

CHAPTER-VIII

INSTITUTE OF RAIN AND MOIST DECIDUOUS FORESTS RESEARCH JORHAT

The Institute of Rain and Moist Deciduous Forests Research, Jorhat, Assam was established with the primary aim to carryout research on various forestry oriented problem of north east states of India. This North Eastern part of the country is considered as one of the mega biodiversity region with a fragile eco-system. It sustains a wide variety of flora and fauna. This Institute is committed to need based research on aspects like conservation of forest eco-systems, particularly in evergreen forests; tree improvement and propagation; management and containment of shifting cultivation; and eco-rehabilitation of degraded lands.

PROJECTS COMPLETED DURING 1998-99

Nil

OLD PROJECTS CONTINUED DURING 1998-99

Project 1: Genetic improvement of *Dipterocarpus retusus* BL Syn. *D. macrocarpus*.

Objectives: (a) To select plus trees. (b) Establishment of seedling seed orchards and seed production areas. (c) Vegetative propagation of *D. retusus*.

Achievements

1 (one) ha seedling seed orchard was established in the Institute Campus Deovan. SSO consisting of 18 progenies selected from Digboi, Deomali, Jaypor and Jayrampur Forest Division was established. Survey and Analysis of 5 ha areas has been completed in East. Magherita Range (Powai R.F., Assam). Sample analysis was completed of 10 ha areas of *Terminalia myriocarpa* at Chowkham F.R. (Namsai, F. D.).

Project 2: Genetic Improvement of *Gmelina arborea*.

Objectives: (a) To select plus trees. (b) To propagate vegetatively the plus trees. (c) To develop facilities for propagation. (d) To establish VMG clonal seed orchard and seedling seed orchard.

Achievements

Clonal seed orchard of 1 ha area and seedling seed orchard of 1 ha area were established at Deovan. The CSO has 26 superior clones and the SSO comprises 20 progenies selected from Lanka, Lunding and Langting Forest Ranges. Five ha land has been earmarked to establish CSO and SSO of *G. arborea* in Manipur. Negotiations are on for the same with Assam; Mizoram and Arunachal Pradesh Govts.

Project 3: I. High values merchantable biomass production of Teak through genetic improvement. II. Introduction and genetic improvement of *Tectona grandis* and *Terminalia myriocarpa*.

Objectives: (a) Selection of seed production area and plus trees. (b) Screening of clones and vegetative propagation.

Achievements

Scoring has been completed for selection of seed production area of 5 ha *Terminalia myriocarpa* (Hollock) at Ruskin Range under Pasighat Forest Division.

A number of plus trees of *Tectona grandis* were selected.

82 superior clones were selected from National Germ plasm bank, Lohara Research Stations, Chandrapur, Maharashtra for establishment of vegetative multiplication garden. The bud sticks collected from selected plus trees have been set for rooting by means of patch budding.

Project 4: Genetic conservation and improvement of bamboos and canes.

Objectives:

Long term: (a) Conservation of bamboo and cane germplasm. (b) Genetic improvement of bamboo and cane.

Short term (a) Survey of different bamboo and cane growing areas. (b) Selection, identification and *ex-situ* conservation of bamboos and canes.

Achievements

Six species of bamboos, namely *Bambusa balcooa*, *Bambusa tulda*, *Bambusa nutans*, *Bambusa pallida*, *Bambusa bambos* and *Dendrocalamus hamiltonii*, have been selected for this purpose. Survey has been conducted in different parts of Assam, Meghalaya, Arunachal Pradesh and Manipur for selection of candidate clumps. Data collected on 500 clumps based on clump height, clump girth, straightness, length of internode, no. of culms per clump, no. of dry culms, no. of new culms and diseases or pest incidence are being processed.

Out of the planted 308 propagules processed from 154 candidate clumps from the selected species, only 95 propagules have been reported to survive. Further research is in progress.

Project 5: Seed biology of selected forest tree species.

Objectives: (a) Study of phenology and reproductive biology of important forest tree species. (b) Storage trials on forest seeds.

Achievements

Survey was continued to observe flowering, fruiting, seed setting etc. as a part of study of reproductive biology of *Terminalia myriocarpa*.

Seed storage behaviour of *Aquilaria agallocha* was observed on the basis of desiccation studies.

Standardisation of estimation of moisture content of *Artocarpus chaplasi* and *Mesua ferea* was achieved.

Germination capacity of *Dipterocarpus macrocarpus* of different provenance was tested and suitable germination methods have been worked out.

Project 6: Ecological monitoring of biological diversity and strategy of conserving thereof in the Kaziranga National Park.

Objectives:

Long term: Evolving eco-restoration measures for maintenance of biological diversity in the different ecosystems and communities.

Short term: (a) Survey of present status of biological diversity in different ecosystems and communities. (b) Study of population dynamics of plant communities including rare and threatened species. (c) Determination of productivity potentials of different ecosystems in the Park.

Achievements

Potential experimental sites were identified. Projects have been prepared in consultation with park authorities.

Project 7: Structure and functioning of *Dipterocarps - mesua* forest ecosystems.

Objectives:

Long term: To prescribe silvicultural practices for better management of forests on the basis of sound ecological principles.

Short term: (a) To describe the composition, structural pattern and dynamics of the forest communities. (b) To quantify the magnitude of disturbance in the forest ecosystems and causes. (c) To develop prediction models for establishing height diameter relationship of dominant tree species.

Achievements

Selection of site completed. Preliminary investigations on height diameter relationship at one site were made.

Project 8: Study of changes in microflora including mycorrhizae due to shifting cultivation.

Objectives: To assess the status of microflora including VAM fungi in different phases of shifting cultivation as well as in various sites of different fallow periods.

Achievements

Soil samples were collected from different depth i.e. 0-10 cm, 11-20 cm and 21-30 cm. During different phases of shifting cultivation at Silonijan in Karbi Anglong district, Assam to study the population dynamics of fungi and bacteria. It was found that total no. of fungal colonies ($\times 10^3 \text{g}^{-1}$ soil) were more in the soil samples collected after burning as compared to that of before burning phase. This number decreased during cropping phase and then again increased after harvest phase. In case of bacteria, total number of colonies ($\times 10^5 \text{g}^{-1}$ soil) were less in the soil samples collected after burning as compared to that of before burning.

Project 9: Study of the diseases of important forest tree species in nurseries, plantations and natural forest of Northeastern India.

Objectives: (a) To identify the cause. (b) Describe the symptoms. (c) Study epidemiology and work out suitable control measures for the diseases of economically important tree species of Northeastern region of India.

Achievements

During the survey of forest nurseries at Udali Tin-Ali, Lanka of Nagaon district, seven foliar diseases were recorded in *Rauwolfia serpentina*, *Anthocephalus Kadamba*, *Michelia champaka*, *Phoebe goalparensis*, *Canarium resiniferum*, *Tectona grandis* and *Gmelina arborea*, out of which leaf blight of *C. Resiniferum* caused by *Pestalotia* sp. was found to be most severe. Recently, *Dipterocarpus macrocarpus* has

been found to be severely infected by *Colletotrichum* sp. in institute's nursery at Deovan. Two sprays of Blitox50 @ 0.2% at 7 days interval successfully controlled the disease. While surveying social forestry nursery at Jonaki nagar in Golaghat district, severe thread blight was recorded on *Melia azaderach* with 80 to 100% mortality. During a survey of *Albizia procera* plantation in Lanka Reserved Forest, Nagaon, Assam, high mortality of *A. procera* was noticed in all the 5 ha of plantation. About 15-20% died completely and remaining trees were in various stages of infestation. Loss of Rs. 2000/- per tree has been estimated. The study on etiology of these diseases is in progress. Five villages of Jorhat district were surveyed for bamboo blight disease. It was found to cause mortality in young clumps and the rate was highest in *Bambooswa balcooa* (70-90%). The fungus *Fusarium equiseti* was found to be associated with early blight symptoms.

Project 10: Mycorrhizae screening.

Objectives: (a) To determine status of VAM association in economically important forest tree species of wet evergreen forests of Arunachal Pradesh and Assam. (b) To maintain pure VAM spores of identified species.

Achievements

Various nurseries and plantation of this region were surveyed. Root and rhizosphere soil samples were collected for study of VAM fungi and assessment of percent root colonization. Spores of VAM fungi were isolated and quantified.

During the survey in different localities of Majuli, a river island in Jorhat, VAM fungi belonging to 2 genera viz. *Glomus* and *Gigaspara* were found to be dominant in the rhizosphere soil samples. The analysis of soil samples revealed an inverse correlation between organic carbon and number of VAM spores/100g soil.

It was found that the population of VAM fungi varied from 104 to 206/100g in plantation soil and from 40-152/100g in case of nursery soil. Root colonization also showed variation between 25-56% in plantations and 23-60% in nursery.

Survey conducted for VAM fungi in village bamboo groves showed that the population of VAM fungi in rhizosphere of *Bambusa tulda* was between 50-106/100g soil, whereas it varied in the root colonization between 18-50%. The indigenous VAM spores collected during the survey were inoculated into *Dendrocalamus hamiltonii* and *Calamus tenuis* respectively in a pot experiment to study the effect of VAM fungi on growth of bamboo and cane. Multiplication of indigenous VAM spores using trap plants is in progress.

Project 11: Isolation, identification and maintenance of Vesicular Arbuscular Mycorrhizal (VAM) fungi associated with some economically important forest plant species of North-eastern India.

Objectives: (a) To collect soil and root samples from different nurseries and natural forests. (b) Isolation, purification and identification of VAM spores from collected samples. (c) Testing of efficiency of VAM spores against target plants, and maintenance of efficient VAM species using suitable trap plants.

Achievements

Soil and plant root samples were collected from permanent site of IRMDFR, Deovan to study the status of VAM fungi.

Project 12: Study of successional changes in plant communities under shifting cultivation.

Objectives: (a) To evaluate the successional changes in plant communities. (b) To establish floristic pattern. (c) To enumerate the important species/life form in different fallow land and natural forest.

Achievements

It has been observed that occurrence of number of plant species vary considerably in different seasons of the year. Maximum number of species were recorded during post monsoon season i.e., 83 spp. While 75, 65, and 65 spp. were reported during monsoon winter and summer seasons respectively. In the vegetation pattern, *Chromolaena odorata* and *Lantana camara* exhibited the dominant identity in all the fallow lands. Dominance of *Chromolaena odorata* gradually decreased while that of *Lantana camara*, increased with the age of the fallows. Species diversity was found to increase upto 2nd year jhum fallow and gradually decreased with the subsequent fallows. Index of dominance was inversely proportional to the diversity of the community. The distribution pattern in all communities showed random contagious trend but exhibited contiguous pattern dominantly. It is only after the 4th year fallow, that regeneration of a few tree species was observed. *Gnetum gnemon*, *geodorum* spp., *Costus speciosus*, *Globa* spp; *Curcuma* pp., *Piper* spp., *Abrus* spp., etc. were observed as jhum affected species. In the disturbed natural forest, *Dillenia pentagyna*, *Hydrocarpus kurzii* and *Litsea laevis* were found dominate. In primary natural forest *Castanopsis* spp. *Mesua ferrea*, *Elaea carpus* spp., *Vetiva Lanceifolia*, *Litsea* established their dominance. Higher value of species diversity was evident in the primary condition. Biomass contribution of the fallow land showed that both above and below ground phytomass increased with the increase of the age of the fallow. The percentage of total nitrogen in the studied plant sample was observed to be higher in the above ground parts than the below ground parts.

Project 13: Study of changes in morphological, physical and chemical properties of soil under shifting cultivation areas.

Objectives: (a) To measure nutrient fluxes as well as pools to prepare nutrient status of the soil. (b) To analyse nutrient cycles using ideas from system ecology.

Achievements

Soil samples were collected from shifting cultivation areas fallow lands (1,2,3 & 4 years old) and nearby natural forest. Collection of samples were made during four seasons in the year viz. monsoon, post-monsoon, winter and summer. Samples were also collected before burning the slash, after burning, during cropping and at harvest from three different depth viz. 0-15 cm, 15-50 cm and 50-100 cm. Soil moisture, pH, conductivity, bulk density, texture, organic carbon, N,P,K Ca and Mg were analysed.

Soils under natural forest were comparatively more acidic than the fallow land. Just after burning the slash, pH value significantly increased. A gradual increase of soil acidity was noticed during cropping and harvesting period. The value remained more or less stable upto 2nd year fallow.

The value of pH decreased with the increase in depth. Highest value of pH was recorded in summer season followed by monsoon, post monsoon and winter season. The moisture was significantly higher in natural forest than in fallow land and shifting cultivation sites. Moisture content increased with the soil depth. Bulk density of the natural forest was much higher than the fallow land. The textural class of all the soil studies was sandy loam. Highest percentage of sand and lowest value of clay was recorded in natural forest and before burning the slash. After burning, the percentage of sand significantly decreased. Seasonal changes had no effect upon textural properties of soil.

The value of conductivity increased significantly after burning of slash and began to decline with cropping.

The value of organic carbon, total N, available P, and exchangeable cations was considerably higher in surface layer.

The value of all the nutrients was found higher in natural forest than in fallow land.

The loss of cations was recorded in the run off and leaching of nutrient which continued upto post monsoon season.

Project 14: Studies on the microfaunal components of litter ecosystem and their changes in relation to shifting cultivation.

Objectives: (a) To ascertain impact of shifting cultivation on the litter microfauna in terms of species diversity, density and distribution. (d) Entomofaunal diversity of the above ground vegetation and their changes in relation to shifting cultivation. (e) Trends in entomofaunal succession in forests and litter ecosystem.

Achievements

During fallow periods due to regeneration of some vegetation, terrestrial insect population starts to recover though it is not the same as in the natural forest. Population of biological control arthropods like Hymenoptera, Neuroptera and spiders indicate only slight variation from natural forest.

During cropping season, homopteran formed the major group per unit area followed by coleopterans, hemipterans, dipterans and spiders.

During post harvest season orthoptera formed the major group followed by homopterans, mites, coleopterans, heteropterans, lepidopterans, hymenopterans and dipterans. But in two year fallow, homopterans dominated followed by dipterans, spiders, thysanopterans, coleopterans, orthopterans, heteropterans, and lepidopterans. Similarly in natural forest (actually the sampling was done at a time when the forest was being cut) Diptera was the major group followed by hymenopterans, homopteraans, spiders, coleopteraans, lepidopterans, thysanopterans, orthopterans, heteropterans, neuropterans, collembolans and odonates.

Project 15: Bio-ecological studies on gall forming aphids infesting *Styrax* sp.

Objectives: (a) To study aphid species that produce plant galls in *Styrax* sp. (b) To estimate the extent of damage caused due to the aphid infestation.

Achievements

Observations are being made and data collection is in progress.

Project 16: Microbial control of major forest insect pests of North East India.

Objectives: (a) To explore the possibilities of controlling insect pests of forests with the help of microbes, especially entomopathogenic fungi, bacteria and viruses, which form an important component of Ecologically Based Pest Management (EBPM). (b) To screen the pest populations for their pathogens and build up their collection, which can be used later in biocontrol of the pests.

Achievements

Survey was conducted in and around Jorhat and Golaghat District of Assam for entomopathogens associated with forest insects. *Calopepla leayana*, a species of dipterous fly, were found to be infested with *Metarhizium anisopliae*. *Metarhizium anisopliae*, *Fusarium* sp. and *Beauveria bassiana* were cultured on potato dextrose medium and used for various bioassays.

Different concentrations of spores of two entomogenous fungi viz. *Beauveria bassiana* and *Metarhizium anisopliae* on different larval instars and adults of *Calopepla leayana* were tried to control this pest in Laboratory condition. Laboratory studies of pathogenecity showed differential percentage mortality with respect to different concentrations of spore suspensions. Both the fungal species were found to be significantly pathogenic to all the larval stages as well as adults of *C. leayana*. However, *B. bassiana* was found more virulent as compared to *M. anisopliae*.

Project 17: Preparation of an atlas of the important forest insect pests of North East India.

Objectives: To provide the field worker and scientists an easy identification guide of the insect pests of the tree species and their damage potential in the plantations and nurseries.

Achievements

Detailed survey in various state of Northeast resulted in collection of various pest associated with forest trees in nurseries, plantations and natural forests. Compilation of information on their distinguishing characters, distribution, host plants, nature of damage, damage potential, life cycle, and control measures along with colour photograph is being prepared.

Project 18: Biological control of *Calopepla leayana* (Col.: Chrysomelidae), a major insect pest of *Gmelina arborea* in North East India.

Objectives: (a) To explore the bio-control organisms associated with the pest. (b) To study the population dynamics of the pest and its parasitoids. (c) To device techniques for artificial rearing of both the pest and parasitoids. (d) To control the pest biologically in the plantations and nurseries.

Achievements

Surveys carried out to locate *G. arborea* plantations.

Field surveys were carried out to assess the populations of the pest. Surveys during Oct/Nov. showed that 80% of the trees were severely defoliated. On the completely defoliated trees (80% tree), only pupae were present and their number averaged 60 per tree of which 58% were found to be parasitised by *B. excarinata*. Whereas on the trees with few leaves (20 % trees) the adult beetle population averaged 13.5 and that of pupae 53 per tree. The parasitisation percentage in this case was almost the same as that in the completely defoliated tree i.e. 57.

Parasitoids associated with *Calopepla leayana*:

Name of the parasitoids	Family	Association
1) <i>Forestrella</i> sp.	Teteracampidae	Primary egg parasitoid.
2) <i>Tetracampic</i> sp.	Teteracampidae	Hyperparasitoids of eggs.
3) <i>Brachymeria excarinata</i>	Chalcididae	Primary parasitoids of pupae.
4) <i>Euplemus</i>	Eupelmidae	Hyperparasite of pupae.
5) <i>Undet</i>	Chalcidoid	Hyperparasite of pupae.

Parasitisation of Oothecca by *Forestrella* sp.

Field parasitisation of oothecae by *Forestrella* sp. at different sites at Jorhat, on an average 25 per cent of oothecae were found to be parasitised and from each oothecae about 20 parasitoids emerged.

Parasitisation of pupae by *Brachymeria excarinata* (Hymenoptera: Chalcididae)

Brachymeria excarinata was found to reduce pupal population by 55 per cent, 25 per cent of pupae collected from the field died without giving emergence to either parasitoids or *Calopepla* adults. Laboratory experiments proved that these pupae died because of stinging by these wasps. Therefore, actual pupal population killed by this wasp should be 80 per cent.

Some microbial pathogens are also reported to associated with *Calopepla leayana*. Entomopathogenic fungi like *Metarhizium anisopliae*, *Aspergillus flavus*, *Fusarium* were found to be associated with larvae/pupae and adults of the pests. These can be exploited to control this pest in a very ecofriendly way. Larvae and pupae were also found to be infected with some unknown pathological syndromes. Detailed research work on these micro organism may throw light to control this serious pest.

Project 19: Standardization of nursery techniques for selected bamboo species of North East India.

Objectives: (a) To develop package of practices. (b) To develop reliable method of propagation from cuttings. (c) To establish wide genetic base. (d) To select superior genotypes. (e) To improve productivity of bamboo plantations.

Achievements: A preliminary experiment was laid out in Randomized Block Design to assess the suitability of various potting media on rooting response of *Bambusa tulda* cuttings.

The suitability of various media can be ascertained only after root induction and tiller formation. Observations are being taken at regular intervals. Result is awaited.

Another experiment was laid out in Randomized Block Design to find out the effect of position of node on rooting of cuttings. Observations continue.

Project 20: United Nation Development Programme (UNDP Project).

Objectives: Strengthening and developing ICFRE by involving extension programme for effective transfer of technologies to the farmers, more particularly, the tribal population of Northeast region through demonstration plantations for alleviation of poverty and socio-economic upliftment. (b) To identify and establish existing and additional seed production area, selection of plus trees in different states of this region. (c) To organize training programme for foresters, farmers and villagers on seed technology, seed orchards, seed production area, identification of VAM and Rhizobia, etc.

Achievements

Foresters' Training Programme:

Silviculture and Forest Management division had organized institutional training programme for the foresters of N-E India from 18th-22nd August 1998. Altogether 136 Rangers/Foresters/Forest Guards received training.

A technical bulletin was prepared on the above-mentioned subjects was supplied to each of the trainees to serve as future reference book.

Farmers' Training Programme:

Taking into consideration the practical needs of the farmers of the neighborhood villages of Deovan, IRMDFR, a series of training programmes was organized. 'Nursery Management', training was imparted to 89 farmers on aspects like site selection, clearing, fencing, bed preparation, preparation of soil mixture, seed collection from plus trees, seed processing, pretreatment, sowing, transplanting, stump making, grafting, budding, irrigation, fertilization, sanitation etc.

Training on 'Preservative Treatment of Bamboos' was imparted to 40 farmers.

Exhibition, Kisan Mela etc.

Farmers, students, and rural women of the adjoining villages visited exhibitions arranged by the institute. The exhibits included photographs, models, herbarium and plant based products.

Exhibition on 'Environment & Forests' for students of Class-I to Class-X, belonging to various schools of Jorhat and adjoining areas were conducted.

Several environment awareness programmes like tree planting, drawing competition and seedling distribution were organized during 98-99.

Under tree planting programme a total of 8199 seedlings of *Chukrasia tabularis*, *Oroxylum indicum*, *Dalbergia sissoo*, *Delonix regia*, *Cassia fistula*, *Anthocephalus cadamba*, *Tectona grandis* etc. were planted in and around Jorhat town. Further 1536 seedlings were planted inside the campus of organizations viz. CISF, ONGC, Indian Army and Central School, with the active participation of the user groups.

Under mass seedling distribution programme 25,000 seedlings of *Mesua ferrea*, *Dalbergia sissoo*, *Delonix regia*, *Cassia fistula*, *Cassia siamea*, *Embllica officinalis*, *Tectona grandis* etc were distributed to the 471 farmers of adjoining villages in order to make tree planting a habit.

Project 21: Himalayan Eco-Rehabilitation (IDRC Project).

Objective: (a) To assess and quantify damage due to shifting cultivation and other land use. (b) To develop and test agroforestry interventions and distribute animals to contain shifting cultivation. (c) To undertake baseline and socio-economic impact studies in selected areas. (d) To strengthen the socio-economic and inter disciplinary research capability of ICFRE.

Achievements

Field demonstrations were arranged to educate the *jhumiyas* about the long and short-term benefits of the demonstration model raised.

A socio-economic survey was conducted in selected villages. Free piglets and chicks were distributed.

CONSERVATION OF INDIGENOUS POPLARS IN INDIA

The Institute has undertaken the work on survey and identification of indigenous poplars in north-east India.

Natural regeneration was found profuse especially on freshly cleared soil more particularly, in the Jhum fallows. It has been observed that the local people prefer poplars in their private as well as in the community lands. A survey at Rupa, Chillipam, Jirigaon and Shergaon areas revealed that *P. ciliata* is grown predominantly around nallahs between the hills. A survey was also undertaken at Yachuli Forest Range under Hapoli Forest Division for *P. gamblei*.

NEW PROJECTS TAKEN UP IN HAND DURING 1998-99

Project 22: Recycling of forest based organic matter into value-added compost.

Objectives: (a) Development of suitable technology for production of quality compost from forest based organic matter.

Progress made

Survey conducted to identify hedge plants.

Project 23: Management of nursery diseases of forest tree species through improved cultural practices.

Objectives: (a) To prevent planting material borne diseases, planting media borne disease and air borne diseases. (b) To evaluate the economics of each control method. (c) To raise healthy disease free seedlings.

Progress made

Various nurseries in and around Jorhat and Lanka, Nagaon were surveyed for disease situation in the target species. Root and foliar diseases of *Gmelina arborea* and *Dipterocarpus retusus* have been recorded in nursery. The probable pathogen has been isolated. The status of microfungi (on Phylloplane, rhizoplane and in rhizosphere) with regard to diseases and healthy seedlings of *D. retusus* has been studied. Seed mycoflora of *D. retusus* has been recorded. The ecology of rhizosphere microfungi with relation to *G. arborea* seedlings in soil beds, polybags and in vegetative multiplication garden is being studied.

Project 24: Development of ecologically viable alternative models to shifting cultivation.

Objectives: (a) Development of agroforestry models as alternatives to shifting cultivation. (b) Improvement of physical and chemical properties of soil. (c) Identification of best tree crop models for jhum land. (d) Ecology and economics of different models. (e) Sustainable utilisation of jhum land.

Progress made

Different shifting cultivation sites were surveyed and some new packages have been proposed. 4 ha of shifting cultivated land has been acquired from forest department, Karbi-Anglong to establish plantation of *Dalbergia sissoo*. Preparation for laying out experiment is in progress.

Project 25: Isolation of *Rhizobium* from leguminous forest trees and development of technology to increase nitrogen fixation through biofertilizer.

Objectives: (a) Isolation and identification of *Rhizobium* strains from leguminous forest tree species. (b) To evaluate the efficiency of strains to fix atmospheric nitrogen. (c) To prepare carrier based inoculants to use the efficient *Rhizobium* strains as bio-fertilizers in nurseries and plantations.

Progress made

Different nurseries were surveyed for nodulation status of leguminous tree species. Good nodulations were observed in *Cassia siamea*, *Acacia auriculiformis*, *Dalbergia sissoo*, *Samania saman*, *Albizia procera*, *Leucaneaia lucocephala*, etc. Various biochemical tests for identification of strains are in progress. Plant test for authenticating the strains as *Rhizobium* is in progress.

EXTENSION

PUBLICATIONS

Books :

Dipterocarpus retusus Syn *D. macrocarpus*, past present and future Rawat, Vijay (1998), IRMDFR.

Title- Technical Bulletin on Applied Forestry Research for Field Foresters.

Publication and extension literature brought out by the Institute.

Brochures :

Several brochures on silviculture of different species Viz. Hollong, Gamar, Sal, Bamboo, Canes, Champak and Bakul have been published.

FINANCIAL STATEMENT

I. PLAN

Sl.No.	SUB-HEAD	Expenditure (Rs. in lakh)
1.	A. REVENUE EXPENDITURE	
	(a) Research	92.72
	(b) Administrative Support	42.54
	Total for Revenue Expenditure 'A'	135.26
	B. LOAN AND ADVANCES	
	(a) Loan Advances (Conveyance)	2.00
	(b) House Building Advance	1.86
	Total for 'B'	3.86
	C. CAPITAL EXPENDITURE	
	(a) Building & Roads	-
	(b) Equipments, Library Books	1.67
	(c) Vehicles	
	Total for 'C'	1.67
	GRAND TOTAL FOR A+B+C(PLAN)	140.79
II. NON-PLAN		
1.	A. REVENUE EXPENDITURE	
	(a) Research	-
	(b) Administrative Support (Salary)	-
	Total Non-Plan	-
	TOTAL FOR PLAN + NON-PLAN	140.79
III. FUNDED PROJECT		
	A. World Bank Project	34.24
	B. UNDP Project	5.49
	C. NABARD Project	-
	D. FORTIP	-
	GRAND TOTAL for (A+B+C+D) FUNDED PROJECT	39.73