversity, richness and herbage yield increased downward, but species evenness was highest at mid position in a plot. Among slope species, diversity and species richness were highest in <10%, dry matter yield was highest in 10-20% and species dominance and vegetation height were highest in >20% slopes. In RWH treated area, species diversity and herbage yield

were highest in CT plots; whereas, evenness, richness and vegetation height were highest in VD plots. Lowest availability of soil nutrients indicated greater diversity.

There were 80 numbers of herbs and grass species recorded in October 2008. Number of species increased downward from >20% slope (5.33 m^{-2}) to <10% slope (6.25 m^{-2}). In microsites, number of herbage species was highest down slope and lowest at midslope position. Dry matter production increased downward being highest at down slope position (567.8g m^{-2}).

Dry matter production was 478.5g m^{-2} in 10-20% to 439.2g m^{-2} in <10% slope. Among the treatment, dry matter production was 523.6 g m^{-2} in contour trench plots as compared to 413.5 gm^{-2} in control plots. It was significantly greater (458.8g m^{-2}) in treated area than untreated (244.9 gm^{-2}) area of the site.

Project 2: Studies on carbon sequestration in different forest types of Rajasthan [AFRI-88/EED/2008-11]

Status: Project was started after approval from the RPC in April 2008. The objectives of the project were (i) to estimate carbon stock in forest soils, (ii) to estimate carbon stock in forest litters and (iii) to estimate carbon stock in aboveground and below ground biomass; with broader objective to provide an estimate of carbon stock of forests in Rajasthan for its utilization in planning and execution of afforestation/ reforestation programme in this region.

Dry Teak Forest at Jhaunda, Pratapgarh

Butea Forest in Dhariyavad, Pratapgarh

Boswellia Forest, Arampura, Pratapgarh

Madhuca Forest, Siyakhedi, Pratapgarh

Dry Bamboo Brake, Umarkot, Pratapgarh

Aegle Forest, Samlipathar, Chittorgarh

In the Inproject vegetation in different forest blocks of Banswara, Chittorgarh, Dungarpur, and Pratapgarh Forest Division were surveyed for estimation of carbon stock in vegetation, forest litter and soil samples up to 90 cm soil depth. Tree and shrubs growth measured and herbage biomass recorded. Litter, plant and soil samples collected from 80 sites. A Carbon

Nitrogen and Sulphur (CNS) analyzer and associated chemical purchased for carbon estimation. *Phoenix savannah* and *Madhuca indica* based forests have been identified as the additional types of forest reported in Rajasthan.

Studies at five different forest blocks of Pratapgarh with *Dendrocalamus strictus* as one species showed a total number of 35 trees/shrub species. In this population of trees/shrubs varied from 770 at Arampura to 3280 plants per ha at Jhaunda. Numbers of species were highest in Arampura, whereas, it was lowest in Janagarh forest blocks. Most common species in these sites were *Tectona grandis* and *Dyospyros melanoxylan*. In these blocks, *T. grandis* showed highest abundance, frequency and density. Observations on growth and productivity of *D. strictus* showed highest productivity with greater availability of soil resources and species diversity.

Studies in Euphorbia scrubs type of forest of Jodhpur indicated highest number of vegetation diversity i.e. 13 in north-east aspect, whereas, it was 12 in south-west aspect. Total population of trees and shrubs were 323 and 101 number in 2 ha area in respective aspect.

Phoenix savanna, Karaundia, Chittorgarh

Anogeisus pendula Forest, Chittorgarh

Technology Developed

Technology developed for reclamation/rehabilitation of waterlogged soil in canal command area of IGNP using principle of biodrainage. The technology is raised bund with sand mulching and plantation with species of high transpiration potential. Intervention like protection of the area, soil working and planting of tree species enhanced natural regeneration of tree, shrub and bushes also that transformed a water logged (stagnant water of 20 cm to 1 m) area into productive land. Water logging has receded up to 1.25 cm soil depth within a period of four years.

Project 3: Effect of fertilizer application on growth and yield of ten years old *Salvadora persica* and *Acacia ampliceps* plantation on arid salt affected soil [AFRI-89/NWFPD/2008-11]

Status: Initial growth data and seed yield recorded for *A. ampliceps*. Unfavorable weather conditions (high temp., strong winds and untimely rain) almost destroyed the fruit/seed seed yield in *S. persica*. For *S. persica,* the treatmentwise initial mean height and crown diameter was ranging from 163-194 cm and 173- 203 cm respectively. For *A. ampliceps,* these values were 172-238 cm and 137-223 cm. Rooted slips of Karnal grass were obtained from RRS, (CSSRI, Karnal) Lucknow and Grass slips of Karnal grass and *Sporobolus diander* planted in field with *A. ampliceps*.

Initial soil pH, EC and percent SOC was determined. Percent SOC data ranged from 0.10-0.15, 0.09-0.12 and 0.02-0.12% in 0-25 cm, 25-50 and 50-75 cm soil layer inside the plant pit. While it was 0.18-0.34, 0.14-0.20 and 0.18-0.25% in inter row spaces in *S. persica.* Percent SOC ranged from 0.25-0.42, 0.34-0.46 and 0.24-0.33 in 0-25 cm, 25-50 and 50-75 cm soil layer inside the plant pit and it was 0.24-0.36, 0.29-0.30 and 0.19-0.30 percent in inter row spaces

in *A. ampliceps*. Soil samples for *A. ampliceps* and *S. persica* plants were analysed for micronutrient status.

Treatmentwise phenological observations were recorded fortnightly from January 2009. Fruit setting has been initiated in all the treatments in S. *persica*, maximum mean fruit yield/tree (132 g) was obtained in T_7 closely followed by T_8 (urea + K_2SO_4) treatment. In case of *A. ampliceps* trees were healthy, new leaves initiation was observed, however, flowering has been aborted in most plants in the month of March 2009.

LINKAGED AND COLLABORATION

The linkage and collaboration was established with the following organizations at national level

Tata Energy Research Institute, New Delhi, Central Arid Zone Research Institute, Jodhpur, Jai Narayan Vyas University, Jodhpur, Council of Scientific and Industrial Research, New Delhi, National Medicinal Plants Board, New Delhi, Department of Biotechnology, Govt. of India, New Delhi, National Mission on Bamboo Application, New Delhi, Ministry of Water Resources, New Delhi, Rajasthan Forest Department, Gujarat Forest Department.

PUBLICATIONS

Scientific Reports Prepared and Submitted:

1. Annual report of the project New Biocontrol opportunities for prickly acacia: exploration in India [AFRI/FPD/2008-11] prepared and submitted to AFRS, Australia.
2. Evaluation report of Management of potential insect pests and diseases of important medicinal plants grown in arid and semiarid regions submitted to Dr. Allah Noor.
3. Evaluation report of Combating Desertification Project (2002-03 to 2006-07) Phase VII Jhunjhunu Division, Rajasthan has been prepared.

CONFERENCES/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

Attended

The representatives from Arid Forest Research Institute, Jodhpur (Rajasthan) attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

1. National Seminar on Bamboo, Jodhpur from 17th to 19th March 2009.
2. National Symposium on Agroforestry Knowledge for Sustanability, Climate moderation and challenges ahead at NRC, Jhansi from 15th to 17th December 2008.
3. The Forage symposium 2009- "Emerging Trends in Forage Research and Livestock Product" held at CAZRI, RSS, Jaisalmer on 16th and 17th February 2009.
4. International Seminar on "Role of Plant Taxonomy in Biodiversity Management and human Welfare" organized at Forest Research Institute, Dehradun from 1st to 3rd December 2008.

DG, ICFRE at Tibna, Jodhpur

DISTINGUISHED VISITOR

Director General ICFRE, Dehradun, Shri Jagdish Kishwan visited AFRI from 2nd to 5th July 2008. He visited the

experimental areas of AFRI at 1357 RD in IGNP area, Mohangarh (Jaisalmer), Kumathia enclosure at Kailana and Tibna, Jodhpur district.

INITIATIVES FOR VAN VIGYAN KENDRA

Activities conducted so far

(A) Bikaner (Rajasthan): Area of 25 ha (having old plantation one side fenced with barbed wire) on National Highway-89 has been selected. One FRH, model nursery and one old building for the extension activities are available at the site. Recently, a progeny trial of Rohida (*Tecomela undulata*) over the area 3 ha (spacing 4x4, total plants 1440) has been laid out. Steps have been taken to finalize MoU which will be signed by AFRI and RFD. The farmers training and other activities will be taken up during November-December 2008. The DFO Bikaner has been made the Nodal Officer, RFD for VVK.

(B) Rajkot (Gujarat): Forest Department, Gujarat has agreed for proposed VVK at Rajkot. The MoU will be finalised soon. And thereafter, other activities will be taken up.

(C) Khanwel (Dadra & Nagar Havelli): The Forest Department of Dadara, Nagar Havelli , Daman & Diu have agreed to spare land at Khanvel (Rudana) Nursery for proposed VVK site. Soon MoU and other formalities will be taken up in this regard.

Initiatives for Demo Village

- The Demo village has been established at Harsh (Bilara) in Jodhpur District. Agroforestry trial has been laid down on the farmer's field.
- One week compulsary IFS training was organized in the Institute on "Integrated approach for sustainable development of fragile desert ecosystem" from 9th to 13th February 2009. Twenty seven participants attended the course.
- A one day Regional Workshop on 'Management of Salt Affected Soils through Afforestation' was organized at Van Chetna Kendra, Hariz, Patan, Gujarat on 25th February 2009 to present the outcome & findings of the project on afforestation and planting techniques for arid salt affected soils executed by the AFRI since 1997 in Gangani, Jodhpur which is going to be concluded in March 2009. The workshop was presided by Dr. R.L. Srivastava, Director AFRI, Dr. M.L. Sharma, PCCF, Gujarat was the Chief Guest and Sh. R.N. Tripathi was guest of honour. Sh. R.L. Meena, CF, Kutch welcome the delegates and Dr. Ranjana Arya, Organizing Secretary presented the vote of thanks.
- National Seminar on "Bamboo–Plantation, Management and Its Utilization" was conducted by Arid Forest Research Institute, Jodhpur during 17th to 19th March 2009.

HIMALAYAN FOREST RESEARCH INSTITUTE SHIMLA

Himalayan Forest Research Institute (HFRI), Shimla, Himachal Pradesh was, earlier, established as High Level Conifer Regeneration Research Centre in May 1977 for carrying out research on the problems associated with natural regeneration of Silver fir and Spruce. The Centre developed the technologies for these problems and, then, transferred the same to the State Forest Departments. During reorganization of forestry research at the level of Government of India and coming up of Indian Council of Forestry Research & Education (ICFRE), Dehradun in 1987, the mandate of this Centre was enlarged from Regeneration of Silver fir and Spruce to Eco-Rehabilitation of Cold Deserts, Mined Areas Rehabilitation, Insect-Pests and Disease Management, besides studies on Agroforestry practices in hills and Regeneration of Coniferous and Broadleaved Forests. This Centre was redesignated as Himalayan Forest Research Institute, Shimla in 1998.

An abstract of projects run by the Institute is as follows:

	No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
Plan Projects	3	10	6
Externally Aided Projects	4	3	3
Total	**7**	**13**	**9**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Studies on plant diversity in cold deserts of district Kinnaur, Himachal Pradesh [HFRI-029/02(EBC-11)/PLAN/2004-2009]

Findings: Carried out phytosociological studies at an altitude varying from 2700m to 5000m above msl in Labrang, Pooh, Ropa-Giavung, Lippa-Asrang, Namgia and Hango areas. Labrang area showed that the total number of plant species was 191 belonging to 47 families and 127 genera. In Lippa–Asrang area, total number of plant species was 191 belonging to 49 families and 134 genera. Pooh area revealed that the total number of plant species was 192 belonging to 55 families and 136 genera. In Ropa-Giavung area, total number of plant species was 160 belonging to 51 families and 119 genera. Namgia area revealed that the total number of plant species was 142 belonging to 49 families and 105 genera. In Hango area, total number of plant

Nako Lake

species was 130 belonging to 41 families and 101 genera. The dominant families were Asteraceae, Rosaceae, Ranunculaceae, Lamiaceae and Polygonaceae. The distribution pattern of most of the plant species was contiguous in all the areas. The Index of similarity for shrub and herb species between different altitudes was low indicates remarkable degree of dissimilarity in plant species between different altitudes.

Waldheimia glabra

Corydalis crassissima

Arnebia guttata

Out of 114 medicinal plant species as recorded from the areas, 24 species fall in the category of threatened plants. The ethnobotanical study carried out in Labrang, Dubling, Nako, Maling, Leo, Namgia and Hango villages of Pooh sub-division and documented 40 plant species used for different purposes.

Project 2: Diagnostic studies of indigenous and institutionalized Participatory Forest Management in Himachal Pradesh to assess the most suited approach and its impact on forest conservation [HFRI-025/08(PFM-1)/Plan/2005-08]

Findings: The most preferred species of timber, fuel and fodder were documented by local people in different PFM areas of Himachal Pradesh. The role of women in PFM was studied. It was found that as per the guidelines of VFDC formation under PFM, women were given due representation in the state of Himachal Pradesh. However, practically in the execution of work, their role was not up to satisfactory level except in few VFDs, such as, Dhalwan in Mandi Circle and Kohbag in Shimla Circle, etc. The Participatory Forest Management may not have achieved its objectives completely but it has brought positive change in mind frame and thinking of local people and field staff towards the forest conservation.

Women participation in plantation activities

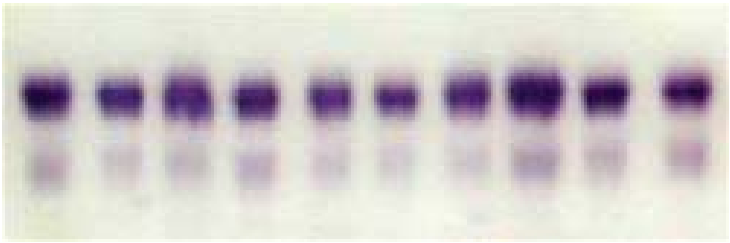
Water harvesting structure constructed

It was observed that the PFM scheme has brought positive change in attitude of people throughout the state barring few places. The PFM scheme was viewed as income generation source on daily wages basis by common people for short duration. Barring the few

shortcomings, PFM scheme has helped in creation of awareness among common people regarding the importance of forest and its conservation.

Project 3: Allozyme variation in natural populations of Deodar (*Cedrus deodara*) [HFRI-030/05(SFG-10)/PLAN-03/2005-08]

Findings: Isozyme analysis has provided new information about the relative amounts of genetic variation present within and among fifteen populations of *Cedrus deodara.* Within population genetic variation was found to be higher as compared to total variation among populations. The population from Cheog forests showed higher genetic distances more than 0.03 with all other remaining populations. The tendency of grouping was witnessed between the populations based on population parameters. Taking allelic diversity and differentiation into consideration population Cheog and Nankhari remains separated from the rest of the populations. Population Chopal, Manali, Chowai, Jhungi, Dhgamoon, Chamba, Shillaru and Mashobra makes one group and the populations Sarain, Chail, Kupwara, Bhadrawah and Kalpa can be combined into one group. The same tendency is observed for genotypic differentiation. The genetic distance values further supports this grouping as population Cheog shows relatively higher genetic distance with the remaining populations followed by population Nankhari, whereas, the other populations show less genetic distance within the group. The tendency of grouping among different populations, despite altitudinal differences, suggests common descent of the populations.



A1	A11	A1	A11	A1	A11	A1	A11	A11	A11
B2	B11	B1	B22	B1	B11	B1	B1	B11	B11

EXTERNALLY AIDED PROJECTS

Project 1: Ecological assessment of forest areas falling under Kol Dam Hydroelectric Project in Bilaspur District of Himachal Pradesh [FT48-88/86(FCA) CATP Kol Dam–HPSFD Funded Project) [FT48-88/86(FCA) CATP Kol Dam–HPSFD/2005-09]

Findings: Carried out phytosociological studies in different catchment areas falling in the Forest Divisions of Bilaspur, Suket, Kunihar, Shimla, Theog and Karsog. Study in Bayali catchment of Suket forest division showed that the total number of plant species was 140 belonging to 66 families and 127 genera. In Hadaboi catchment of Suket forest division total number of plant species was 192 belonging to 72 families and 164 genera. While studying the composition of vegetation in Jattu catchment of Suket forest division, the total number of plant species was 43 belonging to 24 families and 36 genera. In Kasol catchment of Bilaspur forest division total number of plant species was 133 belonging to 60 families and 113 genera. Kandhar catchment of Kunihar forest division revealed that the total number of plant species was 166 belonging to 56 families and 135 genera. In Tattapani catchment of Karsog forest division total number of plant species was 167 belonging to 66 families and 150 genera. Studied the composition of vegetation in Kotlu catchment of Karsog forest division and found that total number of plant species was 219 belonging to 83 families and 188 genera. In Sunni catchment

of Shimla forest division total number of plant species was 227 belonging to 77 families and 194 genera. Matiana catchment of Theog forest division revealed that total number of plant species was 155 belonging to 70 families and 140 genera. The dominant families were Asteraceae, Fabaceae, Lamiaceae, Euphorbiaceae, Rubiaceae and Rosaceae. The distribution pattern of most of the plant species was contiguous in all the catchments. Out of 128 medicinal plant species recorded from the various catchments, 6 species i.e. *Dioscorea deltoidea, Taxus wallichiana, Zanthoxylum armatum, Gloriosa superba, Roylea cinearea* and *Valeriana jatamansi* fall in the category of threatened plants.

Gloriosa superba

Cassia fistula

Punica granatum

Adhatoda zeylanica

Project 2: Study on plant diversity in Rakchham, Chitkul Wildlife Sanctuary of district Kinnaur, Himachal Pradesh [GBPI/IERP/04-05/15/862-GBPI-Funded Project/2006-09]

Findings: Phytosociological studies were carried out at various altitudes in Doje forest, Kanasa area and Shone Khad area of Rakchham beat; Hitch Pawang, Murti Panag, Rani kanda to Jarra and Tumer area of Chitkul beat; Rasrang, Hurba and Shingan area of Batseri beat of the sanctuary. In Doje Forest, number of trees, shrubs and herb species were 15, 31 & 117 with dominance of *Betula utilis, Hippophae salicifolia* and *Polygonatum verticillatum* respectively. In Kanasa Nala, number of trees, shrubs and herbs species

Betula utilis Forest

were 9, 23 & 122 with dominance of *Acer acuminatum, Rhododendron campanulatum* and *Polygonum polystachya* respectively. In Shone Khad, number of trees, shrubs and herbs species were 11, 23 & 115 with dominance of *Hippophae salicifolia, Juniperus indica* and *Rumex nepalensis* respectively. In Hitch Pawang, number of trees, shrubs and herbs species were 3, 29 & 103 with dominance of *Pinus wallichiana, Lonicera parvifolia* and *Polygonum polystachya* respectively. In Murti Panag, total number of tree, shrub and herb species were 7, 18 & 97 with the dominance of *Betula utilis, Berberis jaeschkeana* and *Potentilla atrosanguinea* respectively.

Rhododendron lepidotum

Hippophae tibetana

In Rani Kanda to Tumer Nala, the number of trees, shrubs and herbs species were 1, 11 & 74 with dominance of *Betula utilis, Rhododendron anthopogon* and *Polygonum polyatachya* respectively. In Rani Kanda to Jarrya top, the number of trees, shrubs and herbs species were 1, 8 & 98 with dominance of *Betula utilis, Juniperus indica* and *Thymus linearis* respectively. In Rasrang area, the number of trees, shrubs and herbs species were 13, 25 & 70 with dominance of *Cedrus deodara, Abelia triflora* and *Rumex nepalensis* respectively. Whereas, in Hurba area, the number of trees, shrubs and herbs species were 9, 25 & 73 with dominance of *Betula utilis, Juniperus communis* and *Caltha palustris* respectively. In Shingan area, the number of trees, shrubs and herbs species were 13, 26 & 95 with the dominance of *Betula utilis, Rhododendron anthopogon* and *Thymus linearis* respectively. Three species of Rhododendron viz., *Rhododendron companulatum, R. anthopogon*, and *R. lepidotum* were also recorded from the sanctuary. The distribution pattern of plant species was mostly contiguous in all the studied areas. The population structure of various tree species occurring in different areas of the sanctuary was estimated and recognized three patterns of population structure. Out of 105 medicinal plant species recorded from the various areas, 27 plant species fall in the category of threatened plants. Conducted ethnobotanical studies in Rakchham, Chitkul, Batseri, Themgarang, Boningsaring villages and documented 50 plant species used for various purposes.

Project 3: Inventorization, documentation and to evolve site specific management strategies for the conservation of sacred groves of Kullu valley in Himachal Pradesh [GBPI/IERP/04-05/18/865/2005-08]

Findings: A total of 33 sacred groves were inventorized in the Kullu valley and these sacred groves were found rich in plant biodiversity. A total of 224 plant species were recorded. The sacred groves serve as storehouse of medicinal plants. During the study, ethnobotanical information on 69 plant species were also documented. Deodar (*Cedrus deodara*) was recorded as the dominant tree species in most of the sacred groves. However, the number of deodar trees varied among the sacred groves. A pamphlet on "Dev van Ek Prachin Dhrohar" was

prepared for creating awareness among the local community for conservation and rejuvenation of sacred groves. Reasons for degradation of individual sacred groves were identified and site-specific management strategies for rejuvenation and conservation of the sacred groves were evolved with the participation of people.

Project 4: Studies on population status and berberine content in different provenances of *Berberis aristata* DC. in Himachal Pradesh and standardization of its propagation techniques [BT/PR-4695/PBD/17/300/2004, dated 13th May 2005/2004-08]

Findings: Seven provenances of *Berberis aristata* were identified in Himachal Pradesh. After identification of different *Berberis aristata* provenance/populations, root samples were collected, cut into small pieces, dried in shade and sent to the Forest Research Institute, Dehradun for estimation of berberine content. The chemical analysis showed maximum berberine content of 2.81 % in sample no. 30 followed by 2.70% in sample no. 5. The high berberine yielding plants identified in this study were mass propagated through stem cuttings, but the rooting percentage and survival of the rooted cuttings were very less. Although, the vegetative propagation of the species is very difficult, the species can be easily propagated through seeds.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Introduction and performance trials of *Gmelina arborea* for Agroforestry in Lower hills of Himachal Pradesh and Jammu and Kashmir [HFRI-039/08(AGF-05)/PLAN/2007-12]

Status: Nurseries of *Gmelina arborea* have been raised at Bir Plasi (Nalagarh), Johron (Paonta Sahib) and Nagbani (Jammu) for raising field plantations. Field plantations-cum demonstration plots have been raised at Puruwala (Paonta Sahib) in district Sirmour and Kot in Hamirpur district of Himachal Pradesh. Survey for taking up field plantation in the state of Jammu and Kashmir is being undertaken. Growth data of the seedlings at nursery stage and in plantation area have been recorded. Preliminary results are encouraging.

Performance trail of *Gmelina arborea*

Project 2: Evaluation of soil fertility status and nutrient return from the important indigenous agroforestry tree species in Himachal Pradesh with special reference to Hamirpur district [HFRI-034/08(AGF-04)/PLAN/2006-11]

Evaluation of Soil fertility status

Status: After conducting a survey, experiments have been laid down in the Aghar and Bilkar Kahan of district Hamirpur. Collection of litter samples is being under-taken which are further being processed and analyzed for various constituents/ nutrients viz., N, P, K, Ca, Mg so as to know the magnitude of nutrient return from five important agroforestry species of this region. Soil samples are also being collected and being analyzed to evaluate the soil fertility status.

Project 3: Standardization of nursery techniques of five prominent indigenous species (*Capparis spinosa, Colutea nepalensis, Caragana gerardiana, Ribes orientale* and *Cratagus songarica*) besides *Eleaegnus angustifolia, Hippophae rhamnoides* and *Rosa webbiana* of Cold Deserts [HFRI-019/03(EBC-08)PLAN/2002-10]

Status: Trials to understand the (i) Effect of different concentration of Indole-3 Butyric Acid on rooting in shoot cuttings of *Ribes orientale, Colutea nepalensis, Eleaegnus angustifolia., Hippophae rhamnoides &* in root suckers of *Rosa webbiana* & *Capparis spinosa*, (ii) Effect of pre-sowing (hot-water and Gibbrellic Acid) treatment on germination behaviour in the seeds of *Ribes orientale, Colutea nepalensis, Hippophae rhamnoides, Capparis spinosa* and *Rosa webbiana* and (iii) Effect of medium (various ratios of sand & soil) on germination behaviour in the seeds of *Ribes orientale, Colutea nepalensis, Hippophae rhamnoides, Capparis spinosa* and *Rosa webbiana* were conducted both in poly house and in nursery conditions. Besides this, experiments on the effect of mulching treatments on *Ribes orientale, Hippophae rhamnoides, Rosa webbiana* and *Capparis spinosa* were also undertaken. Detailed ecological studies for the identified *Capparis spinosa* species were carried out in the selected sites at Mane, Ladang, Kurith, Hurling, Tabo and at Samdoh falling in Spiti Valley of Himachal Pradesh.

Capparis spinosa

It was seen that the experiments as laid out inside the poly tunnels are performing well over the plants growing in the open nursery. Field trials to assess the performance of *Eleaegnus angustifolia, Hippophae rhamnoides, Rosa webbiana* and *Colutea nepalensis* were established which are giving the excellent performance. Mortality replacements in field trials of species like, *H. rhamnoides, C. nepalensis* and *R. webbiana* were carried out. Repeat ecological studies of the identified species in field conditions were also conducted. Major emphasis was laid on *Cratagus songarica*–the species found growing in Lahaul valley only. Arlier trails on different species under study as laid in the nursery and in field conditions were maintained. Data are being compiled.

Project 4: An ecological assessment of floristic diversity in Hemis High Altitude National Park, Ladakh and Jammu & Kashmir [HFRI–031/02 (EBC–12) PLAN/2006–11]

Status 4: During 2008, conducted ecological and taxonomic studies in Markha valley of Hemis High Altitude National Park. Surveyed the area indepth and camped within the valley at various high altitude camp sites; viz, Chilling (3800 m), Kaya (3700 m), Skyu (3800 m), Markha (4000 m), Shingo (4200 m) and Chalak (3900 m) etc. Laid quadrats along the representative slopes within the valleys following the altitudinal gradient, from 3600 m to the upper benchmark of 4400 m above msl. Made floral collections but collected only unique specimens for Herbaria and also documented the vegetation types in the river valleys and also the general flora near habitations.

Back at the Institute, the plant specimens collected during the survey were processed as per standard procedures and put in plant press. The specimens after proper drying, pasting on standard handmade sheets and fumigation will be taken to the DD and WII Herbaria at Dehradun for authentification.

Markha Village

Hippophae and Phragmites formations

Hippophae rhamnoides sub sp. *turkistanica*

Peganum harmala

Project 5: Survey, biology and control of insect pests of important medicinal plants in Himachal Pradesh [HFRI-033/06(FPT-07)PLAN/2005-10]

Status: In total, 37 insect species belonging to five insect orders viz. Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Hymenoptera and 24 families have been recorded from 13 selected medicinal plants, being cultivated in this region. The studies on the biology of *Plusia orichalcea* Fab. on *Saussurea costus* infesting *Picrorhiza kurrooa* Royle ex Benth., *Acrtium lappa* Linn., *Heraclium candicans* Wall. ex DC., *Angelica glauca* Edgew., *Saussurea costus* Falc. and *Valeriana jatamansi* Jones have been summarized. *P. orichalcea* was found to be most active from second week of April to last week of June. Four overlapping generations were studied from March to June. The fecundity of a female varied from 113 to 228 eggs and the total life cycle was completed in 27 to 38 days during different months. Experiments were laid to evaluate the Efficacy of Summeroil, Grownim, Di-methoate 35 EC and Neem Seed Bitter on *Valeriana jatamansi* to control the mite attack in nursery. The data were collected before and after the treatments. During the survey, moderate to heavy attack of White grub were recorded in the nursery at Shillaru and Rorhu area on *Aconitum heterophyllum, Valeriana jatamansi, Picrorhiza Kurrooa, Angelica glauca* and *Saussurea costus*.

Project 6: Management of insect borer complex in Chirpine forests [HFRI-035/06 (FPT-08)2006-11]

Status: *Polygraphus longifolia* Stebbing was identified one of the most destructive pest of Chirpine trees as this beetle bores directly into the bark for oviposition and make the tree vulnerable for other insect borers to infest subsequently. It is graded as formidable pest of Chirpine since it infest trees of all ages from the seedling and sapling to the oldest tree and even the green trees. Owing to the rough thick bark of the Chirpine and the deep crevices in

it, it is by no means easy to detect the attack of this insect without removing the bark. To evaluate the effectiveness of tree trap for entrapping the beetles of *Polygraphus longifolia*, billets of two sizes (80 cm L X 70 cm GBH and 100 cm L X 90 cm GBH) were kept at two experimental sites and the data on insect activity and population abundance of *P. longifolia*, *Cryptorhynchus rufescens* and *Sphaenoptera aterrima* were recorded along with moisture content of the logs. Trees falling into the girth range 90-180 cm were found to be highly susceptible to infestation in comparison with young (below 90 cm) and mature (above 180 cm) stands. Fire incidence and excessive resin tapping increased the susceptibility of the trees to the beetle incidence. Grownim and endosulphan 35 EC at various concentrations ranged from 1.0% to 5.0% for containing the insect pest population was evaluated in the field. Data on population abundance of insect on randomly selected trees during pre and post treatment were recorded.

Cryptorhynchus rufescens

Abnormal increase in population of Chirpine weevil (*Cryptorhynchus rufescens*) was reported in June-July in Solan Forest Division of Himachal Pradesh. The weevil is elongated and measured about 6.6–8.5 mm in length. It attacks the young green sapling to old tree of large size. The young grubs eat out small galleries in an irregular fashion. As it increases in size, the grubs bore deeper galleries in thick bark, cambium and the sapwood. The galleries are packed with red dust. The weevil population ranged from 3-5 per 10 cm^2 of bark area.

Mature grub of *C. rufescens* before pupation

Project 7: Planting Stock Improvement Programme in *Cedrus deodara* [HFRI-028/05 (SFG-08) PLAN-03/2003-08]

Progeny trial of *Cedrus deodara*

Status: The matter to obtain culling permission from the competent authority was pursued with Principal Secretary, Forests Government of Himachal Pradesh, PCCF of Himachal Pradesh and Director, State Forest Research Institute, Jammu from time to time so that seed stands are converted into Seed Production Areas (SPAs). However, the culling permission is yet to be obtained. Progeny trial is being maintained in the nursery and growth data being recorded periodically.

Project 8: Productivity enhancement through selection of superior clones of *Dalbergia sissoo* [HFRI-038/05(SFG-09) PLAN/2007-12]

Status: The clones selected on the basis of morphometric traits were raised in the nursery. These selected clones are being evaluated for their stress resistance. Experiments laid out for insect pests resistance continued. The morphometric variation recorded in selected clones is also being corroborated for genetic variation through isozyme studies. The site to raise advance generation orchard was fenced and prepared for planting.

Project 9: Determination of morphological and physiological quality parameters of nursery stock of Deodar (*Cedrus deodara*) and Ban Oak (*Quercus leucotrichophora*) [HFRI-037/05 (SFG-12)PLAN/2007-12]

Status: Maintained about 30,000 plants of Deodar (6,000 no.) and Ban Oak (24,000 no.) at Model Nursery, Shimla and Shilly nursery, Solan respectively. Very good germination recorded in case of Ban Oak acorns; however, germination failed in Deodar seeds owing to collection made during 2007, considered as a bad seed year. Visited some more nurseries of State Forest Department of Himachal Pradesh and collected information from field functionaries regarding production of Deodar & Ban Oak nursery stock and quality parameters adopted while selecting Deodar & Ban Oak nursery stock. Selected sites in Solan and Shimla Forest Division for establishing field trials of Deodar and Ban Oak nursery stock based on morphological parameters. Carried out experimental plantations based on morphological parameters on approximately 4ha area during July-August 2008 rains. Growth and survival data pertaining to experimental plantations are being recorded regularly. Fresh seeds of Deodar & Ban Oak acorns were collected during October 2008 to January 2009 and subsequently sown in the nursery for studying physiological parameters of nursery stock quality. Compiled secondary information and interim minimum standards for Deodar and Ban Oak nursery stock proposed for further finalization and adoption in the field.

Graded Nursery Stock of Deodar & Ban Oak

Project 10: Standardization of methodology for seed collection, seed handling, storage and breaking seed dormancy in *Juniperus polycarpus* C. Koch and *Fraxinus xanthoxyloides* (Wall. ex G. Don) DC. [HFRI-036/03 (SFG-11)PLAN/2006-11]

Status: The germination data of *Fraxinus xanthoxyloides* seeds treated with different conc. of gibberellic acid ranging from 500 ppm to 3000 ppm statistically analyzed and maximum 74% germination was recorded in seeds treated with 1500ppm gibberellic acid as compared to control which registered only 19.66% germination. Similarly, good germination was observed in *Juniperus polycarpus* seeds treated with different presowing treatments.

Seed Germination in *Juniperus polycarpus*

The seed storage trial in *Fraxinus xanthoxyloides* and *Juniperus polycarpus* by using different type of storage containers/storage environment was maintained and viability test carried out periodically. The *Fraxinus xanthoxyloides* seeds stored in different type of storage containers/ environment showed decreasing trend in seed viability and seeds stored in refrigerator (<5°C) retained >70% viability after 15 months of storage. Similarly, *Juniperus polycarpus* seeds also showed decreasing trend in seed viability and seeds stored in refrigerator (<5°C) retained >50% viability after 15 months storage compared to other storage environment.

EXTERNALLY AIDED PROJECTS

Project 1: Setting up 100 hectares demonstration plot in Himachal Pradesh and production of elite planting material of *Dendrocalamus hamiltonii* [BT/PR/5243/Agr/16/456/2004/ 2005-10]

Status: Raised 50 ha demonstration plots of Tissue Culture and Stem Cutting raised *Dendrocalamus hamiltonii* at Dhadiyarghat in Solan Forest Division. The Tissue Culture raised plants have shown 84 per cent survival and Stem Cutting raised has survived up to 95 percent. Monkeys, Porcupines and landslides were the main reasons of mortality. The growth data are being recorded periodically.

Performance of Tissue Culture Raised Plants

Project 2: Suitability of *Jatropha curcas* L. seeds sources in lower and mid-Himalayan regions of Himachal Pradesh [BT/PR/5094/AGR/16/429/2005-2010] (DBT Funded Project)

Status: Demonstration-cum-experimental plantations established on 23 ha. of area during 2005-06, 2006-07 and 2007-08 at various locations in Himachal Pradesh were maintained intensively during 2008-09 for better survival and growth so that it could be used for future planting material resource as well as training purposes. It was estimated that about 33,500 cutting could be made available to funding agency for future propagation from those demonstration plantations. About 22 fresh seed samples amounting approximately 10 kg collected from different seed sources of Himachal Pradesh during November 2008 and are being analyzed for oil estimation. Growth and survival data pertaining to experimental-cum-demonstration plantations are being recorded regularly. The project has been extended for two years by the funding agency i.e. up to 31st March 2010 for getting possible logical conclusion from the project being executed under Jatropha micro mission of DBT.


Demonstration Plantations of *Jatropha curcas*

Project 3: Production of quality planting material of *Aconitum heterophyllum* Wall. ex Royle & *Angelica glauca* Edgew and extension of their cultivation technology to local communities [GO/HP-07/2006-09] (NMPB Funded Project)

Status: Raised and maintained about 2.20 lacs nursery stock of *Aconitum heterophyllum* Wall. ex Royle (Atish) & 1.05 lacs nursery stock of *Angelica glauca* Edgew (Chora) at two nurseries of the Institute viz., Shillaru nursery (Shimla) and Brundhar medicinal plants nursery (Manali) during 2008-09. The nursery activities mainly included preparation of land for nursery beds, sowing/pricking, shading, irrigation and other maintenance activities. Overall, up to March 2009, the Institute has raised 3.80 lacs of quality planting material of Atish and Chora under this project in different nurseries. Under extension activities of the project, Institute has successfully organized two training & demonstration programmes on 'Commercial cultivation of Atish & Chora' at Mashobra, Shimla on 29th August 2008 for 44 farmers & field functionaries of SFD, Himachal Pradesh and at Mahunaag in Karsog Forest Division of Himachal Pradesh on 5th December 2008 for 60 numbers of farmers, members of Mahila Mandal, NGO & field functionaries of SFD, Himachal Pradesh. Besides these, around 2.00 lacs QPM of Atish and Chora distributed to various end users during the year. The project has completed its period of 3 years on 31st March 2009; however, one year extension for the project is under consideration with the funding agency to fully achieve all the objectives of the project.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Ecological assessment of floristic diversity in Kalatop Khajjiar Wildlife Sanctuary of district Chamba, Himachal Pradesh [HFRI-040/ 02(EBC-13) PLAN/2008-11]

Status: Selected the study sites and carried out phytosociological studies in alpine pasture from Dankund to Jyot, altitude wise from Lakadmandi to Khajjiar and Khajjiar to Sach areas of Kalatop-Khajjair Wildlife sanctuary. Total number of plant species in alpine pasture from Dankund to Jyot were about 30. Documented the plants of medicinal value from the studied areas.

General View of the Sanctuary

Podophyllum hexandrum

Roscoea alpina

Project 2: Management of Indian Gypsy Moth (*Lymantria obfuscata*) in Himachal Pradesh [3-[FPD-4(6)]HFRI/2008-13]

Status: Native baculovirus strains of LONPV was harvested from the infected larvae feeding on Ban Oak forest. The purified occluded bodies were applied with 5 different dilutions on IGM larvae in the dose-mortality-bioassay experiment to get LD^{50} and LD^{90} value of the virus.

Project 3: Survey and bioecology of potential insect pest and pathogen of cone and seed of *P. gerardiana* Wall. [HFRI-042/06(FPT-10) PLAN/2008-10]

Status: During this period a survey tour was organized to the Kinnaur and six sites at four localities i.e. Kalpa (Pangi), Labrang, Kilba and Jhangi were selected for carrying out different survey and observational activities. These areas are surveyed to assess the infestation of insect pests and pathogens on the cones and seeds of the Chilgoza pine. Samples were also collected from these sites. Field visits and assessment of preharvest infestation on cones and seeds of pines i.e. *P. gerardiana* has been recorded. Samples have been collected from field for post harvest evaluation of infestation of insect pests on cones and seeds. Isolation of insect pests and pathogens heve been isolated from infected cones and seeds. New seed bore i.e. borer *Cateremna tuberculusa* Meyrick, 1882 have been reported for the first time as a seed pest of Chilgoza seed. Life history of seed borer *Cateremna tuberculusa* Meyrick, 1882 of Chilgoza has been recorded for the first time. Further investigation on damage by the insects and pathogens on the cones and seeds of Chilgoza is in progress.

Project 4: Assessment of nutritional status of most preferred wild edible plants of Kinnaur district, Himachal Pradesh [HFRI-043/07(NWFP-02) PLAN/2008-11]

Status: A Questionnaire for documentation of wild edibles was prepared and used to collect information on wild edible plants from Kalpa, Rogi, Pangi, Akpa, Rarang, Asarang, Sangla, Batseri, Raksham, Chitkul and Nichar villages. Information on 21 wild edible plants was documented and most preferred wild edible plants were prioritized. Preliminary nutritional analysis of wild edible fruit samples is in progress.

Fruits of *Viburnum cotinifolium*

Unripe fruits of *Hippophae salicifolia*

Project 5: Population genetic analysis and characterization of *Cedrus deodara* germplasm through DNA based markers [HFRI-044/05(SFG-14)PLAN/2008-11]

Status: Collected plant samples (needles) from 11 populations from the state of Himachal Pradesh. These samples were collected from 50 individual trees selected randomly within the population with each selected tree photographed, numbered and geo-referenced. Standardized genomic DNA isolation and purification techniques at FRI, Dehradun.

Selected trees of Deodar for DNA analysis

Project 6: Development of techniques for raising Deodar (*Cedrus deodara*) plantations through tall plants [HFRI-045/04(SFG-15)PLAN/2008-11]

Status: Carried out survey and selected forest near Shillaru in Shimla district for extraction of Deodar wildlings for experimental purposes under the project. Besides this, also selected a site near Shillaru nursery for establishing pilot scale field trial. Carried out experimental plantation of Deodar tall wildlings during August 2008 on that selected site. Nursery studies for raising tall plants could not be initiated as Deodar seeds of last year's collection (2007 was considered as bad seed year in case of Deodar) failed to germinate in nursery. Fresh seeds of Deodar were collected during October 2008 and subsequently sown in the nursery for studying the techniques of raising Deodar tall plants. Growth and survival data pertaining to experimental plantation are being recorded regularly. However, initial field survival results of Deodar tall wildlings are not encouraging.


Field Planting of Tall Wildlings of Deodar

EXTERNALLY AIDED PROJECTS

Project 1: Network Project on, "Population assessment and identification of superior genetic stock of *Picrorhiza kurrooa* Royle ex. Benth and *Valeriana jatamansi* Jone by screening different populations from North-western Himalayas (Himachal Pradesh and Uttarakhand)[GO/HP-03/2009/2008-11]

Status: This is a multi-institutional project. To draw roadmap for implementation of the project, two workshops were organized at Himalayan Forest Research Institute (HFRI), Shimla and Jaypee University of Information & Technology (JUIT), Waknaghat, Solan. The protocols have been developed for administrative and research issues. Published the brochure on *Picrorhiza kurrooa* and *Valeriana jatamansi* for proper identification of the species in the field. Existing available strains of both the species have been sent to IHBT, Palampur and JUIT for analysis of active ingredients.

Network partners during the workshop

Project 2: Taxonomy, biodiversity & habitat association of Noctuid Moths in various conifer forests of Himachal Pradesh [0265/T/HFRI/029/0809/156/2008-11]

Status: Surveys carried out to selected localities as representatives of the habitat type in the study area i.e. Chirpine forest of Town Bhrari (Hamirpur), Malan (Kangra) & Sairighat (Solan); Kail forests of Theog (Shimla); Deodar forest of Narkanda and Theog (Shimla); Chilgoza forests of Kilba and Akpa (Kinnaur) and Silver fir & Spruce forest of Narkanda (Shimla). Total 629 specimens of Noctuid moths have been collected for these sites. Various environmental factors (Temperature, humidity & altitude), other parameters (latitude & longitude) and pest incidence in the field have been studied. The specimens of collected Noctuid moths are preserved for taxonomic study and biodiversity analysis. Some identification of Noctuid fauna has been made with the help of literature.

Project 3: Field evaluation of superior accessions of *Jatropha curcas* L. under micro-mission programme in Himachal Pradesh [BT/PR-11348/PBD/26/178/2008] [DBT Funded Project/ 2008-11]

Status: Total 504 no. rooted cuttings of superior accessions of *Jatropha curcas* from HAU, NBRI and Biotech Park were received in New Delhi during September 2008. For establishing experimental plantation of *Jatropha curcas*, a site was selected at village Solag, Panjgai in Bilaspur district of Himachal Pradesh (N $31^0$21.356' E $76^0$49.737', Elevation: 938m).

Nursery stock of superior accessions

Multi-location trial of Jatropha

Plantation of rooted cuttings carried out during October 2008, as per the statistical design provided by DBT Jatropha National Coordinator. Seeds of 19 superior accessions of *Jatropha curcas* received from NBPGR have been sown in institute's nursery at Bir Plassi Nalagarh (H.P.) during October 2008. The germination behaviour of these seeds was recorded in the nursery. The growth & survival data are being recorded regularly both at the plantation site and at the nursery.

EDUCATION AND TRAINING

A. ACTIVITIES UNDERTAKEN BY THIS INSTITUTE

1. Education

- A team of 16 numbers of Foresters from DoF-Nepal visited the Institute on 14th June 2008.

2. Trainings

- A training-cum-meeting was organized at village Lanabanka, Sirmour (H.P.) - A Model Village selected by HFRI for dissemination of research findings on 21st June 2008 with a view to showcasing and demonstrating the technologies in forestry research and practices.A camp workshop-cum-village meeting was organized on 3rd August 2008 at Lanabanka – Model Village as selected in District Sirmour for show-casing the research activities of the institute. Farmers including ladies folk of the villages falling in Lanabanka panchayat participated in the workshop.
- A training on "Intercropping of Medicinal Plants: Some innovations and options for diversification" was organized by the institute at Janna (Kullu), Himachal Pradesh on 14th August 2008.
- One day training-cum demonstration programme on "Commercial Cultivation of Patish and Chora" to the farmers and field functionaries of SFD of Himachal Pradesh was held on 29th August 2008 at Mashobra near Shimla under National Medicinal Plant Board Project.

- Training on "Forestry Interventions for Ecorestoration of Degraded Land" was organized at Forest Training School, Sunder Nagar on 17th July 2008. Besides the field staff of the State Forest Department, the meeting was also attended by the farmers of the surrounding areas. In all, 70 participants comprising of villagers, farmers and front line staff of HPSFD, were present during this one day training.

Training on "Forestry Interventions for Eco-restoration of Degraded Land"

- The institute organized a one day Training-cum-field Demonstration programme on "Integrated Pest Management in Chirpine" on 18th September 2008 at Samtana Forest in Aghar Forest Range. About 50 forest officials and 30 farmers of the division were present during the programme.

Training on "Integrated Pest Management in Chir-Pine"

- Five days training on planting techniques and uses of Bamboos etc. under Bamboo Technical Support Group (BTSG), ICFRE, Dehradun was organized by the institute under the aegis of National Bamboo Mission, New Delhi. The training was organized from 13th to 17th September 2008 at Forest Training Institute, Chail.
- One day training and demonstration programme on 'Commercial Cultivation of Medicinal Plants: An Option for Augmenting Rural Income' was organized by this Institute under VVK activities at Veergarh in Kotgarh region of Himachal Pradesh on 13th December 2008.
- One day training and demonstration programme on 'Tree Improvement - A Tool for Productivity Enhancement' under VVK activities has been successfully organized at Bir Plassi, Nalagarh in Nalagarh Forest Division of Solan, district of Himachal Pradesh on 16th December 2008.
- A one day training programme on Commercial Cultivation of Medicinal Plants, was organized at Matiana in Shimla district, on 24th December 2008.
- A one day training on "Awareness and Commercial Cultivation of Medicinal Plants" to the farmers and field functionaries of SFD of Himachal Pradesh was organised on 24th December 2008 at Tattapani district, Mandi under Externally Funded Kol Dam Hydro Electric Project. In all, 50 participants were present during the training.
- A one day training programme on "Commercial Cultivation of Medicinal Plants" under Kol Dam Project was organized at Tattapani, district, Shimla district, on 30th December 2008. About 50 farmers and officials of Himachal Pradesh Forest Department (Karsog Forest Division) participated in the training.

Training on "Commercial Cultivation of Medicinal Plant"

- One day training on "Integrated Pest Management in Nursery of Medicinal plants" was organized at Palampur for the front line staff of Palampur Forest Division on 5th February 2009. Total 40 frontline staff of SFD participated in the training.
- A Village Forest Development Committee meeting at Maloh, Sryuini, Mandi, Himachal Pradesh was organized by this Institute on 25th February 2009 under Participatory Forest Management Project.

B. PARTICIPATED

- Training programme on 'Introduction to ArcGIS-9' from 28th to 30th April 2008 at Himalayan Forest Research Institute, Shimla.
- Conference on "All India coordinated project on Bamboo" held at Indian Institute of Entrepreneurship, Guwahati organized by Rain Forest Research Institute, Johrat on 23rd May 2008.
- Workshop on "e-Governance Initiative by ICFRE and Development of Indian Forestry Research Information System (IFRIS)" from 21st to 23rd May 2008 in the Conference Hall of HFRI.
- Dr. Rajasekaran, Scientist attended the training on "Forest Certification for Sustainable Forest Management" organized by Indian Institute of Forest Management, Bhopal from 25th to 27th June 2008 at IIFM, Bhopal.
- Training on "Main streaming Biodiversity in Environmental Impact Assessment" at Wildlife Institute of India, Dehradun from 18th to 23rd August 2008.
- Training on Statistical Techniques for Research Methodology at IASRI, New Delhi from 26th December 2008 to 7th January 2009.
- Six weeks training on "Basic Forestry" at SFS College, Dehradun, from 15th December 2008 to 23rd January 2009.
- One day brain-storming-cum-interaction workshop for stakeholders (Growers, Traders, Industry and Scientists) on Medicinal and Aromatic Plants of Himachal Pradesh, as organized by Dr. Y.S. Parmar University of Horticulture & Forestry, NAUNI, district Solan on 24th January 2009.
- Training on "Insect Pest Management" with effect from 10th to 19th February 2009 at Indian Institute of Pest Management (ICAR), New Delhi.
- British High Commission supported two days training programme on Regional Case Study Workshop on 16th and 17th February 2009 held at Nainital, Uttarakhand.

PUBLICATIONS

Brochures/ Technical Bulletins/ Booklets/ Pamphlets Published

- A Pamphlet titled Adarsh Gaon : Lanabanka was published by the Institute.
- Singh R. (2008), Chirpine Weevil – A Pest of Chir. HFRI / BR/030: 8 p.

Proceedings etc.

- Proceedings of the workshop on Forest Insect Pest and Disease Management in Himalayas. ICFRE Number: 128-ICFRE-BK-75/ HFRI-BK-1-2009, HFRI, Shimla: 219 p.

Edited Chapters Published in the Books

Joginder Singh, A. Rajasekaran & K.D. Sharma (2008). Traditional ethnobotanical knowledge of Kiran Pargana, Shimla, district, Himachal Pradesh In: Phytotherapeutic Wisdom of Indian Rural Aboriginals" (Ed.), Dr V. Singh, Published by Scientific Publishers (India), Jodhpur, Page No. 253-263.

Research Reports

Ranjeet Singh (2008). Drying of *Dalbergia sissoo* Roxb. (Shisham) in National Provenance Trial at Basantar Bela, Jammu sent to the PCCF, Jammu & Kashmir and Director, State Forest Research Institute, Jammu & Kashmir.

Pawan Kumar (2008). Dying of *Cedrus deodara* (Deodar) in Pangna Forest Range of Karsog Forest Division: (Research Report). Report submitted to the PCCH, H.P.; CF, Mandi; CF (Research) and DFO, Karsog Forest Division.

CONSULTANCY

Work on the constancy on "Studies on Environment Impact Assessment and Preparation of Environment Management Plan" for Integrated Kashang Hydroelectric Project (243 MW); Kuther Hydroelectric Project; Renuka Hydroelectric Project and Formulation of "Catchment Area Treatment (CAT) right from Pandoh Dam to Larji" is in progress.

CONFERENCES/MEETINGS/WORKSHOPS/SYMPOSIA/ EXHIBITIONS

Attended

The representatives from Himalayan Forest Research Institute (HFRI), Shimla, Himachal Pradesh attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

- International Conference on Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood as organized by National Bamboo Mission, Ministry of Agriculture, Govt. of India at New Delhi from 15th to 17th April 2008.
- Meeting in the office of Himachal Pradesh Power Corporation Ltd., Shimla where Environmental Impact Assessment (EIA) and Environmental Management Plans (EMP) as prepared by the ICFRE for Renukaji Project were presented and discussed.
- Second workshop cum meeting of e-Champions on the "Development and Implementation of IFRIS at IWST, Bangaluru" from 16th to 20th 2008.
- Workshop on "Registration of Plant varieties - Protection of Farmers Rights and Traditional knowledge" on 23rd August 2008 at Armsdale Building HP Secretariat, Shimla, as organized by HP Patent Information Centre, State Council for Science, technology and Environment, Govt. of Himachal Pradesh.
- International Conference on "Novel Approaches for Food and Health Security in High Altitudes" held at the Defence Institute of High Altitude Research (DIHAR), DRDO, Leh-Ladakh-194101, J&K, INDIA from 6th to 10th September 2008. During this workshop, two papers were presented by the authors.
- Interactive Meet on "Climate Change: Perspective and Opportunities in Context of Himachal Pradesh" on 16th October 2008 in the Conference Hall of Armsdale Building in the H.P. Secretariat, Shimla.

- Workshop on "User Requirements of Weather and Climate in Western Himalayas" as organized by India Meteorological Department, Meteorological Centre, Shimla at Hotel Holiday Home, Shimla on 20th October 2008.
- Training-cum-Pilot Roll Out of IFRIS was organized by the SRIT, Bangaluru at HFRI, Shimla, from 29th October 2008 to 14th November 2008. All the officials working in the Institute actively participated and gave their feed back for improvement of the respective modules.
- Training on Right to Information Act-2005 on 14th and 15th November 2008 as organized by H.P. Institute of Public Administration (HIPA), Shimla.
- A brainstorming session for prioritizing forestry research for the state of Himachal Pradesh. The meeting was held under the Chairmanship of Additional Secretary (Forests) to the Govt. of Himachal Pradesh on 22nd November, 2008 at Forest Training School, Sundernagar.
- International Seminar on "Role of Plant Taxonomy in Biodiversity Management and Human Welfare" and presented the research paper on "Plant diversity in Lippa-Asrang Valley of District Kinnaur, Himachal Pradesh: Repository for Human Welfare" held at FRI, Dehradun from 1st to 3rd December 2008.
- Training Programme on "Agroforestry" at NRCAF, Jhansi from 24th November to 5th December 2008.
- An Interactive meeting on Network Project titled, "Population Assessment and Identification of Superior Stock of *Picrorhiza kurrooa* Royle ex. Benth and *Valeriana jatamansi* Jones by Screening Different Populations from North-East-West Himalayas (H.P. and Uttarakhand)" on 11th December 2008.
- The Meeting of Board of Governors of ICFRE Society held on 3rd October 2008 at New Delhi.
- The Meeting of ICFRE Society held on 22nd November 2008 at New Delhi.
- The meeting of Directors of ICFRE Institutes held on 19th and 20th November 2008 at ICFRE, Dehradun.
- The meeting of Research Policy Committee (RPC) held at ICFRE, Dehradun from 11th to 13th February 2009. Four research projects were presented before the Research Policy Committee (RPC) of ICFRE, out of which the two research projects were approved for their implementation from April 2009 onwards.
- Symposium on Functional Biodiversity and Ecophysiology of Animals from 21st to 23rd February 2009 at Department of Zoology, Banaras Hindu University, Varanasi.

Organized

- Director, Himalayan Forest Research Institute, Shimla along with team of his officers visited Srinagar from 25th to 29th June 2008. During his visit to the valley, he along with Director State Forest Research Institute, Jammu & Kashmir, met Janab Qazi Mohammad Afzal, Hon'ble Minister of Environment & Forests, Govt. of Jammu & Kashmir and apprised him of the various activities of the council, in general and the institute in particular, in his state. However, the research station scheduled to be inaugurated by him at Ganderbal, Kashmir on 27th June 2008, could not be

Meeting of Director, HFRI, Shimla with Hon'ble Minister of Environment & Forests, Government of J&K

inaugurated due to disturbances in the state.

- One day brainstorming interactive workshop on 6th August 2008 for "Identification and Prioritization of Forestry Research Needs in Himachal Pradesh" in the Conference Hall of the institute.
- A workshop titled, "Need of Forestry Research and Diagnostic Studies for Rural Development" was organized by HFRI, Shimla on 24th March 2009. This workshop was attended by about 40 delegates.
- The institute organized two days Research Advisory group (RAG) Meeting on 23rd and 24th October 2008, where scientific work as carried out by the Scientists during the year was evaluated by the Hon'ble member of RAG.

MISCELLANEOUS

- A workshop was organized by HFRI, Shimla in association with Wildlife Wing of State Forest Department of H.P. on the occasion of World Environment day on 5th June 2008 at Potter's hill Shimla. Establishment of Temperate Arboretum and Botanical Garden (TABG) have also been initiated at the same location for which Wildlife Wing of the State Forest Department of Himachal Pradesh had signed a Memorandum of Understanding for technical collaboration with Himalayan Forest Research Institute, Shimla.
- To make the farmers of Model Village, Lana Baka and Van Vigyan Kendra, Sundernagar, aware of the activities carried out by the Council in forestry research and also by other Research Organizations, two Exposure Visits from 24th February to 1st March 2009 were conducted. During these visits, the farmers were taken to Research station Dhaulakuan (Paonta Sahib), Model village Shyampur, Medicinal plant nursery at Forest Research Institute Dehradun, Shushila Tiwari Herbal Garden, Rishikesh, Medicinal Plant Marketing Depot of Forest Corporation at Bibiwala, Medicinal plant pharmacies/ market in Haridwar, Van Vigyan Kendra at Dehradun, Hara Farms near Yamunanagar. The Farmers were also shown the fields of Progressive Farmers for assessment and adopting the models suitable to their respective areas.

Visit to Green House at Shyampur

INSTITUTE OF FOREST PRODUCTIVITY RANCHI

Institute of Forest Productivity, Ranchi is a premier forestry research organization which was created in the year 1993 after the merger of four centrally sponsored schemes with the objectives to formulate, organize, direct, manage & carryout forestry research & education in the eastern region of the country, encompassing a forest area of approximately 46,581 square kilometer which is 17% of the total geographical area of the country, comprising an operational area of six agro-ecological zones and eight main forest types, it encompasses the picturesque eastern Himalayas in North Bengal, the fertile alluvial expanse of indo-gangetic plains in Bihar and West Bengal, deltaic and coastal mangroves of the world famous Sunderbans, a pocket of Terai Sal forest in the North-West corner of Bihar and tropical deciduous forests of Kaimur and Chotanagpur plateau overlaying rich and enticing mineral resources within its jurisdiction. The Institute caters to the forestry research needs of eastern India.

An abstract of projects run by the Institute is as follows:

	No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
Plan Projects	2	6	6
Externally Aided Projects	1	-	2
Total	**3**	**6**	**8**

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Development of appropriate silvicultural systems for selected medicinal flora of Chotanagpur and Santhal Parganas [IFP-022/FMS-3/2003-08]

Findings: Plant propagules from natural forests of West Bengal and Jharkhand were collected. Vegetative propagation techniques were standardized for *Rauvolfia serpentine*, *Gloriosa superb*, *Asparagus racemosus* and *Withania somnifera* in Jharkhand. Growth of four species of medicinal plants were recorded under the shade of trees viz. Teak, Sisham, Khair and Sal. Exploitable plant parts of three species of medicinal plants were collected and preserved yearwise for a span of four years.

Cultivation of *Asparagus racemosus*

Project 2: Vulnerability assessment of climate change and development of adaptation strategies to mitigate the impact on seed and biomass production in forest trees and herbs [IFP-029/FMS-4/2005–09]

Findings: Developmental stability of leaves in Neem and Sissoo is demonstrated suggesting that air pollutants and their associated changes in the environment such as increase in temperature and humidity did not induce genotypes to change to their environment. Hence, plants have inherent physiological adaptations to overcome evils of environment. Plants do not suffer under optimal water regimes, even under the influence of air pollutants indicating fair resistance to them. However, herbs showed susceptibility to diseases and pests under prolonged exposure to air pollutants.

EXTERNALLY AIDED PROJECT

Project 1. Documentation and inventorization of indigenous traditional medicinal knowledge in selected districts of Jharkhand [IFP-033/EBC–4/NMPB/2005–08] (Funded by NMPB]

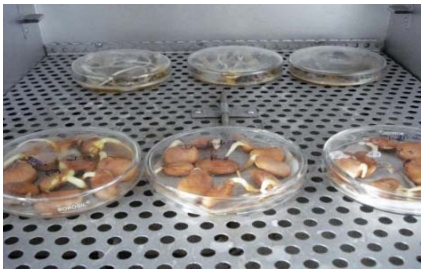
Findings: Traditional medicinal practices commonly used by 22 tribes of Jharkhand were documented. Herbal remedies for common ailments among ethnic communities viz. Arthritis, Diarrhoea, Dysentery, Spermatorrhoea, Bone facture, Epilepsy, Piles, Asthma, Hyperacidity, Paralysis, Infertility (Male & Female), Otitis, Snake bite and Dog bite, etc. were noted. Herbarium specimens were preserved for plants used by different tribes for treatment of disease symptoms. Identification of two major forests in Chotanagpur region having rich biodiversity of flora and fauna was done.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Creation of seed database on economically important forestry species of Jharkhand aiming at functioning of a forestry seed certification agency [IFP-030/FMS-5/2006–11]

Status: Seeds of 15 species were collected and processed. Physical and physiological parameters of seeds (seed weight, length and width, volume, colour and germination per cent, time) were recorded. Data on seed storage and viability in types of containers and different storage temperatures were recorded.



Seed germination test

Project 2: Studies on Reproductive biology and propagation techniques of *Schleichera oleosa* Lour (Oken), an oil bearing tree and important lac host plants [IFP-046/BGT-12/2006–10]

Status: As many as 30 trees were selected from different parts of prominent lac growing region in Eastern India. Trials on cutting, grafting & budding as well as experimentation on micropropagation of Kusum were conducted. A Vegetative Multiplication Garden of Kusum was established at FRC, Mandar. Study on clonal fidelity was initiated with the extraction of DNA from clones. Variation in seed sources on

Blooming of Kusum

the basis of seed germination was recorded. Data on blooming, time of fruit initiation, fruit maturation period & a number of fruits per inflorescence were obtained from Orissa & Jharkhand.

Project 3: Species suitability and reclamation strategy for degraded forest soils of Chotanagpur Plateau, Jharkhand [IFP-031/SLR-7/2006–11]

Status: Nursery and field trials were conducted in order to evaluate the suitability of tree species for degraded soils under Chotanagpur condition at Lalgutwa, IFP, Ranchi and the most suitable species were identified after compilation of growth data of the sixty species tried in nursery and field plantation. Field trials were under progress to study the effect of liming materials, bulky organic and mulching materials, macro and micro nutrients as a strategy to reclaim degraded soils using *Gmelina arborea, Madhuca indica* and *Pongamia pinnata* as test species.

Project 4: Genetic Evaluation & Molecular Characterization of *Jatropha curcas* L. of Eastern India [IFP-038/BGT-10/2007–10]

Status: Twenty eight plus trees were selected from the states of Jharkhand, Bihar & West Bengal. Cuttings from the selected clones were collected & propagated in polybags in the mist chamber. Appropriate number of cuttings were raised for field trials & plantation in the farmers field. Plantation was carried out in selected site at FRC campus, Mandar during rainy season by using RBD design at spacing of 2 metre (of both clonal & seedling origin). After interval of one month, data on growth parameters were taken from the field trial. DNA extraction method and electrophoresis was standardized. One community land & nine farmers land were selected.

Project 5: Improvement of clonal propagation techniques of bamboos and enhancement in field survival [IFP-035/SLR-8/2007–11]

Status: Rooting, Shooting & Rhizome genesis were performed for *B. bambos, B. nutans, B. striata, B. vulgaris* (Black), *D. strictus, D. asper* and *Gigantochloa atroviolaceae.* Survival and performance of Bamboo Planting Stock (BPS) of *B. nutans, B. striata, C. capitatum* and *D. stictus* under pot and field condition as influenced by organic soil treatment (Soil+ Sand; Soil + Sand-FYM Soil + Sand + FYM + Rice Husk & Soil + Sand + FYM + RH + Saw Dust)] have been undertaken. Quarterly data on propagation behavior Rhizome initiation, Rhizome, culm and clump growth were recorded. Planting stock of *D. asper* was generated through *in-vitro* propagation and placed for hardening for different duration (50 to 250 days). Hardened BPS of *D. asper* was planted in field under rainfed condition (without fertilization & irrigation) and their survival rate and growth & rhizome development were recorded. Germination behaviour and performance of *Melocanna baccifera* under Chotanagpur plateau climatic and soil condition were conducted.

Bamboo macro-propagation

Project 6: Assessment of the genetic diversity and development of species specific molecular markers in bamboos in Eastern India [IFP-039/BGT-11/2007–10]

Status: Reviewed literature on genetic diversity/population structure of bamboos and developed marker systems. Germplasm of target species & 15 other species were collected and maintained. Identification of potential primers on the basis of prior studies and commercially available RAPD primers was done.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Studies on collection, processing, sale and utilization of commercially important medicinal plants & NWFPs and their threat of extinction in tribal pockets of Jharkhand [IFP-040/EBC-05/2008–11]

Status: Literature on collection, sale and marketing of medicinal plants were reviewed in selected districts of Jharkhand. Information was collected on local markets, 'hats', NWFP vendors and traders in the districts and blocks under study. More than 30 vendors involved in the trade were interviewed from Ranchi and Gumla markets. Nearly 70 sample specimens were purchased from local markets and stored.

Project 2: Integrated strategy for evaluation of Indigenous fast growing multipurpose trees of Eastern India for plantation forestry [IFP-041/FMS-07/2008–13]

Status: Twenty candidate plus trees were identified in Jharkhand and West Bengal. Information gathered on natural growing areas/provenances in Bihar, Jharkhand and West Bengal. Experiments were designed for evolving clonal propagation procedures.

Project 3: Domestication, mass multiplication and popularization of *Moringa oleifera* genotypes with superior leaf nutritive and cytokinin content [IFP-042/FMS-08/2008–12]

Status: Superior seed sources were identified at 5 locations of Jharkhand and 3 locations in West Bengal. Fifteen candidate plus trees were marked. Shoot cuttings collected from 10 CPTs in North Bengal, 12 CPTs from Orissa & Jharkhand were planted in beds for clonal multiplication. Experiments were designed for clonal propagation procedures.

Superior seed source of Moringa

Project 4: Development of Dynamic Database for Forestry Discussion Forum [IFP-043/CD(IT)-01/2008–10]

Status: Literature were surveyed and completed for Forestry Discussion Forum. An outline of the possible forms for various internet pages to be included and the database structure with all possible records and E-R Diagram for inclusion in the Discussion Forum was completed. Identification of all possible records, fields and relationships between entities for inclusion in the discussion forum was completed. The database structure with all possible records and E-R Diagram to be implemented was finalized. The design and development of the GUI was initiated and was under progress. The programs/codes are being written and processed for information retrieval.

Project 5: Development of low cost technique of enriched vermicompost for commercial production [IFP-044/SLR-09/2008–11]

Status: Production of enriched vermicompost is 8 tonne with the production cost of Rs. 2.00 to Rs. 3.00 per/kg which is 50-75% less than the market

Testing of vermicompost on vegetable crop

price. The available NPK of enriched vermicompost is 3, 42 and 40 times higher than that of cowdung respectively. Enriched vermicompost and vermin wash increase the yield of Potato two and three times than the control respectively.

Project 6: Conservation of medicinal plants through commercial cultivation and value addition by Joint Forest Management Committees/panchayats and farmers in eastern Himalaya and its socio-economic impact [IFP-045/FMS-09/2008–12]

Status: Different areas of Darjeeling hill & foot hill were visited for collection of germplasm and conserved in the seeds garden of an area of 0.5 ha. Seeds were collected from seed garden for production of 107350 nos. QPMs of Sarpagandha, Tulsi, Satamali, Gurmar, Latakasturi & Ulatkambal. QPMs were distributed for cultivation to 78248 nos. of JFMC members through State Forest Department & farmers for commercial cultivation on free of cost during the year to motivate the farmers for cultivation.

Production of QPM

EXTERNALLY AIDED PROJECTS

Project 1: Documentation and inventorization of indigenous traditional medicinal knowledge of Jharkhand [IFP-047/EBC–06/NMPB/2008–10] (NMPB funded Project)

Status: Ethnic communities dominated tribal pockets were selected for the study in different blocks of Sahibganj, Hazaribagh, Ranchi, Latehar and Palamu Districts of Jharkhand. Some blocks were surveyed in Sahibganj, Hazaribagh, Palamu and Latehar districts of Jharkhand. *Souria paharia* and Santal tribes are dominant in Sahibganj, Chero and Birhor tribes are dominant in Palamu and Latehar districts of Jharkhand.

Project 2: Establishment of medicinal plants garden and propagation centre in Chotanagpur Plateau for conservation and production of quality planting material for promotion of *ex-situ* cultivation [IFP-048/FMS–10/NMPB/2008–11] (NMPB funded Project)

Status: Herbal Garden was created in 1 ha. Nursery was created for establishment of propagation centre in 3 ha area. Mist chamber was installed with irrigation facility. The various activities were carried out viz. site preparation, making arrangement for water supply, preparation of nursery beds and soil analysis, etc. Planting materials of about 100 species of medicinal plants of the region were collected and 80 species were planted.

TECHNOLOGY ASSESSED AND TRANSFERRED

Technology Transferred

Institute of Forest Productivity has developed technologies related to improving forest productivity and environmental conservation/reclamation for transfer to user groups.

Technology Assessed

- Macro propagation of bamboos
- Micro propagation techniques of important forestry species
- Laboratory analysis of soil and treatment for deficiencies
- Improved techniques for Lac cultivation

- Recycling of organic wastes by composting / vermicomposting
- Production of quality planting materials in hi tech nurseries using root trainers
- Bio reclamation of problem soils and mined over burdens
- Propagation techniques of selected medicinal plants

EDUCATION AND TRAINING

Tranings

Conducted

- Training on "Scientific Cultivation of Lac" was imparted by the Institute to the Forest Guards of SFD, Jharkhand from 5th to 9th May 2008.
- Training on "Modern Nursery Techniques" was also imparted to FROs of SFD, Jharkhand from 12th to 16th May 2008.
- A five-day training programme for the farmers and field functionaries of the state of Chhattisgarh under Bamboo Technology Support Group (BTSG), ICFRE, Dehradun of National Bamboo Mission was organized by the Institute during the period from 8th to 12th September 2008.
- Training of "Lac Cultivation through Scientific Method" was conducted by the Institute at Gari and Garu village of Daltonganj on 11th February 2009 and 18th February 2009.

Attended

- "Statistical Techniques for Research Methodology" for Scientific Personnel of ICFRE Dehradun held at ISRI, Pusa from 26th December 2008 to 8th January 2009.
- "Pest Management in Forestry" held at National Centre for Integrated Pest Management (ICAR), New Delhi held from 10th to 19th February 2009.

LINKAGE & COLLABORATION

Linkages and collaboration were established with the following organization:

International

EWI, USA; DFID (U.K.); IDRC, UNDP

National

NABARD
Department of Biotechnology (DBT)
Damodar Valley Corporation (DVC)
ISM, Dhanbad
BAU, Kanke, Ranchi
SFD, West Bengal
FSI, Eastern Zone, Kolkata
MoEF, Govt. of India
National Medicinal Plant Board (NMPB)
Central Coalfields Limited (CCL)
Indian Institute of Natural Gum & Resins, Namkum
HARP, Plandu
SFD, Jharkhand
SFD, Bihar
Planning Commission, Govt. of India
ESSAR, Ranchi

PUBLICATIONS

- Annual Lac Bulletin
- Brochures – Lac cultivation; Medicinal plants; Bamboo cultivation & propagation; Important species of Agroforestry; Indigenous fruits of Jharkhand.

CONSULTANCIES

- Memorandum of Understanding (MOU) between the Institute of Forest Productivity, Ranchi and NGOs signed on 24th October 2008 for implementation of sanctioned project on "Biodiversity Conservation through Community based Natural Resource Management" in the state of Jharkhand being funded under GOI-United Nations Development Programme–CCF-II.
- Consultancy job on "Preparation of Conservation Plan of the specified Faunas at Karo and Tetariakhar OCP" for obtaining environmental clearance from MOEF of the mining projects of CCL, Ranchi for a period of 3 months.
- Consultancy services for "Bio diversity Assessment Report" for the proposal of 2000 MW Pit Head Thermal Power Station and Chakla Coal Mine of Essar Power (Jharkhand) Limited, Ranchi for a period of 6 months.
- Memorandum of Understanding (MOU) between the IFP, Ranchi and an NGO 'GRAM GAURAV', Hapamuni, P.O. - Gumla, Jharkhand executed for the purpose of developing a Model Village at Hapamuni under establishment of Demo Village for extension technologies on forestry research.

CONFERENCE/MEETINGS WORKSHOPS/SYMPOSIA/EXHIBITIONS

Attended

The representatives from Institute of Forest Productivity, Ranchi attended the Workshops/ Seminars/Conferences/Symposia as given below during the period under report:

- The Institute participated in an exhibition of the products organized by NABARD at Hotel Ashoka, Ranchi on 12th May 2008.
- The Institute participated in a ten days Rural Exhibition-cum-Fair–"Sunderban Kristi Mela-O-Loko- Sanskriti Utsab held from 20th to 29th December 2008" organized by Kultali Milon Tirtha Society, South 24 Parganas, West Bengal. Award of 3rd Pavallion Prize was received by Dr Rajiv Rai on behalf of the Institute from Shri Kantilala Ganguly, Hon'ble Minister for Development of Sunderban, West Bengal.

Dr. Rajeev Rai receiving 3rd Pavallion Prize

- Training programme on "Environment Impact Assessment" organized at Wild life Institute of India, Dehradun from 18th to 22nd August 2008 under HRD Plan for skill upgradation at various levels.
- Second National Conference of Zoology on Recent Trends in Ecological Researches in India with Focus on Jharkhand 2NCZ 2008 organized from 17th to 19th November 2008 under the auspices of Suraj Singh Memorial College, Ranchi.
- Workshop on "Forestry for Common People" organized by ICFRE at Dehradun on 25th November 2008.
- National Workshop on "Extension Strategy in Forestry Research" organized by Directorate of Extension, Indian Council of Forestry Research & Education, Dehradun on 15th and 16th January 2009.

- National Seminar on "Medicinal Plants Seminar-cum-Buyers and Sellers Meet" organized jointly by BAU, Ranchi and NMPB on 28th January 2009.
- "Agrotech – 2009 Kisan Mela" organized during 26th to 28th February 2009 by Birsa Agricultural University, Ranchi.
- International Conference on "Improvement of Bamboo Productivity & Marketing for Sustainable Livelihood" organized from 15th to 18th April 2008 by National Bamboo Mission at New Delhi.

Organized

- A workshop on GOI-UNDP CCF-II project titled "Biodiversity Conservation through Natural Resource Management in the State of Jharkhand" was organized by the Institute on 2nd August 2008.
- A workshop on "Preparation of People's Biodiversity Register under Biological Diversity Act 2004" was organized by the Institute on 19th and 20th December 2008 under UNDP-CCF-II Project – Biodiversity Conservation through Community Based Natural Resources Management.
- One day workshop was conducted on 5th March 2009 at Udai Singh Jote under the project "Conservation of Medicinal Plants through Commercial Cultivation & value Addition by JFM & Farmers in Eastern Himalaya and its socio-economic Impact".
- Awareness meeting on "Importance and Cultivation of *Jatropha curcas"* was organized on 25th and 26th March 2009 at Forest Research Centre, Mandar, Ranchi.

AWARDS

- Sri Satya Prakash Mishra, JRF under the project "Domestication, Mass Multiplication and Popularization of *Moringa oleifera* genotypes with Superior Leaf Nutritive and Cytokinin Content" received 'Young Researcher Award – First Prize' in National Conference on "Recent Trends in Ecological Research in India", from 17th to 19th November 2008 Ranchi.

DISTINGUISHED VISITORS

- Dr. Shashi Kumar, Director (Research) visited the Institute on 1st April 2008 in connection with the evaluation of SASVPS Project.
- Shri B. S. Sajwan, CEO, NMPB, New Delhi and Shri Shiv Basant, Joint Secretary, Ministry of Health & Family Walefare, GoI, New Delhi visited the Institute on 28th April 2008.

MISCELLANEOUS

- The Institute celebrated "International Day on Biological Diversity" on 22nd May 2008.
- Vigilance Awareness Week from 7th to 14th November 2008 was celebrated by the Institute.

Chapter 4

AUDITED ANNUAL ACCOUNTS

G. K. PATET & CO.
CHARTERED ACCOUNTANTS

Tel. : 0135 - { 2658411 / 2650215
Fax : 0135-2658411
(R) 0135-6537028

Office :
'Abhishek Tower'
Ist Floor,
14, Subhash Road,
DEHRA DUN - 248 001

AUDIT REPORT

We have audited the attached Balance sheet of **INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN as at 31st March, 2009** and the annexed Income & Expenditure Account for the year ended on that date, These Financial Statements are the responsibility of the Council's Management. Our responsibility is to express an opinion on these financial statements based on our audit.

We have conducted our audit in accordance with the accounting, standards generally accepted in India, Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material mis-statements. An audit includes examining on test basis evidence supporting the accounting and disclosures in the financial statements. An audit also includes assessing the accounting principles and significant estimates made by the management as well as evaluating the overall financial statements presentation. We believe that our audit provides a reasonable basis of our opinion.

In our opinion and to the best of our information and according to the explanations given to us the said accounts give a true and fair view, read along with Notes on Accounts annexed herewith as Annexure "O"

i) In the case of the Balance sheet of the State of Affairs of the above named Council as at 31st March, 2009

ii) In the case of the Income & Expenditure Account, of the **SURPLUS** for the year ended on 31st March, 2009

For G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.Patet)Partner
Chartered Accountant.
M.No.15736

DATED : 17.08.2009
PLACE : DEHRA DUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2009

PREVIOUS YEAR	LIABILITIES	AMOUNT	TOTAL AMOUNT
	CAPITAL FUND		
1,387,629,115	Opening balance	1,387,629,115	
	Add : Transferred from General Reserve	91,918,875	
	Less: Depreciation	112,221,257	1,367,326,733
217,323,532	**GENERAL FUND**		
	(As Per Annexure 'A')		264,286,976
1,053,509,407	**PENSION FUND / GPF / GSLIS/NEW PEN.SCH.**		
	(As Per Annexure 'B')		1,125,033,295
	CURRENT LIABILITIES & LOANS		
119,287	Amount Payable to Controller ICFRE		
	(As Per Annexure 'C')		154,355
25,999	Amount Payable to PAO, New Delhi		
	(As Per Annexure 'D')		43,279
158,084	Amount Payable to Other Units		
	(As Per Annexure 'E')		223,006
4,297,421	Amount Payable to Others		
	(As Per Annexure 'F')		4,628,262
141,375,969	Project Balances		143,452,945
7,175,363	EMD/Security		8,233,740
	(As Per Annexure 'G')		
2,811,614,177	**TOTAL**		2,913,382,591

NOTES ON ACCOUNTS ANNEXURE: "O" ANNEXED TO AND FORMING PART OF BALANCE SHEET , INCOME EXPENDITURE ACCOUNT.

JAGDISH KISHWAN, (Director General, ICFRE)

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
DATED:17.08.2009
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2009

PREVIOUS YEAR	ASSETS	TOTAL AMOUNT
	FIXED ASSETS	
1,387,629,115	**Fixed Assets** (As per Annexure 'H')	1,367,326,733
0	**Work In Progress**	0
83,528,410	**Advance for Capital Works** (As per Annexure 'I')	89,834,334
	INVESTMENTS	
	CURRENT ASSETS, LOANS & ADVANCES	
	A. CURRENT ASSETS	
1,295,860,983	**CASH & BANK BALANCES** (As per Annexure 'J')	1,409,393,884
	B. LOANS & ADVANCES	
28,499,945	Staff Advances (As per Annexure 'K')	28,992,062
6,663,663	Recoverable from Controller ICFRE (As per Annexure 'L')	10,903,819
7,660,835	Recoverable from PAO, New Delhi (As per Annexure 'M')	5,160,533
1,771,226	Recoverable from Other Units (As per Annexure 'N')	1,771,226
2,811,614,177	**TOTAL**	2,913,382,591

NOTES ON ACCOUNTS ANNEXURE: "O" ANNEXED TO AND FORMING PART OF BALANCE SHEET ,INCOME EXPENDITURE ACCOUNT.

JAGDISH KISHWAN, (Director General, ICFRE)

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
DATED:17.08.2009
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2009

PREVIOUS YEAR	INCOME	AMOUNT	TOTAL AMOUNT
	GRANT IN AID		
	PLAN		
276,500,000	- GENERAL COMPONENT	879,300,000	
263,500,000	-RESEARCH	-	879,300,000
	NON PLAN		
155,000,000	- GENERAL COMPONENT	176,900,000	
15,500,000	- RESEARCH	-	
	- K.V.S. (SHAIRING COST)	4,033,547	180,933,547
	PLAN		
50,000,000	- NORTH EAST	50,000,000	50,000,000
30,401,583	**Revenue Receipts**		42,121,879
790,901,583	**TOTAL**		**1,152,355,426**

NOTES ON ACCOUNTS ANNEXURE: "O" ANNEXED TO AND FORMING PART OF BALANCE SHEET ,INCOME EXPENDITURE ACCOUNT.

JAGDISH KISHWAN, (Director General, ICFRE)

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
DATED:17.08.2009
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION
INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2009

PREVIOUS YEAR	EXPENDITURE	AMOUNT	TOTAL AMOUNT
	NON PLAN (GENERAL COMPONENT)		
82,290,997	Salary Research	72,220,512	
72,511,288	Salary Non Research	68,165,932	140,386,444
	NON PLAN		
15,535,607	Payment to KVS	36,614,327	36,614,327
	PLAN (GENERAL COMPONENT)		
	Salaries		
154,193,708	Research Staff	308,514,109	
69,112,840	Non Research Staff	139,534,922	448,049,031
	Travelling Expenses		
6,824,358	Research Staff	9,257,279	
7,190,029	Non Research Staff	8,170,072	17,427,351
109,814,263	**O.E. (Research Staff)**		154,276,022
	Plan (Research)		
2,180,259	Publication	1,598,130	
7,653,762	M & S (Lab. Contingencies)	8,219,057	
55,409,858	Minor Work / Maintenance	64,323,872	
-	Building & Roads	-	74,141,059
	Plan (North East)		
	Expenses incurred		24,299,258
-	**Depreciation**		112,221,257
49,975,770	**GRANT TO UNIVERSITIES**		49,928,507
30,000,000	Grant to Pension Fund	30,000,000	
30,800,000	Revenue Paid to Pension Fund	36,200,000	66,200,000
97,408,844	Excess of Income Over Expenditure		28,812,170
790,901,583	**TOTAL**		**1,152,355,426**

NOTES ON ACCOUNTS ANNEXURE: "O" ANNEXED TO AND FORMING PART OF BALANCE SHEET ,INCOME EXPENDITURE ACCOUNT.

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

JAGDISH KISHWAN, (Director General, ICFRE)

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
DATED:17.08.2009
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
DETAILS OF GENERAL FUND AS ON 31ST MARCH 2009

ANNEXURE A	TOTAL
GENERAL FUND	
Opening	217,323,532
Add : Excess Of Income Over Expenditure	28,812,170
Add: Depreciation	112,221,257
Add : Received from other units	40,410,371
Less : Transferred to Revenue ICFRE	42,561,478
Less : Transferred to Capital Fund	91,918,875
	264,286,976

JAGDISH KISHWAN, (Director General, ICFRE)

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
DETAILS OF PENSION FUND AS ON 31ST MARCH 2009

ANNEXURE B PENSION FUND / GPF / GSLIS/NEW PEN.SCH.	GPF	GSLIS	PENSION/ NEW PENSION	TOTAL
Opening	219,020,231	235,826	834,253,350	1,053,509,407
Add : Excess Of Income Over Expenditure	2,284,219	10,087	108,828,232	111,122,538
Add : Tfd.from General Fund			0	0
Saving Fund under GSLIS		327,308		327,308
Death Claim		502,721		502,721
Received from PAO	0		3,325,897	3,325,897
Subscription/contribution	55,340,324	1,613,658	15,127,297	72,081,279
New Pension Scheme			777,454	777,454
Misc. receipts	16,768	102,069	17,351	136,188
	55,357,092	2,545,756	19,247,999	77,150,847
Less :				
Death Claim Paid		609,235		609,235
Saving Fund		348,129		348,129
Subscription to LIC		1,652,754		1,652,754
GPF Advance Reimbursement	16,139,449			16,139,449
GPF Part/Final Payment	23,868,090			23,868,090
GPF Final Payment	9,843,882			9,843,882
Pensionary Benefit paid			57,141,726	57,141,726
DCRG			7,138,028	7,138,028
ISO Charges	5,088	1,667	1,448	8,203
	49,856,509	2,611,785	64,281,202	116,749,496
TOTAL:	**226,805,033**	**179,884**	**898,048,379**	**1,125,033,295**

JAGDISH KISHWAN, (Director General, ICFRE)

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

PART OF ANNEXURE B :

PENSION-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2009

INCOME	AMOUNT
GRANT IN AID	
Received through DDG(ADMIN)	30,000,000
Received from Revenue ICFRE	36,200,000
Interest	42,627,377
	108,827,377
EXPENDITURE	
Excess Of Income Over Expentiture	108,827,377
	108,827,377

GPF-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2009

INCOME	AMOUNT
Interest & Dividend	2,284,219
	2,284,219
EXPENDITURE	
Excess Of Income Over Expentiture	2,284,219
	2,284,219

GSLIS-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2009

INCOME	AMOUNT
Interest	10,087
	10,087
EXPENDITURE	
Excess Of Income Over Expentiture	10,087
	10,087

NEW PENSION ACCOUNT INCOME & EXPENDITURE A/C FOR THE YEAR ENDING 31ST MARCH 2009

INCOME	AMOUNT
Interest	855
	855
EXPENDITURE	
Excess Of Income Over Expentiture	855
	855

G.K. PATET & CO. Dehradun Chartered Accountants
17 AUG 2009

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2009

ANNEXURE C	TOTAL
Amount Payable to Controller ICFRE	
GPF Subscription / Refund	87,379
GSLIS	345
Pension Contribution	57,590
New Pension Scheme	9,041
	154,355

ANNEXURE D	TOTAL
Amount Payable to PAO New Delhi	
GPF Subscription/Refund	31,313
CGGEIS	9,220
Any Other Recovery	2,746
	43,279

ANNEXURE E	TOTAL
Amount Payable to Other Units	
Saving Fund	64,071
Death Claim	44,013
Advance Recovery	114,371
CGEIS	551
	223,006

ANNEXURE F	TOTAL
Amount Payable to Others	
LIC	712,984
T.D.S./Service Tax /Professional Tax	48,582
Payble to Conttroller ICFRE	3,186,789
Misc. Recoveries	679,907
	4,628,262

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2009

ANNEXURE 'G'	TOTAL
SECURITY/EMD	8,233,740
	8,233,740

ANNEXURE 'I'	TOTAL
Advance for Capital Works/Equipment	
CPWD	-
CCU	89,834,334
SCIENTIFIC EQUIPMENTS	-
I.T.EQUIPEMTNS	-
	89,834,334

ANNEXURE 'J'	TOTAL
Cash In Hand	927,517
Cash at Bank	319,029,793
FDRs	1,087,901,628
EMD	1,534,946
	1,409,393,884

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'H'

Details of Fixed Assets as on 31st March 2009

	OPENING BALANCE AS ON 01/04/08	ADDITIONS	ADJUSTMENTS	GROSS BALANCE AS ON 31/03/09	DEPRICIATION	CLOSING BALANCE AS ON 31/03/09
PLAN ASSETS						
Land	5,072,750	1,128,270	-	6,201,020	-	6,201,020
Scientific Equipments	114,797,380	53,478,885	-	168,276,265	21,230,523	147,045,742
Furniture & Fixtures	11,915,854	57,012	-	11,972,866	1,194,436	10,778,430
Books & Journals	39,398,619	4,762,678	-	44,161,297	6,266,994	37,894,303
Vehicles	13,845,532	4,696,235	-	18,541,767	2,429,047	16,112,720
Building & Road	1,059,951,716	3,050,000	-	1,063,001,716	53,073,836	1,009,927,880
Office Equipments	132,118,104	3,702,416	-	135,820,520	20,095,397	115,725,123
Tools & Equipments	6,263,850	-	-	6,263,850	939,578	5,324,273
Electrical Fittings	4,179,452	-	-	4,179,452	626,918	3,552,534
IT Equipments	85,858	21,043,379		21,129,237	6,364,529	14,764,709
TOTAL	**1,387,629,115**	**91,918,875**	**-**	**1,479,547,990**	**112,221,257**	**1,367,326,733**

NOTES ON ACCOUNTS ANNEXURE: "O" ANNEXED TO AND FORMING PART OF BALANCE SHEET , INCOME EXPENDITURE ACCOUNT.

NOTE: Depriciation on additions has been charged for half year

"AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED"
FOR G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.PATET)Partner
Chartered Accountant
Membership No. 15736
DATED:17.08.2009
PLACE: DEHRADUN

JAGDISH KISHWAN, (Director General, ICFRE)

M.S GARBYAL , (Dy. Director General, Admin., ICFRE)

S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2009

ANNEXURE K :	TOTAL
STAFF ADVANCES	
> Forest Advance	6,416,437
> Festival Advance	654,480
> Car Advance	630,515
> Scooter Advance	4,001,822
> Cycle Advance	84,001
> House Building Advance (HBA)	9,081,489
> TTA Advance	948,269
> LTC Advance	992,266
> Pay Advance	177,130
> Medical Advance	1,383,920
> Computer Advance	765,800
> TA Advance	1,162,869
> Other Advances	2,693,064
	28,992,062

ANNEXURE 'L'	TOTAL
Amount Recoverable from Controller ICFRE	
GPF Advance	2,105,525
DCRG	6,111,583
Provisional Pension	188,130
GPFPart/Final Payment	2,498,581
	10,903,819

ANNEXURE 'M'	TOTAL
Amount Recoverable from PAO, NEW DELHI	
GPF Advance	1,989,130
CGEGIS	963,856
DCRG	1,899,011
Provisional Pension	282,136
GPF Part/ Final Payment	26,400
	5,160,533

ANNEXURE 'N'	TOTAL
Amount Recoverable from Other Units	
DDOs (Premium for the month of March)	168,944
Deputation & Others	12,168
Service Tax	87,894
International Work Shop	1,500,000
GPF Subscription	2,220
	1,771,226

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

G. K. PATET & CO.
CHARTERED ACCOUNTANTS

Tel. : 0135 - { 2658411 / 2650215
Fax : 0135-2658411
(R) 0135-6537028

Office :
'Abhishek Tower'
Ist Floor,
14, Subhash Road,
DEHRA DUN - 248 001

NOTES TO ACCOUNT – ANNEXURE:-"O" FORMING PART OF BALANCE SHEET AS & INCOME EXPENDITURE ACCOUNT AS ON 31ST MARCH 2009

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION DEHRADUN

1. **SYSTEM OF ACCOUNTING**:
The Institute follows cash basis system of accounting.

2. **FIXED ASSETS**:
The fixed assets on written down value as per schedule H are annexed with the balance sheet ,the management have also compiled schedule of assets showing the gross value of the fixed assets as per Annexure "P" and these have not been verified by us.

3. **DEPRECIATION:**
Depreciation during the year was charged on Written Down Value Basis (WDV)method as per the rates prescribed by the Income Tax Act 1961 and routed through Income expenditure Account. The amount of depreciation has been added to General Fund and deducted from Capital Fund to match the Fixed Assets and Capital Fund balance.
The Depreciation on additions during the year was charged for six months

4. **PROVISIONS:**
Since the books of accounts are being maintained on cash basis no provisions for liabilities like retirement benefits and contingent liabilities, if any is being made.

5. **PROJECT BALANCE**:
The opening balance of units , balance outstanding under various projects and inter unit balances are subject to reconciliation.

6. **PENSION FUND:**
The amount recoverable from controller has been arrived on the basis of data produced by the unit and after reconciling the same with the books of the controller ,pension cell.
The council has been accounting interest on the maturity of FDRs and the actual liability in respect of pension has not determined by the actuary.

G.K. PATET & CO. Dehradun Chartered Accountants
17 AUG 2009

G. K. PATET & CO.
CHARTERED ACCOUNTANTS

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Ist Floor,
14, Subhash Road,
DEHRA DUN - 248 001

7. Grant in aid (Plan General Component) received during the year includes Rs3.00 crores pertaining to Financial Year 2007-08.
Grant in aid (Non Plan General Component) received during the year includes Rs 0.69 crores pertaining to Financial. Year 2007-08.

8. The previous year figures have been regrouped wherever necessary.

For G.K.PATET & CO.,
CHARTERED ACCOUNTANTS

G.K. PATET & CO. Dehradun Chartered Accountants

(G.K.Patet)Partner
Chartered Accountant.
M.No.15736
DATED : 17.08.2009
PLACE : DEHRA DUN

JAGDISH KISHWAN,(Director General, ICFRE)

M.S.GARBYAL,(Dy Director General, Admin, ICFRE)

S.D.Sharma (Asstt. Director General, Admin.,ICFRE)

D.CHATTOPADHYAY,(Fin.Adviser & Chief Accounts Officer, ICFRE)

ANNEXURE 'P'

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN

Details of Fixed Assets as on 31st March 2009

Particulars of Assets	Gross Block of Assets at Cost				Depreciation				Net Block	
	Cost/Valuation as at 01.04.2008	Addition during the year	Deduction during the year	As at 31.03.2009	Depreciation upto 31.03.2008	Depreciation during the year	Adjustment	Total	As at 31.03.2009	As at 31.03.2008
Land	5072750.00	1128270.00	0.00	6201020.00	0.00	0.00	0.00	0.00	6201020.00	5072750.00
Scientific Equipment	224476196.00	53478885.00	0.00	277955081.00	109678816.00	21230523	0.00	130909339.00	147045742.00	114797380.00
Furniture & Fixtures	21777476.00	57012.00	0.00	21834488.00	9861622.00	1194436	0.00	11056058.00	10778430.00	11915854.00
Books & Journals	104367983.00	4762678.00	0.00	109130661.00	64969364.00	6266994	0.00	71236358.00	37894303.00	39398619.00
Vehicles	37519635.00	4696235.00	0.00	42215870.00	23674103.00	2429047	0.00	26103150.00	16112720.00	13845532.00
Building & Road	1457812328.00	3050000.00	0.00	1460862328.00	397860612.00	53073836	0.00	450934448.00	1009927880.00	1059951716.00
Office Equipments	340333752.00	3702416.00	0.00	344036168.00	208215648	20095397	0.00	228311045.00	115725123.00	132118104.00
Tools & Equipments	18117189.00	0.00	0.00	18117189.00	11853339	939578	0.00	12792917.00	5324272.00	6263850.00
Electrical Fittings	12098736.00	0.00	0.00	12098736.00	7919284.00	626918.00	0.00	8546202.00	3552534.00	4179452.00
I T Equipments	122655.00	21043379.00	0.00	21166034.00	36797.00	6364528.00	0.00	6401325.00	14764709.00	85858.00
Total	2221698700.00	91918875.00	0.00	2313617575.00	834069585.00	112221257.00	0.00	946290842.00	1367326733.00	1387629115.00

NOTE: Depreciation on addtions has been charged for half year

JAGDISH KISHWAN, (Director General, ICFRE)

M.S. GARBYAL, (Dy. Director General, Admin., ICFRE)

S.D. SHARMA, (Asst. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN

RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2009

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
OPENING BALANCE AS ON 1-4-2008			**NON PLAN**		
To Cash in Hand			By Salaries (Technical Staff)	72,220,512	
Name of Component	-		By Salaries (Non Technical Staff)	68,165,932	
Plant (GC)	852,547		By Salaries (Research KVS)	36,614,327	177,000,771
Plan (Research)	-				
Non-Plan (GC)	-		**Plan (General Components)**		
		852,547	By Salaries (Technical Staff)	308,514,109	
			By Salaries (Non Technical Staff)	139,534,922	
To Cash at Bank			By T.E. (Technical Staff)	9,257,279	
A/c No. & Name of Component	-		By T.E. (Non Technical Staff)	8,170,072	
Plant (GC)	247,439,877		By O.E. (Technical)	-	465,476,382
Plan (Research)	18,175,160		Maintenance of Vehicle		
Non-Plan (GC)	1,212,374		- Fuel	7,363,195	
To Earnest Money	1,368,582	268,195,993	- Repair	4,739,644	
			- Road Taxes / Insurance	1,029,006	
To FDRs			Electricity Charges	27,091,507	
A/c No. & Name of Component	-		Telephone charges	4,797,352	
Plant (GC)	1,026,812,445		Maintenance of Equipments		
Plan (Research)	-		- Scientific	4,613,740	
		1,026,812,445	- Office	3,405,694	
			- I.T. Equipments / Services	7,674,121	
Grants-in-Aid			Others		
To Plan (General Component)	879,300,000		- Water Charges	2,070,811	
Less Paid to Centre	-		- Stationery	2,717,204	
To Plan DDG(Edu.)	342,493		- Contingency Expenditure	27,609,891	
Less Paid to Centre	-		- Legal / Consultancy charges	3,772,753	
To Non Plan (General Component)	140,285,673		- Municipal Tax	1,450,231	
To Non-Plan (KVS)	36,614,327		- Medicines / X-ray	5,542,551	
To North East	50,000,000	1,106,542,493	- Liveries	351,706	
To Shairing Cost		4,033,547	- Postal / Stamp Charges	740,353	
To Revenue Receipt From D.D.Os		40,410,371	- Advertisement	1,294,440	
To Revenue Receipt Payable to DGICFRE		42,121,879	- Seminar / Conference / HRD	6,472,685	
To Amount Received from DG ICFRE Revenue		36,200,000	- Newspaper Bill	405,925	
			- Extension - Normal	1,609,730	
			- V.V.K. & Dema Villages	10,987,034	
			- Rent building / Equipment	519,379	126,258,951
			Plan (Research)		
			By Fellowship/Scholarship/cash Awards	4,462,463	
			Printings & Publication	1,598,130	
			Field Research Expenses	23,554,608	
			By M & M (Lab Contingencies)	8,219,057	
			By Minor Works/Maintenance	64,323,872	
			Conveyance Advances	-	
			HBA	-	
			By Building & Roads	4,178,270	106,336,400
			By Equipments		
			Scientific Equipments	43,103,244	
			Office Equipments	3,702,416	
			I.T. Equipments/Services	15,311,238	
			Furniture & Fixture	57,012	
			Books & Journals	4,762,678	
			Vehicles	1,959,586	
			By Grants to Universities	50,271,000	119,167,174

G.K. PATET & CO. Dehradun Chartered Accountants

17 AUG 2009

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2009

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
			North East Plan		
			Equipments / Vehicle (7283706+2736649)	10,020,355	
			Expenses incurred	24,299,258	34,319,613
			By Advance Payments		
			CCU -North East	15,130,000	
				-	15,130,000
			By Advance Payments		
			Scientific Equipments	-	
			Office Equipments	-	
			I T Equipments	-	
			Furniture & Fixture	-	
			Books & Journals	-	-
To Revenue Receipt Payable to own Revenue Account No.		19,603,560	**To Revenue Receipt paid to own Revenue Account No.**		18,663,916
			By Revenue Receipt paid to D.G. ICFRE		42,561,478
			By Revenue Receipt paid to Controller ICFRE		36,200,000
To Securities / EMD			By EMD/Security Refunded		2,734,152
Plan (GC)	3,787,529				
Plan (Res)	5,000	3,792,529			
GRANT TO UNIVERSITY:		-			
To Reimbursement from PAO (F) New Delhi			**By Payments made on Behalf of PAO (F) New Delhi**		
GPF Advance	7,506,481		GPF Advance	5,006,179	
CGEGIS	-		CGEGIS	-	
DCRG	-		DCRG	-	
Provisional Pension	-		Provisional Pension	-	
GPF Part/Final Payments (Group'D')	-	7,506,481	GPF Part/Final Payments (Group'D')	-	5,006,179
To Reimbursement from Controller, ICFRE			**By Payments made on Behalf of the Controller, ICFRE**		
GPF Advance	15,515,639		GPF Advance	15,746,148	
DCRG	5,871,172		DCRG	8,955,997	
Provisional Pension	-		Provisional Pension	-	
GPF Part/Final Payments (Group'D')	183,545	21,570,356	GPF Part/Final Payments (Group'D')	1,108,367	25,810,512
To Recoveries from Staff on behalf of PAO (F), New Delhi			**By Payment made to PAO (F) on behalf of Staff**		
GPF Subscription	4,994,425		GPF Subscription	4,981,425	
Refund of GPF Advance	2,251,643		Refund of GPF Advance	2,249,988	
CGEGIS	87,060		CGEGIS	84,435	
House Building Advance	-		House Building Advance	-	
Interest on House Building Advance	54,091		Interest on House Building Advance	54,091	
Car Advance	24,000		Car Advance	24,000	
Interest of Car Advance	-		Interest of Car Advance	-	
Scooter Advance	-		Scooter Advance	-	
Interest of Scooter Advance	-	7,411,219	Interest of Scooter Advance	-	7,393,939

G.K. PATET & CO. Dehradun Chartered Accountants

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INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2009

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Receipt from Staff on behalf of other Offices			**By Payments made to other offices on Behalf of Staff**		
GPF Subscription / Refund	4,047,648		GPF Subscription / Refund	4,055,768	
CGEGIS	96,700		CGEGIS	96,454	
H B A	605,276		H B A	556,760	
Interest on House Building Advance	230,192		Interest on House Building Advance	230,192	
Car Advance	121,410		Car Advance	115,430	
Interest of Car Advance	38,200		Interest of Car Advance	38,200	
Scooter Advance	9,250		Scooter Advance	10,000	
Interest of Scooter Advance	-		Interest of Scooter Advance	-	
Etc. (Please specify)	670,696	5,819,372	Etc. (Please specify)	651,646	5,754,450
To Recoveries from Staff on Behalf of Controller, ICFRE			**By Payments to Controller, ICFRE on Behalf of the Staff**		
GPF Subscription	46,975,130		GPF Subscription	46,877,430	
Refund of GPF Advance	10,364,431		Refund of GPF Advance	10,461,881	
GSLIS	1,616,078		GSLIS	1,616,460	
Pension Contribution	14,750,330		Pension Contribution	14,715,508	
New Pension Scheme	476,988		New Pension Scheme	476,610	
Employer's Share	205,041	74,387,998	Employer's Share	205,041	
			DCRG	-	74,352,930
To Recoveries of Advances from Staff on Behalf of, ICFRE			**By Advances paid to Staff**		
Forest Advance	68,729,128		Forest Advance	68,778,805	
Festival Advance	1,326,180		Festival Advance	1,505,430	
Car advance	108,633		Car advance	545,980	
Interest Car Advance	12,000		Interest Car Advance	12,000	
Scooter Advance	1,673,631		Scooter Advance	994,865	
Interest Scooter Advance	24,953		Interest Scooter Advance	24,229	
Cycle Advance	56,245		Cycle Advance	34,800	
Interest Cycle Advance	2,376		Interest Cycle Advance	2,376	
House Building Advance (HBA)	1,589,335		House Building Advance (HBA)	1,268,364	
Interest House Building Advance	172,256		Interest House Building Advance	112,064	
TA Advance	22,530,413		TA Advance	22,489,165	
LTC Advance	4,738,701		LTC Advance	4,526,757	
TTA Advance	739,802		TTA Advance	1,256,810	
Medical Advance	2,243,118		Medical Advance	2,410,645	
Pay Advance	223,068		Pay Advance	194,753	
Computer Advance	144,200		Computer Advance	200,000	
Etc. (Please specify)	8,936,527	113,250,566	Etc. (Please specify)	9,385,640	113,742,683
To Recoveries from Staff on behalf of Others			**By Payments made to other Offices on Behalf of Staff**		
			By Payments		
By Recoveries Income Tax (Salary)	28,108,446		By Recoveries Income Tax (Salary)	28,066,349	
TDS (Contractor/Firms, Service Tax	3,253,210		TDS (Contractor/Firms, Service Tax	3,289,251	
Professional Tax)	431,235		Professional Tax)	426,047	
PPF	-		PPF	-	
LIC	2,376,395		LIC	2,375,677	
EMD / Securities	2,508,032		EMD / Securities	2,162,773	
Court Attachment	-		Court Attachment	-	
Hindi Translation	-		Hindi Translation	-	
Quarter Rent	-		Quarter Rent	-	
Staff Association	-		Staff Association	-	
Etc. (Please specify)	9,620,962	46,298,280	Etc. (Please specify)	10,586,986	46,907,083
			Any other Payment (Please specify)		-

G.K. PATET & CO. Dehradun Chartered Accountants

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INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2009

RECEIPTS	AMOUNT	TOTAL AMOUNT	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Project Receipts / Revenue Receipt		194,713,005	**By Project Payments/Revenue**		192,636,030
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	16,139,449	
			By GPF Part Final payment	23,868,090	
			By GPF Final payment	9,843,882	
Amount received from Various DDO'S on account of GPF Subscription	55,923,986		Death Claims paid	609,235	
			Saving fund paid	348,129	
			Amount of premium to LIC for GSLIS Subscription	1,652,754	
Amount received from Others on account of refund of excess GPF Payments	-		Pensionary benefit paid	57,141,726	
			Reimbursement of DCRG, Pension to	7,138,028	
			Various DDO's	8,203	
			ISO Charges	2	116,749,498
Closer of New Pension Accounts	777,454				
Bank & FDR Interest	44,922,538				
Amount received on account of Saving			**By Closing Balance**		
Funds under GSLIS	327,308		Cash-in-hand	927,517	
Amount received on account of Death			Name of Component	-	
Claim under GSLIS	502,721		Cash at Bank with different institutes/units.	-	
Subscription from variuos DDOs	1,613,658		Plan (GC) / Revenue / Project	308,203,593	
Pro-rata Pensionary benefit received from PAO (F)	3,325,897		Plant (North East)	4,038,930	
			Non Plan including share cost	6,787,270	
Amount received from Various DDO's on account of Pension Contribution	14,543,635		Non Plan A/c	-	
			Name of Component	-	
Amount recovere on account of ecvess payment of pension by bank	-		FDR's	1,087,901,628	
			EMD	1,534,946	1,409,393,884
Amount received from other Departments on account of Pensionery benefits	-				
Govt. Securities					
FDR Interest / SB interest					
Misc.	136,188	122,073,385			
		3,141,596,026			**3,141,596,026**

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S.D.SHARMA, (Asstt. Director General, Admin., ICFRE)

D. CHATTOPADHYAY, (Fin. Adviser & Chief Accounts Officer, ICFRE)

G.K. PATET & CO. Chartered Accountants Dehradun

17 AUG 2009

LIST OF ABBREVIATIONS

AGB	-	Above Ground Biomass
ACA	-	Ammonical Copper Arsenic
ADG	-	Assistant Director General
AESP	-	Acidified Exhausted Sandal Powder
AM	-	Arbuscular Mycorrhizae
AWTC	-	Advanced Wood Working Training Centre
BA	-	6-Benzyl Adenil
BAU	-	Birsa Agricultural University
BGT Div.	-	Biotechnology, Genetics & Tree Improvement Division
BR	-	Biosphere Reserve
BSI	-	Botanical Survey of India
CBNRM	-	Community Based Natural Resource Management
CCA	-	Copper Chrome Arsenic
CCB	-	Copper Chrome Boric
CEC	-	Cation Exchange Capacity
CF	-	Conservator of Forests
CG	-	Chhattisgarh
CIMAP	-	Central Institute of Medicinal and Aromatic Plants
CNSL	-	Cashew Nut Shell Liquid
CPT	-	Candidate Plus Tree
CSIR	-	Council for Scientific and Industrial Research
CSO	-	Clonal Seed Orchard
CTPS	-	Chanderpura Thermal Power Station
DBT	-	Department of Biotechnology
DDG	-	Deputy Director General
DFID	-	Department for International Development
DG	-	Director General
DNA	-	Deoxyribo Nucleic Acid
DVC	-	Damodar Valley Corporation
EBC Div.	-	Ecology & Biodiversity Conservation Division
EC	-	Exchangeable Capacity
ECM	-	Ectomycorrhizal Fungi

EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
e.mail	-	Electronic mail
EPN	-	Entomopathogenic Nematode
ERS	-	Environmental Research Station
ESP	-	Eletrostatic Precipitator
ETP	-	Entire Trans Planting
EWI	-	Earthwatch Institute
FDA	-	Forest Development Agencies
FMS Div.	-	Forest Management & Silviculture Division
FRC	-	Forest Research Centre
FRI	-	Forest Research Institute
FRO	-	Forest Range Officer
FS	-	Fibre Strength
FSI	-	Forest Survey of India
FT-IR	-	Fourier Transform Infrared
FTA	-	Forestry Training Academy
FYM	-	Farm Yard Manure
GA	-	Gibbrelic Acid
GC-MS	-	Gas Chromatography-Mass Spectrometry
GLC	-	Gas Liquid Chromatograph
GoI	-	Government of India
GPS	-	Global Positioning System
GUI	-	Graphical User Interface
HARP	-	Horticultural & Agroforestry Research Programme
HRD	-	Human Resource Development
HP	-	Himachal Pradesh
HPLC	-	High Pressure Liquid Chromatograph
IAA	-	Indole Acetic Acid
IARI	-	Indian Agricultural Research Institute
IBA	-	Indole Butyric Acid
ICFRE	-	Indian Council of Forestry Research & Education
IDRC	-	International Development Research Centre
IFGTB	-	Institute of Forest Genetics & Tree Breeding
IFP	-	Institute of Forest Productivity
IFRIS	-	Indian Forestry Research Information System

IINRG	-	Indian Institute of Natural Resins and Gums
ILRI	-	Indian Lac Research Institute
ISM	-	Indian School of Mines
IT	-	Information Technology
ITTO	-	International Tropical Timber Organization
IWST	-	Institute of Wood Science & Technology
JFMC	-	Joint Forest Management Committee
JFM	-	Joint Forest Management
JSFDCL	-	Jharkhand State Forest Development Corporation Ltd.
LAN	-	Local Area Network
L-DOPA	-	L-3,4-dihydroxyphenylalanine
MADP	-	Medicinal Aromatic and Dye Plants
MoE	-	Modulus of Elasticity
MoR	-	Modulus of Resistance
MoU	-	Memorandum of Understanding
MoEF	-	Ministry of Environment & Forests
MP	-	Madhya Pradesh
MPCA	-	Medicinal Plant Conservation Area
MS	-	Maharashtra
MTE	-	Mid Term Evaluation
MW	-	Microwave
NAA	-	Naptha Acetic Acid
NABARD	-	National Bank Agriculture & Rural Development
NAP	-	National Afforestation Programme
NBM	-	National Bamboo Mission
NERIST	-	North-East Regional Institute of Science and Technology
NERIWLM	-	North-East Regional Institute for Water and Land Management
NFT	-	Nitrogen Fixing Tree
NGO	-	Non Government Organization
NMBA	-	National Mission of Bamboo Application
NMPB	-	National Medicinal Plant Board
NRC	-	National Research Centre
NWFP	-	Non Wood Forest Products
PF	-	Project Formulation
PGPR	-	Plant Growth Promoting Rhizobacteria
PSB	-	Phosphate Solubulizing Bacteria

QPM	-	Quality Planting Material
RBD	-	Randomized Block Design
RPC	-	Research Policy Committee
SASVPESY	-	Samudai Adharit Samanvit Van Pravardhan Evam Sanrakshan Yojna
SEPC	-	Shellac Export Promotion Committee
SFD	-	State Forest Department
SLR Div.	-	Soil & Land Reclamation Division
SPM	-	Suspended Particulate Matter
SPA	-	Seed Production Areas
TBO	-	Tree Borne Oilseeds
TERI	-	The Energy and Resources Institute
TFT	-	Thin Film Transistor
TFRI	-	Tropical Forest Research Institute
TLC	-	Thin-Layer Chromatograph
UNDP	-	United Nation Development Programme
UNDP CCF-II	-	UNDP's Country Cooperation Framework–II
UV IR	-	Ultra Violet Infrared
VAM	-	Vesicular Arbuscular Micorrhizae
VPN	-	Virtual Private Network
VVK	-	Van Vigyan Kendra
WB	-	West Bengal
WPM	-	Woody Plant Media

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Indian Council of Forestry Research and Education (ICFRE Hq.), P.O. New Forest Dehradun - 248006	Shri Jagdish Kishwan, Director General Phone : 0135-2759382; 2224855 Fax : 0135-2755353 E-mail : dg@icfre.org	Dr. Sudhanshu Gupta, Secretary, ICFRE Phone: +91-135-2758614, 2752933 (R); Fax: +91-135-2750298 E-mail: sudhanshu@icfre.org sec@icfre.org	All matters related to ICFRE Hqrs., Dehra dun
Forest Research Institute, P.O. New Forest, Dehradun-248006	Dr. S.S. Negi, Director Phone : 0135-2224444, E-mail: negiss@icfre.org dir_fri@icfre.org	Shri A.S. Rawat, Group Coordinator (Res.), Phone: 2224316, 0135-2752670 (O) 2224580, 0135-2752621 (R)	All Research & Account matters
		Shri T.C. Nautiyal, Registrar, FRI University Phone : 0135- 2751826, 2224439 (O) 0135-2752183, 2224585 (R) Email : nautiyaltc@icfre.org	University matters
		Shri Piar Chand, Registrar, FRI Phone: 0135-2757021-26 (O) Extn: 4222, 0135-2752678 E-mail:	Establishment, Administrative & all other matters
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