

CHAPTER I

FOREST RESEARCH INSTITUTE DEHRA DUN

Forest Research Institute (FRI), Dehra Dun has its roots in the erstwhile Imperial Forest Research Institute established in 1906 to organize and lead forestry research activities in the country. The Institute caters in particular, to the research needs of the Indo-Gangetic plains of Punjab, Haryana, Chandigarh, Uttar Pradesh, and Uttranchal. This Institute is also a Deemed University and at present offers Post-Graduate courses in Forestry Economics & Management, Wood Science & Technology, Environment Management; Post-Graduate Diploma courses in Plantation Technology, Pulp and Paper Technology, Biodiversity Conservation and Doctoral programmes on various forestry aspects.

PROJECTS COMPLETED DURING THE YEAR 2001-2002

Project 1 : Flora of stress sites of Sultanpur and Raebareilly districts (UP) [FRI-98/Bot.-13/1997-2001]. For technical report contact, Principal Investigator - Dr. Veena Chandra.

Findings : Collected and identified 105 species of flowering plants from the stress sites of the two districts. Ethnobotanical information on 40 species has been collected from the stress and adjacent areas. Maximum diversity has been noted in the rainy season whereas summer season was most hostile to plant growth. Out of the medicinal plants collected from nearby villages, two promising species *Achyranthes aspera* and *Bacopa monnieri* have great market potential.

Project 2 : Selection, identification and evaluation of wild plant species for urban planting [FRI-99/ Bot.-14/1997-2001]. For technical report contact, Principal Investigator - Dr. Sumer Chandra.

Findings : Enumerated 100 wild species with details about the areas of phytogeographical significance, phenology, etc. Germplasm materials of 25 species were collected for multiplication and introduction. *Crateva religiosa*, *Sophora mollis*, *Pavetta indica*, *Mahonia nepalensis*, *Wigandia kunthii* etc. were introduced in Botanical Garden and Arboretum.

Project 3 : Survey, selection, *ex situ* conservation and propagation of Himalayan bamboos [FRI-100/Bot.-15/1997-2001]. For technical report contact, Principal Investigator - Dr. H.B. Naithani.

Findings : The survey and identification works related to the hill bamboos (ringal) revealed that the best quality hill bamboos are distributed in Yamuna and Mussoorie Forest Divisions of Uttaranchal.

Project 4 : Morphological studies on the infraspecific taxa of *Bambusa bambos* (Linn.) Voss and *Dendrocalamus strictus* (Roxb.) Nees. [FRI-114/Bot.-17/1998-2002]. For technical report contact, Principal Investigator - Mr. S.S. Jain.

Findings : 400 specimens of target species were studied for morphological variability typical of Himachal Pradesh, Jammu & Kashmir, Uttaranchal, Uttar Pradesh and Madhya Pradesh and examined for studying the variability at infraspecific level. Field observation on introduced and wild forms of the aforementioned species growing in New Forest and vicinity was completed.

Project 5 : Environmental protection through modified pulping and bleaching process Alkaline peroxide pulping and bleaching of Non woods [FRI-87/C&P-6/ 1998-2002]. For technical report contact, Principal Investigator - Dr. Sushma Mahajan.

Findings : The effluent generated in the bleaching of oxygen delignified soda pulp and soda pulp of kappa number 28 using CEH sequence was characterized. It was found that the effluent quality was improved in respect of total solids, suspended solids and COD.

Project 6 : Studies on modification of industrial lignin for imparting delignifying properties. [FRI-91/C&P-10/1998-2002]. For technical report contact, Principal Investigator - Dr. Sanjay Naithani.

Findings : New chemical additive was tested for its effectiveness with respect to increase in pulp yield, kappa number reduction, strength properties and response towards bleaching. The doses of chemical additives were optimized. Chemical additive had positive effect in terms of increase in pulp yield and kappa number reduction with adequate strength properties of the pulps. Optimum doses of chemical additive were in the range of 0.5% to 1.0% on oven dry raw material basis. The variation of doses depends on the properties required.

Project 7 : Regeneration, mortality and species diversity in sal forest of U.P. [FRI-22/Eco-1/1998-2002]. For technical report contact, Principal Investigator - Dr. J.D.S. Negi.

Findings : Sal (*Shorea robusta*) root system gets ramified extensively in the subterranean soil zone for nutrient supply and moisture. This assists sal in the absorption of nutrients with little interference of the plants of the community. The canopy gap size ranging from 90-135 m² had potentiality for sal establishment. *Syzygium cumini* has been identified as best indicator species for Sal (*Shorea robusta*) natural regeneration. *Flacourtia indica* has been identified as indicator of disturbances in the sal forest of Doon Valley. It was inferred that the moisture was the main factor responsible for the mortality of the sal in Barkot Forest Range.

Project 8 : Studies on partial replacement of phenol with cashew nut shell liquid (CNSL) oil based phenolic adhesive for plywood [FRI-105/FPD(CW)-18/1997-2002]. For technical report contact, Principal Investigator - Dr. S.P. Singh.

Findings : Cardanol based phenolic adhesive was prepared by replacing 60% of phenol with cardanol using sodium hydroxide as catalyst. These adhesives were used for making plywood. Plywoods were prepared using poplar and sal veneers and tested for glue adhesion strength. The results were encouraging.

Project 9 : Chemical modification of wood particles and fibers for enhanced durability and performance of solid wood reconstituted panels [FRI/110/FPD(WP)-23/1997-2001]. For technical report contact, Principal Investigator - Dr. Inder Dev.

Findings : *Eucalyptus hybrid* wood particles were prepared and treated and studied for their properties. In case of termite tests, slight attack was observed on acetylated board and no attack on formalin treated boards. Control samples were almost completely damaged.

Project 10 : Development and evaluation of eco-friendly wood preservative [FRI-112/FPD (WP)-25/1997-2002]. For technical report contact, Principal Investigator - Dr. Inder Dev.

Findings : Zinc fluoroborate impregnation in wood achieved by double treatment of borax and sodium fluoride solution by pressure method, followed with one hr. dip treatment in zinc chloride performed well against termites and fungus. Extractives of *Ipomoea carnea* in alcohol and benzene separated on column revealed presence of three major components and were found very effective against fungus. Copper liginosulphonate complex yield was four times less as compared to copper lignin. Both complexes were found very efficacious against *Poria monticola* and *Polyporous versicolor* at very low concentrations.

Project 11 : Evaluation of physical and mechanical properties of *Albizia chinensis*, *Cupressus cashmiriana* and *Chukrasia* spp. and classification and grading of timber for different end uses [FRI-152/FPD (TM)-34/2000-2001]. For technical report contact, Principal Investigator - Mr. J.D. Jain.

Findings: *Chukrasia* spp. and *Albizia chinensis* have been classified as suitable for use in construction, door frames and shutters, packing cases and crates, cabinet making, tool handles, furniture, flooring etc. on the basis of their physical and mechanical properties.

Project 12 : Evaluation of natural resistance in different clones/hybrids of *Populus deltoides* against important defoliators [FRI-76/FED-6/1997-2001]. For technical report contact, Principal Investigator - Mr. A.P. Singh.

Findings : Significant variations in leaf area eaten and pupal weight of the defoliator, *Clostera cupereata*



Larvae of *Clostera fulgurita*, a potential pest of Poplar in Northern India

exist amongst the 400 clones / hybrids of *Populus deltoides*. It is possible to differentiate, rank and identify these clones/hybrids in terms of their relative natural resistance to this defoliator. Some American clones have been identified as relatively more promising in terms of both relative natural resistance to the defoliator and growth performance.

Project 13 : Sustainable management of sodic soil [FRI-27/FSLR-4/1997-2002]. *For technical report contact, Principal Investigator - Dr. M.N. Jha.*

Findings : Using fly ash as an ameliorant for sodic soils can effectively solve the problem of its disposal and at the same time improve the bio-productive potential of land, which was otherwise lying waste due to sodicity. This study indicates significant variation in growth through application of various combinations of fertilizers.

Project 14 : Soil geological studies in the degraded land and problem soils for sustainable afforestation [FRI-84/FSLR-7/1998-2002]. *For technical report contact, Principal Investigator - Dr. A.K. Raina.*

Sub-project (i): Study the genesis of degraded lands and sodic soils through mineralogical studies.

Sub-project (ii): Investigate the ameliorative role of trees on sodic soils through mineralogical and micromorphological studies.

Findings : Studies carried out in the degraded lands of Raipur range of Mussoorie forest division suggest that relief and age acting on geology governs the existing soil conditions whereas effect of altitude and climate on geology gives rise to natural vegetation. The study further provided the diagnostic support to determine the interrelationship between geology, soil and vegetation as a useful tool for sustainable management of such sites.

The micromorphological and mineralogical studies carried out in sodic soils of eastern Uttar Pradesh revealed that the root and faunal activity has started making the soil porous. The calcic pan has started dissolving in to soft lime due to ameliorative role of trees in these sites. The findings of the studies have been compiled in the form of a project report.

Project 15 : Efficiency of organic vis-à-vis chemical fertilizer in improving the productivity of sodic soils [FRI-85/FSLR-8/1997-2002]. *For technical report contact, Principal Investigator - Dr. M.K. Gupta.*

Findings : Potential to use the organic fertilizing material (oil cakes) has not been explored adequately in our country. Most of the treatments containing oil cakes have shown better performance on the growth of the Eucalyptus in comparison to the chemical fertilizers. Biomass production was maximum under Neem cake treatment followed by Mustard cake. Favourable changes in the pit soil were recorded after adding these soil amendments.

Project 16 : Studies on sustainability of soil fertility in natural forest ecosystems of Doon Valley [FRI-123/FSLR-10/19982001]. *For technical report contact, Principal Investigator - Dr. M.N. Jha.*

Findings : All the field and laboratory studies related to soil, water, vegetation, litter, ground flora etc. for six sites have been completed.

Project 17 : Evaluation of the ameliorative role of tree plantation on soil properties in sodic areas [FRI-124/FSLR-11/1998-2001]. For technical report contact, Principal Investigator - Dr. S. D. Sharma.

Findings : The study carried out under different age groups of tree plantations indicated that three year old plantation do not ameliorate significantly. Nine years old plantations show remarkable amelioration effect up to 90 cm. Maximum girth and height of *Dalbergia sissoo* and maximum crown area of *Prosopis juliflora* were observed up to nine years. However, twelve years old plantations improved the physical and chemical properties of soils and turned the calcic pan very soft and powdery. The study further indicated that the mixed plantations were more efficient in improving the soil attributes in comparison to monoculture plantations. Among the monoculture plantations, *Leucaena leucocephala* has proved more efficient in ameliorating the sodic soils followed by *Prosopis juliflora*, *Dalbergia sissoo*, *Acacia nilotica*, *Eucalyptus* hybrid and *Terminalia arjuna*.

Project 18 : In vitro rejuvenation multiplication of Eucalyptus hybrid, chir pine, shisham, bamboo and neem.

Sub-Project: In vitro multiplication of teak and neem [F.R.I.-20/G&TP-2(iii)/1997-2001]. For technical report contact, Principal Investigator- Dr. S.K. Sharma.

Findings : Tissue culture-propagation methodology has been developed using nodal segments from mature trees which has the potential for mass multiplication of selected CPT's with traits of commercial significance. Regeneration of plants has also been achieved from leaf and internodal segment, which can be used in future genetics engineering studies. Somatic embryogenesis has been recorded using leaf and internodal segment from mature trees.



In vitro multiplication of *Dalbergia sissoo*

Project 19 : Genetic improvement of *Pinus roxburghii* including provenance research [FRI-21/G&TP-3/1997-2001]. For technical report contact, Principal Investigator- Mr. D.P. Uniyal.

Findings : The progenies raised from the seeds of CPT's belonging to H.P. & Kumaun region were established at New Forest, Dehra Dun to study the growth performance and subsequently for selection of superior genotypes to multiply them clonally. The data collected on specific gravity of wood belonging to 23 provenances sampled from provenance trial laid out at New Forest in 1981 has shown significant variation, thus this information may be used for selection of trees with desired specific gravity of wood depending on end use of wood. Based on growth performance at age 20 the ranking position has changed for provenance Nahan (H.P.), which has come to No 3 at the site New Forest, Dehra Dun. Nainital and Nurpur provenances are maintaining their superiority in height and diameter over other provenances even at age 20 years.

Project 20 : Studies on cultivation and optimum time of harvesting of temperate and alpine medicinal plants of high market value. [FRI-30/NWFP-3/1997-2002]. For technical report contact, Principal Investigator - Dr. A.K. Sharma.

Findings : Identified *in situ* indicator species for *Taxus baccata*, *Nardostachys jatamansi*, *Picrorrhiza kurroa* and *Colchicum luteum* which are all red listed species. The present study identified the nutrient requirements of these species under natural conditions. The project resulted in developing the vegetative techniques for the multiplication of *Taxus baccata* and the cultivation packages for *Nardostachys jatamansi* and *Picrorrhiza kurroa*.

Project 21 : Improvement of the nursery technique of commercially important forestry species (FRI-4/Silva-4/1997-2002). For technical report contact, Principal Investigator - Assistant Silviculturist (E).

Findings : Standardized the proper depth of sowing of *Juglans regia* in nursery. Standardized storage, germination, viability and longevity of seeds of *Hardwickia binata*.

Project 22 : Studies on isolation and characterization of polysaccharides of abundantly available seeds, trees, shrubs, leaves, bark and exudates gums [FRI-51/ Chem-1/1997-2002]. For technical report contact, Principal Investigator - Dr. P.L. Soni.

Sub-project (i) : Preparation of flocculants by chemical modification of the galactomannan/starch derived from the biopolymers for the treatment of industrial discharge and recovery of materials.

Findings : Molecular weight of guar gum and its carbamoylethylated derivatives was determined. Carboxymethylation of *Cassia tora* gum (CTG) was done. Different reaction parameters with medium were optimised. Rheological studies of the products were done. Quaternisation of *Cassia tora* gum was done. Rheological properties of the modified products were determined.

Sub-project (ii) : Chemical investigation of *Kydia calycina* bark polysaccharide.

Findings : GLC of the oligosaccharides obtained from *Kydia calycina* bark and their specific rotation and melting points were determined. GC-MS and NMR studies of the oligosaccharide and polysaccharide have been carried out and their structures proposed.

Project 23: Effects of water stress on some clones and provenances of *Dalbergia sissoo* [FRI-148/Bot-20/2000-2002]. For technical report contact, Principal Investigator - Dr. S. Nautiyal.

Findings : Five selected clones of *Dalbergia sissoo* were screened for their water stress tolerance behaviour.

Project 24 : Development of adhesives from renewable sources. [FRI-52/Chem-2/ 1997-2002]. For technical report contact, Principal Investigator - Dr. P.L. Soni.

Findings : Statistical analysis of data obtained from the resins developed from .

tannins of *Uncaria gambier* and *Acacia catechu* showed replacement of phenol up to 50%. Among tannins it was found that *Uncaria gambier* shows far better results than *Acacia catechu* which met Indian Standard IS: 303 - 1989, Boiling Water Resistance (BWR) quality standards. Fortification of urea formaldehyde by tannin of *U. gambier* upto 20% shows better results than *A. catechu* and that of standard urea formaldehyde resin. Results met Indian Standard IS : 303 - 1989 Moisture Resistance (MR) quality standards.

Project 25 : Resin tapping by borehole methods in *Pinus roxburghii* [FRI- 127 / Silva-10/1998-2002]. For technical report contact, Principal Investigator - Mr. G.S. Rawat.

Findings : Studies were conducted on borehole resin tapping in chirpine (*Pinus roxburghii*) in order to standardize optimum depth and diameter of hole including treatments to obtain maximum yields of resin.

PROJECTS CONTINUED DURING THE YEAR 2001-2002

Project 1: Computerization of herbarium of Forest Research Institute, Dehra Dun [FRI-15/Bot-5/1997-2003]. Principal Investigator - Dr. Sas Biswas.

Status : 200 type specimens and species diversity of 10 genera and 30 species as represented in FRI Herbarium were studied for the development of database. Generic entity of 50 taxa was nomenclaturally studied for database incorporation. Role of FRI Herbarium for studies and development of management strategies with respect to forest biodiversity and genetic resources was ascertained while conducting short-term training course on Biodiversity Conservation organized by FRI.

Project 2 : Computerisation of anatomical database of Indian hardwoods for the purpose of their identification [FRI-17/Bot-7/1997-2002]. Principal Investigator - Dr. Sangeeta Gupta.

Status : The wood structure details module has microstructural data for about 500 Indian hardwood species. The wood microphotographs of 25 species of families *Magnoliaceae*, *Annonaceae* and *Dilleniaceae* were taken and stored. Data of 5000 wood samples present in FRI Xylarium has been stored.

A new module on 'Feature Detail' has been added. This module explains and illustrates all 221 features given by IAWA and acts as help wherever required during data entry.

Project 3 : Improved utilization of raw materials for pulp and papermaking including juvenile tree utilization [FRI-129/C&P-14/1999-2003]. Principal Investigator - Mr. A.K. Rai.

Status : Proximate chemical analysis of 29 checked clones of *Populus deltoides* was completed. Nine clones of ten years aged *Populus deltoides* were evaluated for the preparation of Kraft pulp and high yield pulp for the writing, printing and newsprint grades of papers.

Project 4 : Studies on isolation and characterization of polysaccharides of abundantly available seeds, trees, shrubs, leaves, bark and exudates gums [FRI-51/ Chem-1]. Principal Investigator - Dr. P.L. Soni.

Sub-project (i) : Study of *Cassia tora* seed gum (CTG) to find its uses [1997-2003].

Status : GLC analysis of different oligosaccharides obtained from cold water and hot water soluble polysaccharide were studied. Melting point and optical rotation of oligosaccharides were measured. Methylation of pure polysaccharide and oligosaccharide obtained from cold water soluble polysaccharide was also studied.

Sub-project (ii): Chemical investigation of *Prosopis juliflora* seed polysaccharide [2001-2003].

Status : The alcohol precipitated cold-water soluble polysaccharide from seed endosperm of *P. juliflora* on hydrolysis with $2\text{NH}_2\text{SO}_4$ followed by paper chromatography indicated presence of Galactose and Mannose in the polysaccharide. Rheology of the polysaccharide was carried out using Brookfield Digital Viscometer. The flocculant and emulsifying property of the polysaccharide was also determined.

Project 5 : Phytochemical examination for the utilisation of leaves, barks, fruits and root of Indian forest trees. [FRI-53/Chem-3]. Principal Investigator - Dr. Rameshwar Dayal.

Sub-project (i) : Screening of *Cephalotaxus harringtonii* needles for bioactive principles [1997-2003].

Status : Essential oils, isolated for the first time from the needles & twigs, were analysed, fifteen compounds were identified in both the oils with Germaerene-D, Caryophyllene and -Cadinene as the major constituents. A pure alkaloid was isolated from the methanol extract using chemical separation/CC/HPLC.

Sub-project (ii) : Development of pest control agents and other bioactive compounds from *Vitex negundo* [1997- 2003].

Status : Essential oils, three extracts and two pure compounds of the leaves were prepared and screened for their pesticidal activity against the larvae of poplar defoliator, *Clostera fulgurita*. All showed 100% to 80% mortality depending on the concentration. Three pure compounds namely -sitosterol, ursolic acid lactone & ursolic acid were characterised from the benzene extract of the bark.

Sub-project (iii): Studies on vegetable dyes from *Parthenium hysterophorus*, *Ageratum conyzoides*, *Eupatorium* and *Azadirachta indica* [2000-2003].

Status : Methods were standardised to isolate the dye from the deoiled cake available in plenty. Optimum dyeing conditions using the dye and mordants were determined. Good shades were obtained on silk/wool/cotton. Dyeing trial of baggase pulp with *Eucalyptus* bark dye was also done. Solid dye was isolated from Poplar bark, *Cassia* and *Grewia* seeds.



Fabric dyes from *Parthenium hysterophorus*, *Ageratum conyzoides*, *Eupatorium* and *Azadirachta indica*

Project 6 : Studies on tree borne oilseeds [FRI-54/Chem-4]. *Principal Investigator - Dr. P.P. Jain.*

Sub-project (i) : Studies on oilseeds of forest origin to find new resources of oils and wetting agents [1998-2002].

Status : Seeds of *Diploknema butyracea* (Chura/Phulwara), were collected from the Silviculturist (Experimental), FRI, Dehra Dun. Yield of oil from untreated as well as treated kernel was determined. The yield of oil from the untreated kernels was found to be more than that of treated kernels.

Physico-chemical properties such as specific gravity, refractive index, acid value, saponification value and iodine value, were determined from oils obtained from the untreated as well as treated kernels. The physico-chemical properties were found to be almost the same.

Project 7 : Management of sal heart wood borer in natural forests.

Sub-project (i): Management of sal heartwood borer in natural forests [(FRI-63/FED-2/1993-2004)]. *Principal Investigator R.S. Bhandari.*

Status: Large scale trap tree operations were conducted in sal forests of Shiwalik Circle and Rajaji National Park, Dehradun. The total number of beetles captured and destroyed during trap tree operations were 5,74,753.

Under the Kairomone studies, the efficacy of Kairomone isolated from green sal logs showed that out of seven (7) extracts formulated only four (4) extractives showed more than 80% attraction of beetles. Further investigation is in progress.

Sub-project (ii): Phytochemical investigation of Sal (*Shorea robusta*) to isolate suitable kairomones for the management of sal heartwood borer [FRI-63/FED-2/ 1999- 2004]. *Principal Investigator - Dr. Rameshwar Dayal.*

Status : Bergenin was characterised from the acetone extract of the roots. Ether and methanol extracts of the bast, sapwood and heartwood were prepared and screened for their activity at Entomology Division. Olfactory sensillum for chemoreception as seen in electromicrograph, were identified in the antennae of the beetle. This reveals that the insect uses olfactory cues in locating the sal tree.

Project 8: Impacts of pollutants on tree species of Doon Valley. [FRI 116/Eco-3/1998-2003]. *Principal Investigator - Dr. Laxmi Rawat.*

Status : Soil samples were collected along the gradient and along the highway. Effects of pollutants on some ecophysiological parameters like canopy structure, dust deposition, chlorophyll a & b; leaf pH and moisture content etc. were studied.

Project 9 : Plant growth strategy characterization, diversity and vegetational dynamics of rehabilitated and derelict mined ecosystem in western Himalayan [FRI-130/Eco-5/1999-2004]. *Principal Investigator - r. H.B. Vasistha.*

Status : Monitoring of vegetation changes in different microhabitat conditions in rehabilitated and derelict mined ecosystem of Doon Valley was done. Soil moisture and soil temperature under different microhabitats were monitored. Soil samples for organic and nutrient analysis samples were collected. Phenological observations of plants growing under different microhabitats were recorded.

Project 10 : Role of forest cover in landslides in the Himalaya [FRI-131/Eco-6/ 1999-2002]. *Principal Investigator - Dr. H.B. Vasistha.*

Status : Observations relating to size of landslide, slope, altitude, vegetation and cover type were recorded on Mussoorie and Chamba road in Uttaranchal.

Project 11 : Ecological study of *Dalbergia sissoo* (Roxb.) with special reference to mortality [FRI-147/Eco-7/2000-2003]. *Principal Investigator - Dr. J.D.S. Negi.*

Status : The preliminary ecological studies have been conducted in the natural and plantation ecosystems of *Dalbergia sissoo* in Uttaranchal. It was observed that elevated nutrient concentration in foliage and leaf litter along with sandy soils and high percentage of nutrient withdrawal appears to be suitable site for *D. sissoo*.

Project 12: Bio-Ecology and management of some important key defoliators of agroforestry species. *Ascotis selenaria imparata* Walk and *Selepa celtis* More (FRI-132/FED-7/1999-2002). *Principal Investigator - Dr. H.R. Khan.*

Status: Studied insect pest situation, incidence and extent of damage due to *Selepa celtis* (Noctuidae) on 14 tree species and *Ascotis selenaria* (Geometridae), infesting on 10 species of agroforestry and medicinal importance. The observation on pest life cycle was recorded. The experiments on food preference feeding potential on various host plants, attacked due to *S. celtis* and *A. selenaria* were completed.

Project 13. Bioecological studies on insect pests of bamboos and their management. (FRI-144/FED-8/2000-2005). *Principal Investigator - Mr. R.S. Bhandari.*

Status : Surveyed bamboos growing areas in and around Dehra Dun, recorded the incidence and extent of insect damage due to various insect pest. It was found that *Estigmena chinensis* is a major borer in the localities surveyed in addition to *Oregma bambusae*, a sap sucking aphid species, *Cyrtorachilus dux*, *Xylocopa* sp. and termites. The incidence of attack was found to be 7.91% due to *E. chinensis* while 0.96% due to *O. bambusae*, 3.55% due to *C. dux* and 2.47%, due to termite attack and 1.84% due to *Xylocopa* sp. The bioecological observation on the pests are recorded, studies are in progress.

Project 14 : Environmental conservation strategies for land use in lower Western Himalayas : Butterflies as indicators in monitoring environmental changes in urban gradients [FRI-145/FED-9/2000-2004]. *Principal Investigator - Arun P. Singh.*

Status : Surveyed the selected site, carried out identification of original, pre-developmental butterfly community of LWH present in tropical moist deciduous sal (*Shorea robusta*) forests of Dehra Dun valley. The data for more than 135 species of butterflies, their food plants, habitats, their breeding season/period has been collected from sal forests..

Project 15 : Ecological impact assessment of bio-reclamation projects in Raibareilly and Sultanpur [FRI-086/FSLR-9/1998-2002]. *Principal Investigator - Dr. (Mrs) P. Soni.*

Status : Phytosociological studies were conducted in the entire four different plantation sites. The survey conducted during 2001 showed decline in density per ha in all the plantations.

Project 16 : Effect of trees on agricultural crops [FRI-8/SF-1/1996-2002].
Principal Investigator - Mr. Shivendu K. Srivastava.

Status : All the experiments of the project completed. Data is being analysed.

Project 17 : Studies on agroforestry systems and development of suitable agroforestry models in Punjab, Haryana and Uttar Pradesh [FRI-118/SF-3/1998-2003].
Principal Investigator - Dr. Rajiv Kumar.

Status : Socio-economic survey completed in six villages of Gurgaon district and data analysed. Seventeen villages in three blocks of Kurukshetra district in Haryana were selected for socio-economic studies. Analysis of socio-economic studies in twelve villages of Yamuna Nagar district completed. Growth of clonal trials of *Populus deltoides* was recorded. Study of intercropping with urad was conducted. Five nursery experiments related to *Populus deltoides* cuttings laid. Data of intercropping of turmeric in 4-year old plantation of *Populus deltoides* analysed.

Project 18 : Forest community interface A study on the impact of participatory forest management on the status of forests and on socio-economic development of rural people in Dehra Dun district of Uttaranchal [FRI-133/SF-4/1999-2002].
Principal Investigator - Mr. Shivendu K. Srivastava.

Status : Survey completed in thirteen villages for study of impact of PFM in Dehra Dun district.

Project 19 : Development of packing boxes from different bamboo spp. for horticultural produce [FRI-111/FPD(TM)24/2000-2002].
Principal Investigator - Mr. Dhyan Singh.

Status : Newly designed packing boxes were made from *Bambusa arundinacea* and their performance was compared with conventional boxes. It is found that these boxes are stronger than conventional boxes in Flat Drop test and weaker in Top Bottom Compression test.

Project 20 : Studies on natural durability and efficacy of preservatives in treated bamboo and plantation grown wood species [FRI-135/FPD(WP)-31/1999-2002].
Principal Investigator - Dr. Inder Dev.

Status : *Bambusa balcoa* was treated with CCA and CCB at three retention levels by Boucherie and Wick methods. Chemical analysis of the treated bamboos was carried out at different length to select samples of different retentions. Samples were then installed in the test yard at Jodhpur after proper marking and field layout. Periodic inspection of Bamboos installed earlier in the test yard at Dehra Dun, alongwith other species like *M. azederach*, *A. indica*, *A. excelsa*, *E. hybrid* etc., was carried out.

Project 21 : Develop simple technology for treatment of joinery timbers [FRI-149/FPD(WP)-32/2000-2002].
Principal Investigator - Mr. P.B. Dobriyal.

Status : *Calophyllum elatum* Wight (poon) and *Dipterocarpus indicus* Bedd. (gurjan) samples were dip treated for different intervals with Low Organic Solvent Preservatives (LOSP). Studied penetration and retention by qualitative and quantitative methods.

Project 22 : *In vitro* rejuvenation, multiplication of *Eucalyptus* hybrid, chirpine, shisham, bamboos and neem.

Sub-project (i) : *In vitro* multiplication of chirpine and bamboos [FRI-20/G&TP-2(i)/1997-2002]. Principal Investigator - Dr. Sarita Arya .

Status : Chirpine - Embryogenic cultures were successfully established for *Pinus roxburghii*. Immature zygotic embryos prior to cotyledon formation were found to be the best for induction of embryogenic callus.

Bamboos - Tissue culture raised plants of *Dendrocalamus asper* were produced and field planted. The flowering in tissue culture raised plants was obtained. Somatic embryogenesis has been induced in *Dendrocalamus asper*. *In vitro* cultures were multiplied in *Bambusa wamin* and *Gigantochloa atter*. Protocol for *in vitro* multiplication of *Bambusa wamin* was standardized. Tissue culture raised plants were field planted.

Sub-project (ii) : *In vitro* multiplication of shisham and eucalyptus [F.R.I. 20/G&TP-2(ii)/1997-2002]. Principal Investigator - Dr. I.D. Arya.

Status : Standardized micropropagation technology through axillary bud proliferation for *Dalbergia sissoo* and *Dalbergia latifolia*. Somatic embryogenesis was induced in Shisham on auxin supplemented medium. Microphotographs of somatic embryos were taken. Tissue culture technology has been standardized for clones of *Eucalyptus tereticornis* and two F₁ hybrids.

Project 23 : Studies on disease resistance of newly introduced germ plasm (Progenies of *Populus deltoides*) [FRI-136/Path-6/1999-2002]. Principal Investigator - Mr. Amit Pandey.

Status: Newly raised clones of poplar were recorded for disease incidence and the pathogens were identified.

Project 24: Seed mycoflora of important tree species and its management [FRI-137/Path-7/1999-2002]. Principal Investigator- Dr. N. S. K. Harsh.

Status : Seed mycoflora was studied in the seeds of *Cedrus deodara* and *Dalbergia sissoo*. *Chaetomium globosum* was found to inhibit germination in *C. deodara*. The fungal infestation of seeds was checked by seed treatment with bavistin and thiram. Ether and alcohol extracts of *Ricinus communis* plant was found to inhibit seed mycoflora in *Acacia catechu* and *Albizia lebbek*.

Project 25 : Parasitic and symbiotic associations of tree species used for harsh site afforestation [FRI-138/Path-8/2000-2004]. Principal Investigator- Dr. Y. P. Singh

Status : A calendar of Symptoms and Signs for the members of Primary Farm Forestry Cooperatives (PFCCs) is in the final stage of processing. Besides, a disease perception assessment questionnaire has been finalized in socio-economic format precluding survey.

Project 26 : To study and develop the techniques of cultivation of *Uncaria gambier* to propagate it in the field and popularize the species in India [FRI-126/NWFP-6/1998-2003]. *Principal Investigator - Dr. P.P. Bhojvaid.*

Status : Germplasm of *Uncaria gambier* was procured from Indonesia. Germination trials were conducted at FRI, Dehra Dun and RFRI, Jorhat, and IFGTB, Coimbatore. The germination percentage was 95%.

Project 27: Studies on nursery techniques/cultivation of important medicinal plants for socio-economic development of rural poor [FRI-146/NWFP-7/2000-2003]. *Principal Investigator - Dr. P.P. Bhojvaid.*

Status: The cultivation packages of *Andrographis paniculata*, *Barleria prionitis* and, *Asparagus racemosus* are being standardized.

Project 28 : Poplar improvement in India [FRI-2/Silva-2/1997-2003]. *Principal Investigator - Mr. Dinesh Kumar.*

Status : Raised field trials of clones of *Populus deltoides* that have been (i) developed at FRI by collection of seeds from natural stands of USA (ii) developed at FRI through hybridization among promising clones of previous introduction and (iii) developed abroad and found promising in few plantations in India. A progeny trial was also raised of control-pollinated and open-pollinated progenies developed through hybridization. Interspecific hybridization has been conducted in poplar and raised the seedlings of *Populus deltoides* (clone G48) x *P. euphratica* hybrid in nursery. Three clones of *P. alba* have been introduced from natural stands.

Project 29 : Paulownia propagation and introduction [FRI-73/SF-2/1997-2002]. *Principal Investigator- Mr. Dinesh Kumar.*

Status : A Field trial was established for clones of *Paulownia* at FRI. Introduction trials were laid in Tehri and Uttarkashi. Spacing trial has been laid. The data was recorded from old field trials. The results indicate that growth of *Paulownia* in farmers' fields in the plains of Uttar Pradesh and Uttaranchal is relatively slower than poplar and its form is not satisfactory.

Project 30 : Role of forests in soil & water conservation: quantative evaluation [FRI-117/Eco-4/1998-2003]. *Principal Investigator- Dr. Kalyan Singh*

Status : Studies on hydrology, soil and vegetation of Kulhal forest watershed (Bhura Shah Rao) were conducted. Sal forest watershed intercepted 20.2 percent of total rainfall (1925 mm), whereas bare land had nil interception. The surface runoff water in sal watershed was about 17 percent and in bare land watershed was 61 percent of total rainfall. The sediment yield was about 26 tons/ha/yr in forest and 120 ton/ha/yr in bare land watershed. The rain water had input of N (NO₃) 0.32, P (PO₄) 0.01 and K 1.82 kg/ha/yr. Runoff water NPK out put was 130, 76 and 92 kg/ha/yr in sal watershed and 286, 325 and 412 kg/ha/yr in bare land watershed, respectively. It indicates that forests can save double the nitrogen content and about four times of phosphorus and potash contents in runoff water as compared to bare land watershed.

NEW PROJECTS INITIATED DURING THE YEAR 2001-2002

Project 1 : Complete elimination of sulphur and chlorine compounds in pulping and bleaching by Milieupure oxydative (MILOX) process [FRI-150/C&P-15/2001-2005]. *Principal Investigator - Dr. K.S. Bhandari.*

Status: To eliminate sulphur and chlorine /chlorinated compounds from pulping and bleaching, *Eucalyptus tereticornis* wood chips were pulped using formic acid treatment sandwiched between two peroxyformic acid treatments. Bleached pulps of about 75.1% (ISO) brightness possessing adequate strengths properties were obtained.

Project 2 : Development of suitable silvicultural practices for JFM [FRI-180/Silva- 14/2001-2006]. *Principal Investigator - Asstt. Silva. (G).*

Status : The initial data from 3 sites of Uttaranchal namely, Sia Kempty village, Mussoorie, Aamwala village, Dehra Dun and Balsoun village, Karnprayag have been collected.

Project 3 : To standardize formation of compost from *Parthenium sp.* under different variable with reference to quality [FRI-182/Silva-16/2001-2002]. *Principal Investigator - Assistant Silviculturist (E).*

Status : Compost prepared by Barkely process and the prepared compost has been sent to soil lab for compost analysis.

Project 4 : To develop knap-sack manual root trainer carrier for carrying root trainer trays in different proportions and standardize model of knap-sack type manual root trainer carrier.(FRI-183/Silva-17/2001-2004). *Principal Investigator - Assistant Silviculturist (E).*

Status : The design and material to be used in fabrication of root trainer carrier and the technical drawing are being finalized.

EXTERNALLY AIDED PROJECTS

PROJECTS COMPLETED DURING THE YEAR 2001-2002

Project 1 : Development of Binsar and Chaukori Tourist Village, Uttaranchal [FRI-166-Bot-27/ 1999-2001, Dept. of Tourism, UP]. *For technical report contact, Principal Investigator - Dr. Sas. Biswas.*

Status : Floristic data base integrated with the development of tourist village for biodiversity consevation, awareness and education was developed. Field surveys in Binsar and Chaukori were made.

Project 2 : Biological control of important forest insect pests and screen forest seed for insect infestation [FRI-156/FED-10/1994-2001/WB]. *For technical report contact, Principal Investigator - Dr. H.R. Khan & Dr. M. Ahmad.*

Status : Poplar Defoliator - Surveyed poplar nurseries and plantations at

selected sites in UP, Uttaranchal and Haryana following the screening of the parasites and predators of key defoliator of poplar, *Clostera cupreata*. The studies on promising ones, their efficiency parasitisation potentials were worked out. Statistical analysis of the data indicates interesting correlation among parasitizing days, number of progeny produced and female percentage in offsprings. Recovery of the parasitoids and infestation level by poplar defoliator, *C. cupreata* was recorded. It was observed that parasitoid releases caused over 60 per cent reduction in pest population in treatment nurseries.

Shisham Defoliator - The parasitoids *Podagrion pachymeran*, *Copidosoma varicorne*, *Apanteles* sp., *Meterorus* sp., and *Disophrys sisso* were collected and studied in detail. The larval parasitoid *C. varicorne* was found effective and its parasitisation potential was high.

Seed Pests : The insect species belonging to genus *Caryedon*, *Bruchidius*, *Sitophilus*, *Dioryctria*, *Eucosma*, *Dichocrocis*, some time 100% incidence of attack was observed.

Chemical control experiments were conducted in seed orchards, seed production areas and seed stands belonging to 15 important tree species in Haryana, Uttar Pradesh, Uttaranchal and Himachal Pradesh.

Project 3 : Optimization of reconstituted wood from bamboo/lantana [FRI-167/ FPD(CW)-35/2000-2001/INBAR]. For technical report contact, Principal Investigator - Dr. S.P. Singh.

Status : Project completed and detailed report was submitted to SARMET/INBAR.

Project 4 : Tree Improvement [FRI-157/G&TP-6/1994-2001/WB]. For technical report contact, Principal Investigator - Dr. S.K. Bagchi.

Status:

Study of floral biology and breeding system to develop hybrids specific to-site in order to maximise productivity : Floral biology and breeding system of Shisham was studied. Control selfing and control crossing was done. Prior to this pollen fertility and stigma receptivity were ascertained. This species was found to be both self as well as cross compatible.

Develop technique for rejuvenation of mature plant tissue to maximise multiplication rate: Achieved rejuvenation in *Eucalyptus* through coppicing and serial cuttings, in *Dalbergia sissoo* through root suckers collected from mature trees during dormant season which produced high level of juvenility while in *Pinus roxburghii* - 6 year old seedlings were successfully rejuvenated. Clonal variation in rooting ability was being observed in the pine.

Develop In vitro and in vivo technique for mass multiplication of selected genotypes : Standardized technique for *in vivo* for *Dalbergia sissoo*, *Pinus roxburghii* and *Eucalyptus*. Under *In vitro* studies protocols for clonal multiplication were developed for *Eucalyptus*, Shisham and *Populus* sp. In Chir pine somatic embryogenesis has been achieved using immature zygotic embryos. The protocol developed for *Eucalyptus* is now successfully being used for mass multiplication of superior phenotypes.

Project 5 : Planting Stock Improvement Programme (FRI172/G&TP-9/1994-2001/WB). For technical report contact, Principal Investigator Mr. D.P. Uniyal.

Status : Under PSIP 4 components viz. Seed Production Areas (SPAs), Clonal Seed Orchards (CSOs), Seedling Seed Production Areas (SSPA's) and Vegetative Multiplication Gardens (VMGs) were established in the states of Punjab, Haryana, U.P., Uttaranchal and F.R.I. The four most important plantation species i.e. *Eucalyptus tereticornis*, *Dalbergia sissoo*, *Populus deltoides* and *Pinus roxburghii* were taken up under this programme. Established 181.80 ha SPA's, 28 ha. CSO's 25.20 ha SSPA's, 9.10 ha of VMG and thus achieved the targets.

The SSPA's were evaluated to estimate various genetic parameters and the data used for selection of superior clones in *Eucalyptus* and *Dalbergia sissoo*.

VMG : Rejuvenation and rooting techniques for all the four species were standardized. In *Populus* the hedges established in 1999-2000 were being repeatedly hedged for getting cuttings of selected clones. Three fold increase in cutting production has been achieved and this technique is cost effective technique.

Development of Central Nursery : The Central Modern Nursery facility was established under the World Bank Project for conducting experiments and providing training to SFD.

Project 6: Examine biofertilizers beneficial to economically important tree species and develop practical methods for field application [FRI-158/Patho-10/ 1994-2001/WB]. For technical report contact, Principal Investigator-Dr. N.S.K. Harsh.

Status : Mycorrhized seedlings of *Dalbergia sissoo* and *Eucalyptus tereticornis* performed better in the field in terms of survival and growth in comparison to uninoculated ones after one year, however, the beneficial effect was more marked in the latter species. Genetic material of poplars (19 families) is being screened for endo- and ectomycorrhizal status. Pot cultures of mycorrhizal fungi were multiplied and maintained.

Project 7: Market monitoring of tree products [FRI-159/RSM-8/1994-2001/WB]. For technical report contact, Principal Investigator - Dr. N.S. Bisht.

Status: There is an information gap and asymmetry, which makes the direct consumers of wood and timber vulnerable to manipulation by the traders. Due to the qualitative differences and huge price difference among various species, the people are rarely in a position to judge the species and qualities of wood they buy. This adds to uncertainties concerning price or in other words increases the effective price paid by the consumers. The timber markets are regionally segmented, different market centers show fairly unconnected price trends, trends which can not, many a time, be explained in terms of transport cost differences. There is no policy support to tree growers by the Government.

Project 8 : A UNDP-GEF initiative on selected options for stabilizing greenhouse gas emissions for sustainable development [FRI-176/ FSLR-12/2001-2002/TERI]. For technical report contact, Principal Investigator-Dr. M.N. Jha.

Status: FRI is the sectoral focal institute for this project of UNDP-GEF in the

forestry sector. FRI is working with TERI, New Delhi for development of suitable projects. Necessary initiatives have been taken as per the terms and conditions and three projects in the forestry sector have been submitted to the MoEF for UNDP-GEF funding. The three projects have been proposed by FRI, AFRI, Jodhpur and IISc, Bangalore.

Project 9: Storage of forest tree seeds [FRI-165-Silva-12/1994-2002/WB).
For technical report contact, Principal investigator - Dr. R.C. Thapliyal.

Status : Studies on seed aspects of bamboo species viz. *Dendrocalamus membranaceus*, *D. strictus* and *Bambusa nutans*, *Dalbergia sissoo*, *Azadirachta indica*, *Grewia optiva*, *Ulmus wallichiana* and *Acer caesium* were conducted to investigate seed maturity, viability, germination and seed storage behaviour. The seeds of all the species exhibited orthodox storage behaviour, except *A. indica*, and maintained viability best at reduced moisture content. The seeds of *A. indica* showed intermediate storage behaviour and best retained viability moisture content. Also, studies on seeds of *Aphanomixis polystachyana*, *Cryptocarya floribunda*, *Dillenia indica* and *Dysoxylum binecteriferum* were conducted to screen them for recalcitrant behaviour.

Project 10: Study on alternative eco-friendly wood varieties for handicraft & futuristic wood availability in Rajasthan and Kerala States [FRI-168/FPD (WWF)-36/ 1999-2001/Minst. of Textile, GOI].
For technical report contact, Principal Investigator - Director, F.R.I./ Mr. S.P. Badoni.

Status : The survey of Rajasthan and Kerala States for wood availability was completed.

Project 11 : Commissioning and installation of wood plasticization plant and ammonia fumigation chamber at Jodhpur & Trivandrum [FRI-169/FPD-37(Ws)/ 1999-2001/Minst. Of Textile, GOI]. *For technical report contact, Principal Investigator - Dr. C.N. Pandey.*

Status : The equipments for wood plasticization and ammonia fumigation were installed and demonstrated to the user groups at Trivandrum & Jodhpur.

PROJECTS CONTINUED DURING THE YEAR 2001-2002

Project 1 : Bamboo improvement scheme for APFDC [FRI-164/Bot-25/1999-2002/APFDC, Hyderabad]. *Principal Investigator - Dr Mohinder Pal.*

Status : Consultancy was provided on the improvement of planting stock of *Dendrocalamus strictus* by selection and multiplication at nursery stage, selection of Candidate Plus Clumps (CPCs) in the field, recording data on CPCs, multiplication of CPCs vegetatively and implementation of Bamboo Improvement Scheme as per the proposed Action Plan.

Project 2 : Revision of forest flora of Andaman & Nicobar Islands [FRI-155/ Bot.- 21/ 2000-2003/FD, A&N]. *Principal Investigator- Dr. H.B. Naithani.*

Status : Field tour of North, Middle, Little Andaman and South Andaman were under taken and 400 herbarium specimens were collected. A preliminary check

list of indigenous flora of the region was completed. Rare, threatened and other spectacular plants of the area explored were enlisted.

Project 3: Conservation of nitrogen fixing plants : A reliable approach for the rehabilitation of degraded sites in Himalayan Ecosystem [FRI-161/Bot.-22/2001-2004/G.B. Pant Institute, Almora]. *Principal Investigator - Dr. T.C. Pokhriyal.*

Status : Survey of Nitrogen fixing species has been conducted in the lower and middle Himalayan ranges of Dehra Dun, Tehri, Pauri and Uttarkashi Districts. A total of 83 species of herbs, shrubs and climbers have been recorded for their nodulation behaviour and nitrogenase activity. Some of the N fixing species have been planted in the nursery and seeds of 6 species have been collected for further propagation.

Project 4: Screening and identification of fast growing fuelwood, fodder species for higher biomass projection in Garhwal Himalaya [FRI-162/Bot-23/2001-2003/NATP,ICAR]. *Principal Investigator - Dr. S. Nautiyal.*

Status : Three nurseries are identified for conducting nursery experiment at different altitudes. Ten fuelwood and fodder species were identified from the literature for screening purposes. The collection of seeds of Shisham, Mulberry, Bakain, Oak, *Albizia sp.* etc. from superior genotype is being done.

Project 5: Vegetational survey and inventorization of species in the ridge forests of Delhi [FRI- 165/ Bot.- 26/ 2000-2002/ Govt. of NCT, New Delhi]. *Principal Investigator - Dr. H.B. Naithani.*

Status : Survey was conducted in the Southern and Central Ridge Forest, Delhi. 200 plant specimens were collected and 200 quadrates laid out in the localities of South Ridge for studying the species richness, frequency and dominance.

Project 6 : Creation of germplasm bank of commercially important tree species of Punjab [FRI-178/Bot-28/2001-2004/PFD]. *Principal Investigator - Dr. S. Nautiyal.*

Status : Land for creation of field Gene Bank has been selected. 158 clones of Poplar have been planted in the field for raising Entire Tree Transplants. 83 clones of *Dalbergia sissoo*, 50 clones of Bamboos and 100 progenies of Neem from various sources have been raised for planting in the proposed Gene Bank.

Project 7 : Long term impact of monoculture of forest tree species on forest and non forest lands in Punjab [FRI-177/Eco-8/20012004/PFD]. *Principal Investigator - Dr. J.D.S. Negi.*

Status : Survey of different forest species in forest and non forest lands (*Dalbergia sissoo*, *Eucalyptus* spp. and *Populus* spp.) was completed in Hoshiarpur, Dasuya, Garshankar, Gurdaspur, Amritsar, Ludhiana, Muktsar, Bhathinda, Ferozepur and Patiala Forests Division and sites were selected for biomass productivity and nutrient cycling study. Meteorological data were collected from Kandi Area Maintenance Division and Hoshiarpur. Soil samples collected were estimated.

Project 8: Development of ecorestation model for iron ore mines of Bihar & Orissa [FRI 179/Eco-9/2002-2006/MOE&F]. *Principal Investigator - Dr. (Mrs.) P. Soni.*

Status : Selection of suitable mining sites for project was made. Four sites i.e. excavated benches, OB dumps, *Acacia auriculiformis* plantation and degraded forests were selected. Soil and rock samples from all the selected sites were collected and reconnaissance survey for vegetation done.

Project 9 : Genetic improvement and production of nursery planting stock of khair, shisham, and kikar [F.R.I.-170/G&TP-7/2000-2005/PFD]. *Principal Investigator- Director, F.R.I.*

Status : Established 1 ha clonal seed orchard of *Dalbergia sissoo* comprising 20 superior clones selected based on the clonal performance. Also established two ha. progeny trial of *Acacia nilotica* comprising 30 families in Punjab. Prior to field planting progenies were evaluated at age 1 in the nursery.

Standardized the air layering and grafting technique in *Acacia nilotica* which is a prerequisite for establishment of clonal seed orchard.

Project 10 : Consultancy for operationalization of seedling production through clonal technology [FRI-171/G&TP-8/ 2001-2004/PFD]. *Principal Investigator- D.P. Uniyal*

Status : Established hedge garden of *Dalbergia sissoo* comprising ramets of 20 clones with high productivity potential, which were identified from the CPT'S selected earlier. In *Populus deltoides* established hedge garden comprising 22 productive clones.

Provided specification, design for HI TEC MIST CHAMBER and imparted training to personnels of SFD, Punjab on clonal propagation of Eucalyptus and *Dalbergia sissoo* including root trainer technology and compost preparation.

Project 11: Central scheme for development of agro techniques and cultivation of medicinal plants used in ayurveda, siddha, unani and homeopathy. [FRI-173/NWFP-8/ 1998-2003, Minst. Of Health, GOI]. *Principal Investigator - Dr. P.P. Bhojvaid.*

Status : Field trials were conducted and growth data was recorded for standardization of propagation methods of the project species namely *Elaeocarpus ganitrus*, *Prunus cerasoides*, *Habenaria intermedia* and *Microstylis wallichii*.

Project 12: Studies on interrelationship between production levels and marketing of important forestry species in Punjab [FRI-174/RS&M-9/2000-2003/PFD]. *Principal Investigator - Dr. N.S. Bisht.*

Status : Data on 39 markets (out of total 103) have been collected. Production levels of 10 villages of the state have been collected. Data on the import of timber in the state were collected. Also, details of various wood based industries of the state have been collected.

Project 13 : Evaluation (by volumetric assessment) of the standing crop of Eucalyptus trees and coppice crop in captive plantation in Hempur, District Udham Singh Nagar [FRI-186/RS&M-10/ 2001-2002/NEPA Ltd.).

Principal Investigator - Dr. N.S. Bisht.

Status: Reconnaissance survey of the area was carried out. 1 % sample enumeration was carried by random sampling method. Accordingly, a sample of 3.40 ha. was drawn out of the total area of 305 ha. of Eucalyptus plantation. 34 sample plots each measuring 0.10 ha were laid, enumeration was done and diameters at breast height (dbh) were recorded. Besides this, for measurement of volume, 280 no. of sample trees belonging to different diameter classes were felled out of which 116 no. of trees were also measured for assessment of weight. The regression equations were developed. The number of trees in 305 ha belonging to different diameter classes, and the total volume were estimated. The total weight of debarked poles and the firewood were estimated.

Project 14 : Studies on Himalayan pines [FRI-175/Silva-12/1996-2002/USDA]. *Principal Investigator - Mr. G.S. Rawat.*

Status : Seedlings of chir pine (*Pinus roxburghii*) raised from 65 sources in root trainers were maintained at FRI, Jarmola and Sandra nurseries in Uttarkashi. Observations have been recorded to evaluate provenance variation in growth and adaptation in different populations of chir pine. Seeds of *Pinus wallichiana* were collected from its natural distribution ranges. The seeds were extracted, processed and stored for further studies. Preliminary investigation on seed germination, moisture etc was carried out. Survey has been conducted for site selection for nursery trials of this species. A technique has been developed for extraction of seeds from cones of *Pinus roxburghii* within 4 days in nursery without use of any oven or other equipment in comparison with about 21 days required by the traditional method. A manual tool has been developed for undercutting of chirpine. About 65% survival of bare root seedlings has been achieved with undercutting operation compared to 25% achieved in the previous year. Still there is a need to further refine the technique to attain about 95% survival, which is achievable with the use of containerized seedlings.

Sub-project: Studies on stem rust of chir pine.

Co-investigator - Dr. A.N. Shukla.

Status: Rust spores were inoculated on chir pine seedlings and infection developed after two months in the form of needle spots, shrinkage of tips, crooked tips and violet discolouration. After one year cankers with pycnia, developed on the inoculated seedlings in the field.

Sub-project : Investigation on mycorrhizae in chir pine. *Co-investigator - Dr. P.S. Rawat.*

Status : A study on characterization of mycorrhizae of chir pine in five seed sources namely Baijnath, Dharamsala, Jandrana, Batrana beat and Lada of Himachal Pradesh was conducted.

Soil samples collected from nurseries of New Forest, Mundali range and Aambag (Kalsi) processed for estimation of nematodes. Overall 4 groups of nematodes i.e. Tylenchids, Dorylaimida, Mononchida and Aphelenchida recorded in all three nurseries. The highest mean nematodes population was observed from New Forest and lowest in Aambag nursery.

Project 15 : To develop technique, know how and process to produce and prepare cellulose (purity > 0.98) of different D.P. Ranging from 800-3000 (4 grades) with brightness > 80% [FRI-154/ Chem-6/ 1999-2002/ GACL, Vadodra]. *Principal Investigator- Dr. P.L. Soni.*

Status: The technology entitled "Process for preparation of - cellulose from bamboo at 1 kg. batch size" was assessed and transferred to GACL, Vadodara by charging a fee of Rs. 1,00,000.00.

NEW PROJECTS INITIATED DURING THE YEAR 2001-2002

Project 1 : Evaluation of *Radiata pine* from New Zealand [FRI-184/FPD-38(CW)/ 2002-2005/Ace Global Ltd., New Delhi]. *Principal Investigator - Dr. S.P. Singh.*

Status : Initiated the project.

Project 2 : Establishment of manufacturing process & market utilization of Eucalyptus wood for value added project for domestic and export market. [FRI-185/FPD-39(WS)/ 20012004/PFD]. *Principal Investigator - Dr. C.N. Pandey.*

Status : Initiated the project.

Project 3 : Qualitative and quantative importance of mulberry leaf production by application of chemical and biofertilizers in Doon valley of Uttaranchal [FRI-189/path-11/External/2002-2005/Sericulture Institute, Sahaspur]. *Principal Investigator- Dr. Y. P. Singh.*

Status : A survey for mycorrhizal status of 15 mulberry genotypes was taken up. The mulberry roots seem moderately colonized with endomycorrhizal fungi having infection. Vesicles, chlamydospores and extra metrical hyphae is quite frequent in roots and rhizosphere soil of different mulberry genotypes.

Research Achievements under Institute's Jurisdiction.

Sl.	Name of State	No. of Projects Completed in 2001-2002	No. of Ongoing Projects in 2001-2002	No. of Projects Initiated in 2001-2002
1	Uttaranchal	6	11	7
2	Uttar Pradesh	7	4	-
3	Punjab	1	4	1
4	Haryana	3	3	1
5	Chandigarh (UT)	-	-	1

Technologies Assessed and Transferred

- ◆ The technology of "Process for preparation of - cellulose from bamboo at 1 kg. batch size" was assessed and transferred to GACL, Vadodara. Signing amount charged Rs.1.00 lakh.
- ◆ The technology of "Borehole Resin Tapping in Chirpine (*Pinus roxburghii*)" is being transferred and assessed in the chir growing states like Himachal pradesh and Uttaranchal in collaboration with the Forest Departments of these states.
- ◆ Cultivation packages of *Spilanthes oleracea* was provided to Ayurvedic Institutes.

Education & Training

Trainings

1. Short Term Training Courses on the following subjects were organized during the year 2001-2002, in which officials of the Govt. of India, the State Departments, Public Sector Undertakings as well as representatives from various industries were the participants.
 - Seed & Nursery Technology
 - Plantation Technology
 - Agroforestry
 - Planting Stock Improvement
 - Plywood Manufacture
 - Field Identification of Forestry Species & Management of Forest Herbarium
 - Biodiversity Conservation
 - Eco-restoration of Wastelands
 - Handicraft training
 - Cultivation and Utilization of Medicinal Plants
 - Forestry Extension
2. Training on "Research Writing" was organised for the scientists of ICFRE from 5th to 9th. Nov, 2001 at FRI Dehra Dun in which 30 trainees participated.
3. Training was organised on "Conservation and Sustainable Management of Medicinal Plants in India: Problem and Prospects" sponsored by National Medicinal Plant Board from 18th to 22nd March, 2002 in which 40 IFS officers representing 19 states and U.T. of India participated.
4. A special one week training course on "Fibre Morphology of Paper" was conducted for the trainees of National Institute of Criminology and Forensic Science, New Delhi from 30th Oct. to 2nd Nov., 2001 in which 8 trainees participated.

International Trainings

Sl.	Name	Place of Training	Duration
1.	Dr. Vineet Kumar, Scientist C	Department of Pharmaceutical Chemistry, Albert- Ludwigs University, Freiburg (Germany)	05.06.200 to 30.09.2001

2.	Dr. Pradeep Sharma, Research Assistant Grade-I	Forst Botanish Institute, Bugenweg, Gottingen, Germany	15.03.2001 to 12.06.2001
3.	Mrs. P. Patel, Scientist B	Florida (USA)	3 Months

Linkages and Collaborations

National

A project on "Evaluation of Radiata Pine from Newzealand for natural durability and treatability aspect" was initiated in the year 2002 funded by M/s. Ace Global, New Delhi.

International

MoU for collaborative research work on pharmacological screening of pure compounds was signed between FRI, Dehra Dun and Bergische Universitat 42097, Wuppertal, Germany.

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 109. Y.M. Dubey and V.K. Jain; A note on dielectric constant of some Indian timbers" (in press).
 110. Y.S. Negi and V.K. Jain; Utilisation characteristics and end uses of some plantation grown timbers" (Under approval).

Books

- 1 Raina, A.K. (2001). Significance of minerological approach in biorejuvenation of mined lands. In "Environmental Concepts and Management Approaches for Mined lands" (Ed.) P. Soni, V. Chandra and S.D. Sharma. ICFRE Publication, Dehra Dun.

2. Raturi, R.D., Chauhan Luxmi Gupta, Sangeeta & Rao, R. Vijendra (2001) Indian woods their identification, properties and uses Vol. VI. ICFRE Publication, Dehra Dun.
3. Rawat, G.S. (2001). Borehole resin tapping technique in chirpine (*Pinus roxburghii*). ICFRE Publication, Dehra Dun.
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- 5- Sharma, S.D. and Gupta, M.K. (2001). Afforestation of mine spoils concepts and technology. In "Environmental Concepts and Management Approaches for Mined lands" (Ed.) P. Soni, V. Chandra and S.D. Sharma. ICFRE Publication, Dehra Dun.

Consultancies

Consultancies were provided on following topics for the amount mentioned against them.

- Testing of Wood Samples : Rs.14,83,000/-.
- Utilization of timber : Rs.23,500/-.
- Ammonia fumigation chambers : Rs. 2,64,000/-
- Plant Tissue Culture : Rs.20,000/-
- Borehole method of resin tapping :Rs 38,800.00/-
- Expert advice for sustaining the forest of Delhi. Delhi Golf Club Ltd., New Delhi : Rs.16000/-
- Shisham mortality :Rs.4000/-
- Insect identification service : Rs.700/-
- Testing of wood, non-wood material and samples for natural termite resistance : Rs.17,000/-
- Herbal Garden Maintenance : Rs.6137/-
- Medicinal plant resource base : Rs.28.300/-

Patents Obtained/Filed

Patent filed in October, 2001 for an " Eco-friendly Wood Preservative Formulation" through NRDC, New Delhi.

Commercialization of Technology

Technology for the preparation of compost from plant biomass was sold to M/s Hundal Agro Tech, 1-Vikas Puram, General Mahadev Singh Road, Dehra Dun, for Rs. 40,000/-.

Tissue culture Technology for micropropagation of Eucalyptus was transferred to Centre for Research and Application in Plant Tissue Culture, Haryana State Council for Science & Technology, Hisar.

Conference, Meetings, Workshops, Symposia and Exhibitions

1. Delhi-Uttaranchal Trade Fair at Parade ground, Dehra Dun, Date 28th April to 7th May 2001.
2. National Technology Day at Sunder Nagar, Himachal Pradesh. Date 11th May 2001
3. Van Mahotsava at Central School, FRI, Dehra Dun on date 9th July, 2001.
4. Training cum Demonstration Workshop at Pinjore, Haryana, Date 19th July, 2001.
5. S.M. Swaminathan Research Formulation Exhibition at M.N. Ghosh Auditorium ONGC, Kaulagarh Road, Dehra Dun, Date 13th September, 2001.
6. 'Kissan Mela' at Punjab Agriculture university, Ludhiyana, Date 27th to 28th September, 2001.
7. "Hindi Saptah" at FRI, Dehra Dun, 24th to 28th September 2001.
8. Vigilance Week at FRI, Dehra Dun, 31st October to 6th November, 2001.
9. Exhibition on First Anniversary of Uttaranchal at Dila Ram Bazar (CCF office), Rajpur Road, Dehra Dun, 9th to 15th November, 2001
10. International Trade Fair at Pragati Maidan, New Delhi dated 14th November to 27th November, 2001.
11. National Forestry Liaison Meeting at FRI, Dehra Dun. Date 20th to 21st November, 2001.
12. National Science Day Exhibition at DEAL, Dehra Dun 28th Feb, 2002.
13. World Forestry Day at FRI, Dehra Dun Date 21st March 2002.
14. Environmental Conference at Mahender Tehri Garhwal. 31st March, 2002.

Conferences/Meetings/Workshops/Symposia:

1. Patent Awareness Workshop at CPPRI, Sharanpur on May 25, 2001 (Dr. P.L. Soni, Head, Dr. Rameshwar Dayal, Scientist E and Dr. V.K. Varshney, Scientist C).
2. Expert Committee Meeting on Botanical Pesticide at DBT, New Delhi on July 31, 2001. (Dr. Rameshwar Dayal, Scientist E).
3. Workshop on Patent Intellectual Right Awareness at Roorkee University on Sept. 6, 2001 (Dr. P.L. Soni, Head, Chem. Div.).
4. International Seminar on Globalisation of Indian Essential Oils at Agra on Sept. 21-23, 2001 (Dr. P.L. Soni, Head, Chem. Div. and Research Scholars).
5. Programme Steering Committee Meeting on Biofuels and Bioenergy at DBT, New Delhi on Sept. 24, 2001. (Dr. Rameshwar Dayal, Scientist E).

6. Meeting on Prospecting for Botanical Pesticides at DBT, New Delhi on Oct. 22, 2001 (Dr. Rameshwar Dayal, Scientist E).
7. National Symposium on Recent Trends in Natural Product Chemistry at HNB University, Srinagar, Garhwal, Nov. 5-7, 2001 (Dr. V.K. Varshney, Scientist C).
8. Convention on Natural Dyes at IIT, Delhi on Dec. 17-18, 2001 (Dr. Rameshwar Dayal, Scientist E).
9. 89th Indian Science Congress at Lucknow University, Lucknow on Jan. 3 to 7, 2002 (Dr. V.K. Varshney, Scientist C and Ms Sandeep Kaur, Research Scholar).
10. Meeting of PCD-18 on Natural & Synthetic Fragrance Material, Sectional Committee Meeting at BIS, New Delhi on Jan. 22, 2002 (Dr. V.K. Varshney).
11. IVth Meeting of Task Force on Application of Biotechnology and Biodiversity Conservation and Environment at DBT on Jan. 23, 2002. (Dr. P.L. Soni, Head, Chem.Div.).
12. Technical Advisory Committee Meeting on Natural Dyes at DSIR, New Delhi on Jan. 28, 2002 (Dr. Rameshwar Dayal, Scientist E).
13. IPR Issues and Opportunities in Research & Education, held at IIT Roorkee on Feb. 16-17, 2002 (Dr. Vineet Kumar and Dr. P.K. Gupta, Scientist C).
14. XVI Carbohydrate Conference at CTCRI, Trivandrum on December 6-7, 2001. (Dr. P.L. Soni, Head, Chemistry Division and Research Scholars).
15. Workshop on GEF Projects under Operational Programme at FRI, Dehra Dun from 31.May 2001 to 2.June 2001.
16. One day Workshop on Market Monitoring of tree products on 4th December, 2001 at FRI, Dehra Dun.
17. CTA Workshop and Peer Review on 'Seed Technology' at CSFER, Allahabad 11-12, Dec 2001.
18. World Environment Day 5th June, 2001 at FRI, Dehra Dun.
19. Workshop cum Peer Review of Chirpine organised by CTA Chirpine 29-30 Oct., 2001.
20. CTA Workshop on Poplar CSFER, Allahabad
21. CTA Workshop on Socioeconomic FRI, Dehra Dun
22. Meeting on Development of Project on Elite Germ Plasm and Tree Genetic Resources and setting up the National Bureau of Tree Genetics Resources organized by ICFRE.
23. Workshop on Industrial Technology Demonstration was organized by Forest Products Division on 6th December 2001.
24. National Workshop on Watershed Management Strategies in Uttranchal at IGNFA, Dehra Dun from July, 20th -22nd; 2001.

25. Industrial Technology Demonstration on Technology Day, May 11, 2001 at Sunder Nagar, H.P.
26. Industrial Technology Demonstration on Natural Dyes and Compost for Haryana Forest Department at Pinjore on July 19, 2001.
27. Kissan Mela at Punjab Agriculture University, Ludhiana, September 27-28, 2001.
28. Science & Industrial Exhibition and Fair at VVPG College, at Shamli, Muzzafarnagar from Dec. 19-22, 2001.
29. India International Trade Fair at New Delhi, Nov. 14-29, 2001.
30. Brain storming session on Application of Biotechnological tools in Forest Tree Improvement organized by DBT, at New Delhi.
31. Workshop on "Plant Genetics Resources" held at NBPGR, New Delhi.
32. Symposium on Plant Tissue culture and molecular Biology held at New Delhi.
33. Land Care Movement: State level consultation for Uttaranchal 12-13th Sept, 2001:
34. SAARC Workshop on Disaster Management March 2002. National Forestry Liaison Meeting, 2002.
35. Watershed Management Strategies in Uttaranchal State, 20th-22nd July' 2001.
36. Development of Hydropotential of Uttaranchal, 4th Nov, 2001, Uttaranchal Hydropower Corporation, Dehra Dun.
37. National Seminar on Approaches for Increasing Agriculture Productivity in Hill and Mountain Eco-system at ICAR Research Complex, Umiam, Meghalaya from 19th to 20th Oct., 2001.

Awards

Dr. Rameshwar Dayal, Scientist-E, was awarded Vishist Vaigyanik Puraskar of Ministry of Environment and Forests, Govt. of India for the year 1999-2000 for outstanding contribution in the field of "Phytochemistry of Forest Trees".

Dr. Rameshwar Dayal, Scientist E was awarded ICFRE cash award for the year 1998-99 for outstanding contribution to research in the field of "Forest Utilization".

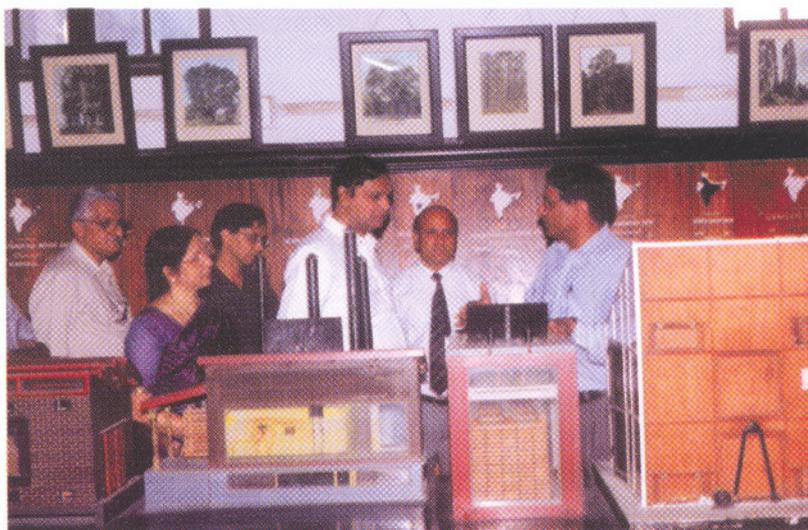
Dr. Sadhna Tripathi, Scientist 'D' has received ICFRE Cash Award for the year 1997-98 in Forest Protection.

Dr. Nawa Bahar Rai received Brandis Award for the year 2002 for contributing cover photograph in The Indian Forester.

Distinguished Visitors

Prof. A. Huttermann, Director, Techn. Mykologiei, University of Gottingen, Germany visited the Chemistry Division of this Institute from 27th to 31st August, 2001 to discuss formulation of a collaborative project proposal on "Development of biocomposites by enzymatic methods for industrial applications" with the support from German Agencies.

Ms Heather Crompton, Asstt. Manager, Forestry Programme, ACIAR, Australia visited FRI from 12th to 13th September, 2001 for finalizing formalities for the collaborative research project on "Eco-friendly wood preservatives from sal" to be funded by ACIAR, Australia.



Hon'ble Minister for Environment & Forests,
Thiru T.R. Bалу visited FRI on 27.03.2002.

Dr. B.C. Rogers,

Associate Professor University of Durban Westville, visited the Institute on 17th September, 2001 to gather information about Indian *Combretum* species and for exploring the possibilities for a collaborative research on this species.

F.R.I (DEEMED UNIVERSITY)

Forest Research Institute, Dehra Dun was conferred the status of 'Deemed University' by the Ministry of Human Resource Development, Government of India, New Delhi vide notification No. F-9-25/89 U-3 dated 6-12-1991. After the conferment of Deemed University status academic activities of the Institute have increased tremendously and it has been fostering research and education in Forestry, Environment and other allied disciplines in a more meaningful and productive way. Besides turning out students having formal academic and practical education of university standard in specialized areas of study newly introduced in the country, such as, Forest Economics & Management, Plantation Technology, Biodiversity Conservation and Pulp & Paper Technology, to man responsible positions in forestry research, wood based industries and plantation activities, the Deemed University has been fostering pioneering research in specialized areas under Ph.D. programme.

Academic Courses and Admissions

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

- M.Sc. Forestry (Economics and Management)
- M.Sc. Wood Science and Technology
- M.Sc. Environment Management
- Post Graduate Diploma in Plantation Technology
- Post Graduate Diploma in Pulp & Paper Technology
- Post Graduate Diploma in Biodiversity Conservation.

The M.Sc. courses are of two years duration whereas Postgraduate diploma courses are of one year duration. The student intake capacity for each course is 15 except PGD in Pulp & Paper Technology where the intake capacity is 10.

Admission to these courses is made on the basis of a candidate's performance in All-India Competitive Entrance Test. The ICFRE under World Bank assistance has been providing studentship of Rs. 1000/- p.m. to each admitted student. During the year 100 students were admitted in all to the above six courses.

PG Diploma in Biodiversity Conservation Course

- Wildlife Institute, Dehra Dun.
- Simlipal Biosphere Reserve, Baripada, Mayurbhanj.
- Indira Gandhi Wildlife Sanctuary, Pollachi.
- Periyar Sanctuary, Idducki.

PG Diploma in Plantation Technology Course

- Wimco Seedlings Ltd. Nainital.
- Bokaro Steel Plant, Bhilai, Bihar.

PG Diploma in Pulp & Paper Technology Course

- Ballarpur Industries, Cuttack
- Ballarpur Industries, Yamunanagar
- Star Paper Mills, Saharanpur
- Centuary Pulp & Paper, Nainital
- Ruchira Paper Industries, Sirmour (HP)

M.Sc. Wood Science & Technology Course

- Ecoboard Industries, Pune
- Vidarbha Veneer Industries, Nagpur
- Hittachi Manufacturing Company, Calcutta
- Unique Plywood, Delhi

- Kitply Industries, Rampur
- Paharpur Cooling Towers Ltd., Calcutta
- Century Plyboards, Calcutta
- Evergreen International Ltd., Gurgaon
- Sarda Plyboards, Ahmedabad
- Janardan Plyboards Industries, Dehra Dun
- Saraswati Art Palace, Jodhpur
- Merbok Company, Malaysia

The Deemed University has a well-equipped computer center where compulsory training to Research Scholars and Students belonging to all the six courses are provided regularly. Each student is also assigned a Dissertation Project to be completed under the guidance of Faculty Members, eminent Foresters and Scientists.

The students are helped to secure suitable employment, for which campus interviews are arranged from time to time.

Students Welfare Activities

- F.R.I. (Deemed University) provides medical facilities to its students.
- Hostel accommodation is available in F.R.I. Campus.
- The facilities for indoor games and common room are provided to the hostlers.
- Library and computer facilities are available to the students

Ph.D. Programme

Research is an essential function of a National Institute like the Forest Research Institute (Deemed University) and increasing emphasis is being given to this important aspect of academic pursuit. Highly qualified Foresters/Scientists and talented Research Scholars have been generally supported by sponsoring agencies like the World Bank, ICFRE, UGC and CSIR, etc. With the support of these organizations the research activities under Ph.D. programmes have increased manifold. At present 140 Research Scholars have been registered including registration of 17 Research Scholars in the current year. During the year 65 Research Scholars have been awarded Ph.D. Degree.

National Forest Library and Information Centre

The National Forest Library and Information Centre (NFLIC) is a storehouse of mankind's intellectual output, and it plays a very intimate role in the research, extension and teaching functions of the Forest Research Institute.

The NFLIC has been providing all types of library and information services to its users viz. reference, referral, lending, reprography, current awareness, inter-library loan, retrieval of information from machine readable databases, etc.

During the year, 985 carefully selected books were purchased at a total cost of Rs.13,90,658/-. Additional 701 books were received on gratis. Thus a total of 1686 books were added to the collection during 2001-2002 making the total collection of the library 1,57,566.

Realizing the importance of scientific periodicals in advanced level of research, the NFLIC subscribed 123 foreign and 81 Indian periodicals. Besides, it also received 345 periodical titles on gratis.

For providing efficient and effective retrospective search and current awareness, the NFLIC subscribed CAB CD, Tree CD, Biological Abstracts, and AGRIS bibliographical databases on CD ROM format. These databases were accessible on ICFRE intranet.

The NFLIC completed bar-coding of the remaining documents by preparing barcode labels of 43,697 documents for their efficient circulation.

The binding of books and periodicals is an essential library activity. For increasing their shelf life, during the year, a total of 2667 sets of periodicals and books were got bound at a total cost of Rs.80, 395/-.

For reading outside the premises of the NFLIC, a total of 13, 055 documents were issued to the users during the year.

Under the Documentation Unit a total of 1500 records were classified for ledgering. 1531 references and 5584 authors, subjects and species cards were filed. Two new plant species files were also opened during the year. Besides, 129 queries of the readers were attended.

The NFLIC has been selling books and other publications of the ICFRE through its Book Depot. During the year, it earned revenue of Rs 1, 49,376/- by selling 1091 books and 37 VHS cassettes.

The NFLIC has been running an ENVIS Project on Forestry. Under this project, 12 issues of a monthly **Forestry News Digest** were published by scanning 14 daily newspaper received in the NFLIC. A maiden issue of the **ENVIS Forestry Bulletin**, an half yearly publication was also published.

Under the Forestry Research Education and Extension Project of the World Bank, the NFLIC received 1250 grey literature documents from the state consultants. A total of 6549 accepted grey literature documents were processed and an electronic database for their efficient retrieval was compiled.