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TROPICAL FOREST RESEARCH INSTITUTE
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EXECUTIVE SUMMARY

- Lac host species viz. *Flemingia macrophylla* and *Flemingia semialata* were transplanted for the establishment of lac based Silvi-agri-lac system in the tropical region of Jabalpur. *F. macrophylla* species performed better as compared to *F.semialata*.
- Plantation of *Phyllanthus emblica* (Aonla) cv. NA7 and NA10 were performed excellently during the 1st year of plantation. Both cultivars needed additional inputs including timely irrigation and proper doses of fertilizer for ease establishment. Aonla cv. NA7 & NA 10 was established at the spacing of 10mx8m and 10m x 6m intercropped with *Cajanus cajan* (Arhar) in Factorial RBD. Collected and analysed soil samples for the estimation of nutrient status of soil before the initiation of the system. The data on soil analysis revealed pH 6.35- 7.50, EC 0.08 – 0.25 m mhos /cm and organic matter 1.21- 1.53% , available macro nutrients (Nitrogen 188.0 – 344.96kg/ha, Phosphorus 14.83 – 41.92 kg/ha and Potassium 60.05 – 396.33 kg/ha calcium 20.0 – 38.0 kg/ha manganesium 14.0- 40.8 kg/ha. All nutrients were found in medium range except available phosphorus which was very low both at Farmer's field and research station. After one year of growth, Aonla cv. NA-7 attained the height ranging from 86.0 cm to 114.3 cm and Aonla cv. NA10 from.93.6 to 172.1cm with agriculture crop in the study sites at 10 m x 10 m spacing.
- Seedlings of *Psidium guajava* and *Pterocarpous marsupium* were raised and intercropped with *Cajanus cajan* for the development of Silvi-horti-agri system. *P. marsupium* plants exhibited 50% survival and performed poorly in the lateritic soil .
- Two non conventional lac host shrubs viz. *Flemingia semialata and F. macrophylla* were procured from the National Institute of Natural Resin and Gum, Namkum, Ranchi (Jharkhand) and transplanted on the selected sites. After one year of growth, the height of both host shrubs ranged 90-250cm in *F.macrophylla* and 60-150 cm in *F. Semialata*.
- Three new species of white grubs *(Holotrichia rustica*, *H. mucida* and *S. ruficollis*) were identified for the first time and they caused vast scale damage to teak seedlings in forest nurseries. Detailed bio-ecology of the white grub complex was investigated in Maharashtra, based on which the model for the integrated management was proposed to Forest Development Corporation, Maharashtra.
- As an important component of IPM, the selected systemic insecticides were tested against white grub (larva of *H. Rustica* beetles) in Maharashtra. Monocrotophos (0.05%) and dimethoate (0.1%) with persistance upto 10 DAS against the beetles were recommended for restricted use. Imidocloprid, Ethion and Carbaryl proved to be less effective with less persistence.
- Release of indigenous strain of eggs parasitoid, *Trichogramma raoi* @ 1.25 lakh/ha was found to be effective in minimizing at least 50% damage impact caused by teak defoliator and leaf skeletonizer.

- Aonla cv. NA-10 was found to be realtively resistant followed by Kanchan against gall forming insect *Betousa stylophora*, defoliator *Garcillaria acidula* and bark eating caterpillar *Indarbela quadrinotata*.
- In nursery, foliar spray of monocrotophos 36 E.C. 0.05% followed by metasystox 25 E.C. 0.05% and soil application of phorate 10 G and furadon 4G each @ 25 g per 1mx1m plot were also found to be equally effective against *Betousa stylophora.*
- Thirty Braconid larval parasitoids with varied degree of field parasitisation were recovered from key insect pests of forest tree species from Chhattisgarh and Maharashtra. They were expected to be important biological control agents against key forest insect pests.
- Blue gum chalcid wasp, *Leptocybe invasa*, found to be a major threat to Eucalyptus in nurseries of central India.
- Major insect pests were identified for medicinal plants viz. muskdana, *Abelmoschus moschatus*, kalihari, *Glorisa superba* and ashwagandha, *Withania somnifera*.
- Twenty five species of *Apanteles* were also recorded, for the first time, from Orissa, which are promising biological control agents of key defoliators of teak and sal forests.
- Seven entomopathogenic nematode strains native to central India were isolated. One of them identified new-to-science as an important biological control agent against major forest insect pests.
- Technology was developed for formulation of three value added food products viz. Mahua jam, squash and chutneys from dried *Madhuca indica* (Mahua) flowers. All the products developed were according to the Food Products Order (FPO) specifications.
- Twelve training programmes were conducted during the year. Target groups were farmers/NGOs/Women Self Help groups/Women Van Samiti members.
- 100 women master trainers of Chhindwara region were provided training for preparation of three value added food products from dried mahua flowers in an attempt to poverty alleviation of rural masses.
- The centre also published one extension literature in Hindi (brochure on औशधि पौधा सतावर: परिचय एवं खेती) during the period for public awareness and dissemination of scientific knowledge among the public.

Summary of the Projects

Project type	**Completed projects**	**Ongoing projects**	**New projects initiated during the year**
Plan	10+3(dropped)+1(deferred)=14	10	7+1(initiated & dropped) = 8
Externally Aided	7	11+1(3 subprojects)=12	8

INTRODUCTION

Tropical Forest Research Institute (TFRI) Jabalpur, situated on the bank of Gour River on Mandla Road, is one of the institutions under Indian Council of Forestry Research & Education (ICFRE). The institute is headed by Director and has staff strength of 199 including 35 Scientists and 10 officers. The Institute came into existence in April 1988, although its origin goes back to 1973 when a Regional Centre of FRI, Dehradun was established at Jabalpur to provide research support to the problems of forest management in central India. It has an area of 109 ha and a constant liaison with state forest departments, NGOs working in the field of forestry and allied areas, universities imparting education in forestry, and forest based industries. It caters to the forestry research on three states of central India, viz. Madhya Pradesh, Chhattisgarh, Orrisa and Maharashtra. Thrust areas of research in the institute relate to non-wood forest produce, rehabilitation of mined areas and other stress sites, development and demonstration in agroforestry models, planting stock improvement, sustainable forest management, biodiversity conservation and control of forest diseases and pests.

Centre for Forestry Research & Human Resource Development (CFRHRD), Chhindwara came into existence on 30th March 1995 under TFRI, Jabalpur. The mandate of the centre is to take up forestry research in the specialized areas like biodiversity conservation, non-wood forest products, forest protection, Silviculture and tree improvement. In addition to this, the centre has also been assigned to develop human resource in forestry sector by imparting vocational training leading to poverty alleviation through self employment in central India.

2. RESEARCH HIGHLIGHTS

2.1 Ecosystem Conservation and Management

2.1.1 Overview

The institute is working on climate change, documentation of phyto-diversity and its conservation and management, tribals and their traditional knowledge system in central India.

2.1.1.1 Summary of the achievements under the theme

The Biodiversity division is responsible for documentation of floral diversity of forests; enlist rare and endangered species for their conservation and sustainable use. Ethno-botanical surveys are also carried out to document patterns of utilization of rich biological diversity in the Indian region by various ethnic communities, including the primitive tribes. Investigation on floristic diversity in teak plantation of various age groups in Barnawapara Project Division, Raipur, Chhattisgarh is being carried out to determine the changing of plant diversity in different year old plantation, changing of soil properties in those teak plantation and the similarities between plant species in each of those teak plantations and plant species in natural forest of teak.

Conducting study on assessment of soil–vegetation carbon pool in dry deciduous mixed forest of Betul under National Carbon Pool assessment project of IIRS Dehradun. A flux tower has been established at Teak Forest of Betul Madhya Pradesh by IIRS Dehradun. The field studies have been carried out around 1 km periphery of tower for inventory of vegetation, estimation of leaf area index, analysis of soil moisture percentage and analysis of carbon and nitrogen of soil, litter and leaf samples is in progress to support national carbon pool modeling.

Documentation and distribution of Forest Invasive Species (FIS) of Jabalpur, Katni, Mandla and Seoni districts of Madhya Pradesh have been carried out. Enumerate FSI their diversity and distribution through laying out quadrats in different types of forest. Total 39 FIS species have been recorded. Phenological observation has also been recorded.

Studies have been carried out on utilization pattern of plants in ethno-medicinal uses prevalent in tribal pockets of Satpura plateau in Madhya Pradesh. Field survey was conducted to identify rich tribal pockets in Mandla, Jabalpur, Katni and Chhindwara districts of MP for documentation of traditional knowledge from traditional herbal healers. In all 507 plants of medicinal value, which are being utilized by 134 traditional herbal healers of tribal pockets of above four districts for cure of various diseases prevailing among tribal / local people were documented.

2.1.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	2	1	1
Externally Aided	1	3	1

2.1.2 Climate Change

Utilization of Automatic weather station/Agrometeorological station data for agriculture, forestry and hydrological applications in Madhya Pradesh

Conducted grass biomass studies from three national parks *viz.* Kanha National Park (KNP), Bandhavgarh National Park (BNP) and Madhav National Park (MNP) in Madhya Pradesh in 3 seasons including March, September and December. The studies were conducted near Automatic Weather Station (AWS) and Agrometeorological Station (AMS) installed by Space Applications Centre (SAC), Ahmedabad to quantify grass biomass per unit area. Maximum grass production was found in September (post rainy season) and December (winter season), which gradually decreased in the month of March.

Measured soil moisture profile by volumetric method at an interval of 30 cm and till the depth of 150 cm near AWS and AMS in MNP, BNP and KNP. Soil moisture increased with depth due to vertical seepage and accumulation of water to lower horizons in different seasons. Maximum soil moisture was recorded in September, followed by December and March.

Quantified Specific Leaf Area (SLA) of abundantly available tree species in MNP, BNP and KNP in the selected seasons. No regular trend in different seasons was found in SLA.

Developed regression equation for quantifying above ground biomass against GBH for *Shorea robusta*.

Conducting grass biomass studies at Supkhar (KNP)

Collecting meteorological data from AMS installed at Raunda

2.1.3 Ecology & Environment

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

Plantations promote understory regeneration by shading out grasses and other light-demanding species, changing understory microclimates, improving soil properties and increasing vegetation structural complexity. With this view the project has been started to determine the changing of plant diversity in different year old plantation, changing of soil properties in those teak plantation and the similarities between plant species in each of those teak plantations and plant species in natural forest of teak.

Team at work with forest officials

Teak plantation

Preliminary survey of Barnawapara project has been completed for selection of sites and collection of maps etc and site details have been recorded. Quadrats have been laid out in 25 compartment of teak plantation of various age groups. Enumeration of vegetation has been carried out, 102 quadrat have been laid out in 1, 4,7,10, 13,16,19,22,25,28,31 year's old plantation of teak. 84 trees, 12 shrubs and 36 herbs species have been recorded other than teak. 126 soil samples have been collected and analysis of soil samples is in progress.

Soil, Vegetation – Atmosphere Carbon Fluxes Measurement and Modeling (SVF)

The Indian Institute of Remote Sensing (IIRS) has undertaken a National Carbon Project (NCP) under Geosphere Biosphere Programme (GBP) of the Indian Space Research Organization (ISRO) to estimate the carbon pools and fluxes in different terrestrial ecosystems of India. The project envisages temporal inventory of the forest and soil carbon stocks as well as measurement and modelling of carbon exchange along atmosphere-vegetation boundary. Six carbon flux measurement towers using eddy covariance techniques are installed in five major forest types of the country. Betul (teak forest) in Madhya Pradesh is one of them. The objectives of the project are to measure the vegetation and soil parameters to support modelling and to collect the data related to silviculture, inventory, management and utilization, to estimate the net ecosystem exchange of carbon

Collection of Herb/Shrub Biomass

Litter decomposition bags

Litter trap

Achievements:

- Carried out inventory of teak forest in experimental site.
- Collected leaf sample of 9 tree species for Leaf Area Index, collected soil sample and analyse soil moisture % and soil carbon %.
- Collected soil sample and analyse the EC, pH, N, P and K.
- Determine litter production and decomposition rate and Herb/Shrub Biomass.
- Recorded data of phenophase of 10 species.

Documentation and distribution of Forest Invasive Species (FIS) of Jabalpur, Katni, Mandla and Seoni districts of Madhya Pradesh.

Alien species are non-native or exotic organisms that occur outside of their natural adapted ranges due to their dispersal potential. Many alien species support our farming and forestry systems. Alien species become invasive when they are introduced deliberately or unintentionally outside

Hyptis suaveolens in mixed forest

their natural habitats into new areas where they express the capability to establish, invade and compete with native species. Many of the plant species intentionally introduced in various countries in the past have become major threat to the forest biodiversity and their control measures consume substantial financial resources.

Achievements:

- Preliminary survey of four districts (Jabalpur,
- Mandla, Katni and Seoni) has been completed for selection of site and collection of maps etc.
- Preliminary survey for the selection of sites has been made in four districts of MP.
- Three sites at each district have been selected for the study.
- Site details of the study sites have been recorded.
- 48 quadrate 20m x20m have been laid out for the enumeration of the vegetation in all four districts.

Lantana camara in Teak forest

- 144 quadrats (5x5 m.) laid out for the study of shrubs and saplings along with invasive species.
- 144 quadrats (1x1 m.) have been laid out for herbs and grasses in all sites.
- Number of tree species along with height, girth and shrubs, herbs and grass occurring in the respective quadrats have been recorded.
- 39 invasive species so far been documented and identified from forest area of above four districts.
- Phenological studies of invasive species are in progress.
- Mechanical control experiment of FIS is laid down in two 10x10 m. quadrats within 20x20 m quadrats and one 20x20 m quadrat is kept as control. The observations are in progress..
- Phenological observations have also been recorded and vegetation analysis is in progress.

Cassia tora

Hyptis suaveolens infestation

Monitoring the impact of climate variables on plant diversity in Bhimashankar permanent preservation plot of Sub tropical hill forest of Maharashtra

Climate is probably the most important determinant of vegetation patterns globally and has significant influence on the distribution, structure and ecology of forests. These changes may contribute to declining global biodiversity. Global change poses a threat to tropical forest biodiversity. Though the magnitude of this impact has proven challenging to predict and measure. A significant obstacle to measuring and predicting the effects of global change on tropical forests has been the paucity of baseline information. The study are being carried out in Bhimashankar permanent preservation plot of subtropical hill forest ($8A/C_2$), one of the 23 preservation plots of Maharashtra state. The Bhimashankar preservation plot is rich in biodiversity and efforts will be made in the present study to monitor the impact of possible climate variables on vegetation dynamics. Previously, plant diversity of this preservation plot was studied by TFRI, Jabalpur in the year 1999 and such types of study which include scientific investigations at ecosystem level have not been undertaken in this region. The data generated through this study will be provided the basis for future strategies to be adopted for ecosystem monitoring in relation to climate change on global basis.

Subtropical hill forest

Achievements

Secondary information collected from available resources. Collection of climatological data is in progress. Preliminary survey was carried out in comptt. no. 19 for general information pertaining to site, terrain, physical features and vegetation. Floristic identification for inventorization and phenological observations on important species was carried out**.** Total 16 tree species recorded**.** Vegetation sampling was done to know the type of plant species present, so that vegetation of the area can be assessed quantitatively & qualitatively. Simple Random Sampling has been carried out through laying out quadrats.

Ecological assessment of diversity of medicinal plants in conservation areas of Chhattisgarh and strategies for their protection

The forest community comprises of biological system having a number of plants and animal species as their components. Vegetation at a particular site is the result of various climatic and bio-edaphic factors. A working list of known plant species is considered to be a fundamental requirement for plant conservation. Systematic and periodic surveys for floral composition and documentation of endemic and threatened plant species are essential for better management and sustainable utilization of the resources. A large number of important plants are being exploited from wild for commercial use every year. As a result, the populations of most of taxa are decreasing because of over exploitation, extensive destruction of habitat or other environmental

disturbances. The documentation of traditional uses associated with many plants of forest origin is also essential for sustainable resource management.

In view of extremely rich bio-cultural diversity in the state and dependence of forest dwellers for their health requirements on medicinal plants the Government has declared Chhatisgarh as a 'herbal state' in July 2001. Accordingly the Chhatisgarh Forest Policy has specially provided for evolving a feasible mechanism for *in situ / ex situ* conservation, domestication, propagation and non-destructive harvest of medicinal plants with the active help and support from local people including traditional healers and vaidyas.

The review of literature reveals that the conservation areas need to be surveyed regularly for floristic composition, taxonomic characteristics of species and preparation of flora.

To document floral composition, taxonomic characteristics, listing of endemic and threatened species, regeneration of the important species and traditional uses associated with medicinal plants being utilized by the local people/tribals; 7 conservation areas of medicinal plants of CGSMPB have been proposed for study in Chhattisgarh state.

Achievement

- Survey, identification and documentation of medicinal plants in MPCA
- Survey has been carried out at 7 MPCA e.i. Jabarra at Damtari, Keochi at Marvahi, Bandhatola at Kheragarh, Bhatwa at South Kondagaon, Machkot at Jagdalpur, Ghatpandari at North Sarguja and Patia at Jashpur Forest Division. 152 Plant species having medicinal importance have been identified from this region.
- Preliminary information and Primary data was collected for all the 7 MPCA.
- To carry out quantitative assessment of vegetation.
- Quadrats have been laid in 7 MPCA, the vegetation component were enumerated for monsoon season. (20 quadrats for tree, 80 for shrubs and herbs each, at all 7 sites)
- The data is being analyzed for phytosociological attributes.
- To collect specimen for herbarium
- Plant specimens for 48 species has been collected for preparation of herbarium.
- The specimens are being pressed and dried.

Curculigo orchioides

Gloriosa superba

Miragyna parviflora

Uraria lagopidoides

Influence of forest canopy cover on ground flora and micro-climate in Western Ghats (Maharashtra)

Assessed change in ground flora including herbs and shrubs with change in canopy density in the selected sites of Raigad, Ratnagiri and Sindhudurg districts of western ghats (Maharashtra). Number of species in ground flora increased with decrease in canopy density.
Observed effect of canopy structure and density on natural regeneration and growth of ground flora including native and alien species.
Change in soil parameters was also observed due to change in organic matter, litter fall and decomposition, moisture conservation, light intensity, temperature and humidity which was attributed to varying canopy density

Counterbalancing the detrimental effect of Sponge Iron Factory-emitted Particulate Matters (SIFPM) with the protective effect of Vesicular Arbuscular Mycorrhiza (VAM) on the growth of seedlings of important tree species

The project was started to assess the protective effect of Vesicular Arbuscular Mycorrhiza (VAM) on the growth of seedlings of important tree species. The sites selected for the study are industrial areas of Ghugus (Maharashtra), Raigarh, Raipur (Chhattisgarh) and

Bhopal (Madhya Pradesh). Innumerable Sponge Iron Factories have been established in Madhya Pradesh, Chhattisgarh and Maharashtra which emit pollutants mainly in the form of SO_2, NO, NO_2, N_2O_5 and Suspended Particulate Matters (SPM). SPM causes a huge loss to the environment on vegetations like closing of stomata in leaves and dispersal of several toxins in the environment. Around these factories, the average growth of the trees found to be stunted and deformed.

Six months old 1200 plants of ten tree species are presently under study of this project namely *Tectona grandis, Gmelina arborea, Dendrocalamus strictus, Dalbergia sissoo, Pongamia pinnata, Cassia siamea, Azadirachta indica, Emblica officinalis, Peltaforum ferrugineum Schleichera oleosa* and *Butea monosperma* on a critical comparison with control data collected from least polluted areas. Physicochemical estimations in terms of biochemical estimations (Chlorophyll, Sugar, Ascorbic Acid and Phenol) of leaf and soil samples are on process.

Experiments have been made with two sets at the nursery of TFRI; Soil + FYM (Control) and Soil + FYM + SPM (Experimental); the soil has been treated with the SPM collected from the industrial areas affected with the pollution from sponge iron factories. This is a model experiment which shall mimic the polluted condition and analyses of which along with growth data should tell us the magnitude of the loss or how much the plant is immune to pollution effects.

Soil around the feeder roots and feeder roots were collected from different tree species for VAM culture. These soil and root samples were inoculated in different pots with maize seeds for VAM culture. For VAM culture firstly the potting mixture was autoclaved (Soil + Sand + FYM) twice for sterility, and then transferred to earthen pots (10 kg capacity) in field. Then soil and root samples collected from the affected sites were mixed with this pot-mix in 1:20 ratio, and immediately after, 15 maize (*Zea mays*) seeds were sown at 2.5 inch depth. The maize plants were irrigated with sterile water to avoid any VAM contamination from other sources. The Mycorrhiza grew well in 3 months, and after that, the desired VAM was harvested.

It was observed that application of VAM for a particular species as collected from the affected area, cultured, harvested and when applied in pot-mix (mixed with environmentally toxic particulate matters) of nursery-grown seedlings, significantly confer physiological protection as reflected from general health, growth-data (Height, collar circumference, number of branches and number of leaves) and biochemical assays (soluble protein, phenol, carbohydrate, ascorbic acid, chlorophyll a & b). The same trend of improvement was noticed in all the species as mentioned.

4 experimental categories of *Gmelina arborea*

4 experimental categories of *Azadirachta indica*

2.1.4 Biodiversity

Achanakmar-Amarkantak Biosphere Reserve

The continous activities undertaken in the project include updating information on flora and fauna of Achanakmar-Amarkantak biosphere reserve by new additions to the already existing database.

Collected references from recent literature on tropical moist/ dry deciduous type of biosphere reserves from web site and collated with the conditions of the Achanakmar-Amarkanatak biosphere reserve. Collected meteorological data from manual observatory of core zone of BR. Recorded regeneration status of trees from the permanent plots laid at core and buffer zones of biosphere reserve. Surveyed, collected, identified and preserved 300 specimens which includes 180 species of butterflies, 16 species of moths and two species of bugs among the 198 identified species. Recorded status of selected economically important threatened flora in biosphere reserve.

Organized one day workshop on "Achanakmar-Amarkantak biosphere reserve" for the front line staff of the biophere reserve of Chhattisgarh. Carried out biannual publication of Biosphere Reserve Information Series (BRIS), Vol. 3 (1-2). Two meetings held with Director, Achanakmar-Amarkantak biosphere reserve, Chhattisgarh to assess the research needs in crucial areas and discuss management interventions.

Created web based information centre for Achanakmar-Amarkantak biosphere reserve and linked to the website of TFRI, Jabalpur (http://tfri.icfre.gov.in /AABR/index.html).

2.2 Forest Productivity

2.2.1 Overview

Forests may reproduce more successfully when special efforts are made to encourage regeneration. Either artificial regeneration that involves planting seeds or seedlings, or natural regeneration that relies on existing seedlings or seed may be used. During the year under forest productivity research, one project was completed and one project was initiated.

2.2.1.1 Summary of the achievements under the Theme

Experiments on foliar spray of chemical fertilizers were conducted in Morga to observe the effect of different doses of fertilizers, either individually or in combination, on increment in size of tendu leaves.

Studies on sustainable management of medicinal plants in JFM areas in two agroclimatic zone of Madhya Pradesh have been conducted. Germination percentage was improved by pretreatments on *Schleichera trijuga, Terminalia arjuna, Sapindus laurifolia, Terminalia chebula, Ablomoscus moscatus, Rauvolfia serpentina, Emblica officinalis* and *Mxvimusops elengi,* out of 12 target species.

Phyto-sociological studies including regeneration survey of newly recruited seedlings of seed and coppice origin were recorded. Flowered trees were enumerated. Hoeing, cleaning and fire treatments were applied to see its effect on regeneration of sal. Two species of bamboos viz. *Bambusa nutans* and *Dendrocalamus strictus* were selected to establish the bamboo based agroforestry system at experimental area of TFRI and to create the awareness among the farmers of different villages of M.P. and Chhattisgarh state for the adoption of bamboo in their field. Identified and selected two study sites as an OSR experimental area of TFRI and as an OFR in farmer's field, Neemkheda village, Jabalpur district to establish the multitier cropping system by raising Aonla intercropped with Arhar and Adrak. Survey was conducted in Kanhan region of Western Coal Fields Limited, Junnardeo and Pench area of Western Coal Fields Limited, Shivpuri area for selection of coal mine overburden site for laying out experiment. Shivpuri open cast mine-1 has been selected for taking up the experiment.

2.2.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	1(deferred)	2	-
Externally Aided	1	1+1(subproject)	1

2.2.2 Silviculture

Standardization of pruning practices and optimum doses of organic and inorganic fertilizers to increase leaf surface area of tendu.

Surveyed and selected sites in Morga, Kotadol and Litipara in Chhattisgarh state, having good quality and high production of tendu, as suggested by M.D. Chhattisgarh State MFP Federation.

Experiments on foliar spray of chemical fertilizers were conducted in Morga to observe the effect of different doses of fertilizers, either individually or in combination, on increment in size of tendu leaves using RBD statistical design. Maximum increase (16.19%) in surface area of tendu leaves was observed when a combination of 2% nitrogen and 1% phosphorus was applied through foliar spray, which was followed by 1% phosphorus treatment when compared with control.

Experiments on chemical and biofertilizers *viz.* urea, single super phosphate, vermicompost and neem based biofertilizer on enhancement of quality and sustainable production of tendu leaves were conducted at Morga using RBD factorial design.

Experiments on pruning practices of tendu with treatments including time interval of pruning, height of pruning and girth classes were conducted at Morga using RBD Factorial design.

Surface and sub-surface soil samples were collected from the selected sites and analysed in laboratory for their physico-chemical characteristics.

Conducting experiment on foliar spray of chemicals at Morga

Collecting tendu leaves from experimental site

Reclamation of fly ash dykes with suitable amendments at NTPC Korba, Chhattisgarh

Surveyed and selected fly ash dykes at NTPC Korba. Conducted vegetation survey by quadrat method in the surrounding forest area for the assessment of native species and the following species communities were found

Trees – Eucalyptus, *Cassia siamea*, *Cassia fistula*

Shrubs – *Lantana camara, Phoenix sylvestris, Xanthium strumarium*

Herbs – *Hyptis suaveolens, Cassia tora, Triumfetta rhomboidea*

Collected fly ash samples and analyze them for their physio-chemical parameters.

Studies on the effect of different level of seed collection on natural regeneration of Sal (*Shorea robusta*) in Chhattisgarh

Three sites, Bastar, Raipur and Bilaspur agro-climatic zone were selected and sample plots were laid out to study the effect of different level of seed collection, fire and grazing in pure, mixed and degraded sal forests of Bastar, Raipur and Bilaspur agro-climatic zone.Phyto-sociological studies including regeneration survey of newly recruited seedlings of seed and coppice origin and samplings of sal of the all experiments laid out in pure, mixed and degraded sal forests of Bastar, Raipur and Bilaspur agro-climatic zone had been completed. The experimental results showed that different level of seed collection had positive impact on overall regeneration and recruitments. After eleven months of observations very low percentage of recruits were observed to survive (6.64%) on uncontrolled grazing site and fire affected sites.

Best recruits status (17.06) was found to be at the sites with cleaning and loosening of soil practices followed.It was followed by 12.98% at loosened soil site and 11.24% at the sites where undesirable herbs were cleaned.

2.2.3 Social Forestry, Agro-forestry/Farm Forestry

Development of multitier cropping (Silvi-Agri-Spice) system

Identified and selected two study sites as an OSR experimental area of TFRI and as an OFR in farmer's field, Neemkheda village, Jabalpur district to establish the multitier cropping system by raising Aonla intercropped with Arhar and Adrak. Preliminary cultural operations like clearing, weeding, ploughing, levelling of field, basal dressing with Farm Yard Manure were done. Procured and transplanted two varieties of *Phyllanthus emblica* (Aonla) viz. NA7 & NA 10 at the spacing of 10mx8m and 10m x 6m intercropped with *Cajanus cajan* (Arhar) in Factorial RBD. The data on nutrients study revealed that Organic matter , available macro nutrients (N, P, K) were found in medium range except available phosphorus which was found very low in both the field i.e. Farmer's field as well as in research station. The growth parameter of NA-7 Aonla plants (one year old) shows a regular increase in mean height (minimum 86 cm to maximum 114.30 cm at 10mx 8m whereas NA10 is performed min.93.60 and maximum 172.10cm along with agriculture crop in the study sites.

Development of lac based agroforestry (Silvi-Agri-Lac) system

Surveyed the local area for the selection of farmer's field to establish the OFR under the project. Saplings of two species of Lac host viz. *Flemingia semialata* and *Flemingia macrophylla* were procured from the Natural Resin and Gum Research Institute (Jharkhand) Namkum, Ranchi and transplanted in the OSR and OFR selected as two study sites under the project. For the estimation of physical properties and nutrient status of land , soil samples were collected and analysed. Observation on growth and survival of both the species were recorded. Data on growth parameter were recorded and *F.macrophylla* shows better maximum 250cm and minimum 90 cm whereas *F.semialata* shows maximum height 150cm and minimum 60 cm after one year of its plantation. The soil samples were collected and analysed for the estimation of Macro nutrients and physical properties (pH-6.9 -7.4, EC- 0.049 – 0.062 and OM 0.28 - 0.39) and of the sites and data shows that the macro nutrient like Nitrogen 94.08 to 188.16kg/ha, Phosphorus 7.74 -10.32 kg/ha and Potassium 79.21 – 130.40kg/ha , Ca^{++}- 10.02-26.8 and Mg^{++}- ranged 8.8 - 20.0 after the one year of plantation.

2.2.4 Forest Soils & Land Reclamation

Identification of suitable tree species and other vegetation for bio-drainage in Bargi command area (Jabalpur, M.P.)

The study was conducted with the objective to drain out excess water of the soil in water logged/canal seepage areas through vegetative means and to enhance the site productivity along left bank canal of Bargi command area, Jabalpur. The study has been concluded and final draft

report has been submitted to the funding agency. Following conclusions can be drawn from the study:

In the experiments simulated in lysimeters, most of the selected species performed better under water logged conditions compared to control, which could be due to their high water requirement. *Eucalyptus* hybrid, *Pongamia pinnata, Albizia procera* and *Terminalia arjuna* exhibited their maximum growth values under 0-0.25m water regime.

Maximum water use on per day basis was found in *Eucalyptus* hybrid, followed by *Pongamia pinnata* under different depths of water logging in lysimeters. Water use by the species decreased with increase in depth of water logging, which could be due to more surface area of roots in contact with soil water. Significant monthly variation in water use was observed in the species under test, which was directly related to the climatic conditions.

The transpiration rate was found maximum in *E. hybrid*, followed by *P. pinnata* and *T. arjuna*. The results showed that with the increase in water logging, transpiration rate increased in all seven species. Peak transpiration was observed at 12 hour during the period for most of the species, but for some species the peak period shifted to 11 hour or 13 hour.

E. hybrid, followed by *P. pinnata* and *T. arjuna* was found to have significant effect on lowering down the water table in the canal command area. Monthly variation in water table due to tree plantations was found directly related to temperature, humidity and rainfall. Depth of water table in plantations of all the tree species gradually increased from January to mid June, with the increase in maximum and minimum temperature. After this period, water table suddenly increased due to decrease in temperature and onset of rainfall in the second half of June. In July, August and September the water table continued increasing in all the plantations due to high rainfall. Maximum decline in water table in *E.* hybrid plantation was observed at 14.00 – 16.00 hours in summer.

Plantations of different tree species raised along left bank canal of Bargi command

Integrated nutrient management for improved growth of trees on overburden dumps

Survey was conducted in Kanhan region of Western Coal Fields Limited, Junnardeo and Pench area of Western Coal Fields Limited, Shivpuri area for selection of coal mine overburden site for laying out experiment. Shivpuri open cast coalmine at Haranbhata has been selected for taking up the experiment. Overburden samples were collected from the selected site and the samples were analyzed for its physico-chemical properties *viz*, texture, bulk density, pH, EC, organic carbon, Available N,P, K, Cation exchange capacity, Exchangeable Ca, Mg, Available micronutrients viz. iron, manganese, zinc and copper. Plantation has been done with ten species. Initial reading recorded and overburden dump samples analyzed. Further work is under progress.

2.3 Genetic Improvement

2.3.1 Overview

The institute is engaged with genetic improvement of forestry species, encompassing conservation of genetic resources of *Azadirachta indica* and *Rauvolfia serpentina*, improvement of *Diospyros melanoxylon* through collection and selection of germplasm, standardization of clonal propagation techniques for *Dalbergia sissoo*, *Dalbergia latifolia* and *Albizia* procera and biotechnological interventions, including molecular marker assisted evaluation of germplasm for future performance of *Boswellia serrata*.

2.3.1.1 Summary of the achievements under the Theme

In vitro aseptic cultures of *Azadirachta indica* were established from five populations of Madhya Pradesh. Significant increase in shoot length (2.28 cm) was obtained on 0.5 µM BA and 125 mg l^{-1} casein hydrolysate. Shoot regeneration with leaf pieces resulted in maximum number of shoots (3.56) on 0.44 µM BA and 162.86 µM Ads. HPLC method was standardized for quantification of azadirachtin from seeds.

Aseptic *in vitro* cultures of five genotypes of *Rauvolfia serpentina* viz., GO-MN, OR-AG, KL-PB, GO-SG, KL-AJ, were established on MS medium supplemented with 1.5 mg l^{-1} BA.

The germplasm of *Diospyros melanoxylon* was collected from four locations in three agroclimatic zones of Chhattisgarh. Morphometric field data on number of leaves per shrub, leaf area (cm^2) and leaf dry weight were recorded.

Maximum rooting of 44% was obtained on WP medium supplemented with 1.5 mg/l IBA for GBW 4 clone of *Dalbergia sissoo*. One field trial was established comprising 5 clones following RBD design and 81% survival in FZB 1 clone was recorded.

Endogenous auxin (IAA) in selected trees of *Dalbergia latifolia* from Jabalpur, Chandrapur and Jagdalpur showed significant seasonal/genotypic variation. Juvenile and mature shoot cuttings of *Dalbergia latifolia* had 36% and 11% rooting response, respectively.

0.3% $HgCl_2$ and 3% Bavistin® significantly produced highest aseptic cultures in *Albizia procera*. BA and kinetin were the best source of cytokinin for shoot multiplication and kinetin was better than BA for preventing callus formation at the base of the *in vitro* shoots.

Three ramets each of 97 plus trees of *Tectona grandis* maintained at National Teak Germplasm Bank, Chandrapur representing 12 teak growing states and 15-31 progenies (half sib families) of nine plus trees were validated using AFLP and STMS markers

Application of regression equations to ISSR analysis of genomic DNA for total/ polymorphic amplified bands of selected sandal plants of Seoni plantations predicted 2.56% oil content by TFRI reference trees and 1.4% oil content by IWST reference trees at the plantation age of 25-30 years.

2.3.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	2	1	1
Externally Aided	-	2+1(subproject)	2

2.3.2 Conservation of Forest Genetic Resources

Studies on assessment of genetic diversity and structure of *Boswellia serrata* Roxb. populations through RAPD and ISSR molecular markers.

Selection of *Boswellia serrata* trees at TFRI:

Five trees were randomly selected from TFRI campus, having age about 20 years for the standardization of genomic DNA extraction and estimation. Three samples were collected from each of selected trees .

Genomic DNA extraction:

Leaves of selected five trees of *B. serrata* at TFRI, Jabalpur were collected. One gramme of collected fresh leaves were extracted for genomic DNA, using five methods, i.e. Porebski et al. (1997), Aljanabi et al. (1999), Hameed et al. (2004), Padmaltha and Prasad (2006), Deshmukh et al. (2007). The extracted genomic DNA samples were quantified on agarose and UV spectrophotometer.

Among above all the five methods Deshmukh et al. (2007) had the better result than others. The average yield of genomic DNA was 0.76 µg/µl from one gramme of fresh leaf wt. (Range: 14.0

µg - 250.0 µg), wheras the quality of DNA (A260 / A280) was 1.5 which was visualized on 0.8 % agarose gel.

Primer screening:

ISSR primer screening is on progress and 39 primers have been screened till 31st March-2012 and these primers are-UBC-801, 880, 899, 900, 834, 808, 866, 857, 839, 855, 859, 810, 853, 856, 860, 857, 839, 855, 859, 810, 853, 856, 860, 830, 811, 815, 854, 822, 848, 824, 812, 894, 890, 892, 863, 821, 885, 889, 886, 820, 825, 852, 871, 888, 884, 807, 826, 896, 870, 883, 827, 864, 869, 897, 887, 816, 819, 806, 823, 868, 837, 838, 814, 832, 840, 895, 818, 850, 847, 832, 851 has been screened out with 5 genomic DNA samples.

Phenological study:

Phenological data is recorded and this process will be continued for one year with the interval of 15 days. According to this leaf fall is 100%, immature fruits are 11.3% and fruit fall is 23.8%. This data is recorded after taking of three replicates by average.

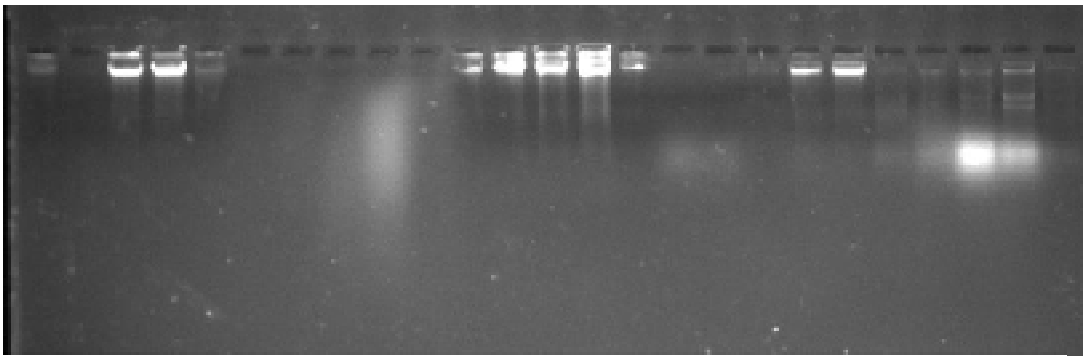


Figure.1: Genomic DNA of B. serrata isolated from different methods

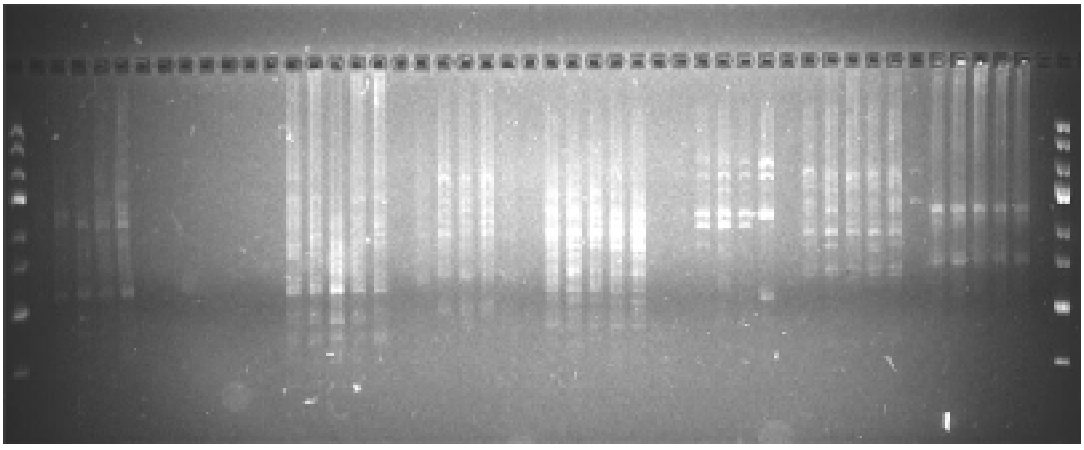


Figure.2: Screening of ISSR primers

Studies on variation in reserpine content in some high yielding genotypes of *in vitro* and seedling raised *Rauvolfia serpentina* Benth.

Effect of genotypes on culture establishment:

The explants collected from different genotypes at institute's campus (Fig 1) were thoroughly washed under running tap water. They were cut to appropriate size (2-3 cm) and swabbed with 70% ethyl alcohol soaked cotton. Thereafter, they were treated with 5% cetrimide for 20 min. and rinsed thoroughly with distilled water. The resultant explants were further treated with 0.2% Bavistin treatment (30 min) + $HgCl_2$ treatment (03 min). The treated explants were inoculated on MS medium supplemented with 2.5mg/l BA. The data recorded was % sprouting and length of axillary shoots.

The axillary buds on the nodal cuttings showed a visible growth after fifteen days in culture and most of them grew into shoots within 25 days (Fig 2). The data on bud sprouting and number of shoots effected by the genotypes used (Table 1). There were significant differences among the different genotypes in bud sprouting response and shoot number. Among different genotypes, GO-MN was found to be significantly more effective in sprouting response (84.33%) and at par with the response of KJ-AJ genotypes (83.32%). However, genotype KL-PB registered a maximum of 6.56 cm of length which was significantly higher than all genotypes. Thus the genotype showed a varied sensitivity to single hormone BA.

Effect of growth hormones on shoot multiplication:

The sprouted axillary shoots were subcultured on MS semi solid medium supplemented with BA (2, 4, and 5 mg/l) and NAA (0.5, 1.0 and 1.5 mg/l). The observation recorded were shoot multiplication (number) and shoot length (in cm).

The data pertaining to the effects of BA and NAA alone or in all possible combinations on shoot multiplication in a three-way factorial experiment are presented in Table 2. Single shoots cultured on different auxin-cytokinin supplemented media produced multiple shoots. A significant effect of different levels of BA and NAA on the rate of shoot multiplication was noticed. Among different genotypes OR-AG was reported to produce of maximum number of shoots (2.85) (Fig 3). In interaction studies, the maximum rate of shoot multiplication (3.91) was obtained on the medium supplemented with 4mg/l BA and 0.5 mg/l NAA, which was statistically higher than the shoot multiplication rate obtained with other concentrations of BA and NAA. In contrast to shoot multiplication, a significant increase in shoot length was obtained in GO-MN genotype which was 4.10. In the interaction study, the maximum shoot length (5.66 cm) was obtained with 2mg/l BA + 0.5 mg/l NAA, which was statistically higher than the shoot length obtained with other combinations (Table 3).

Designs of experiments parameters and sampling strategy:

Each experiment was laid out in factorial CRD with three replications and two factors viz., genotype and treatments on aseptic culture establishment and shoot multiplication. In each

replication at least 20 numbers of individually inoculated explants were taken. The data was recorded on percent aseptic culture establishment and shoot multiplication after 30 days of inoculation. The data collected was analysed with SX statistical package using one way in the first experiment and three way ANOVA in the second experiment and the Least Significant Differences (LSD) were calculated at p=0.05% for comparison of means of the treatments.

Effect of BA and NAA on organogenesis in *in vitro* leaflet explants in five genotypes:

The leaflet explants of five genotypes was divided into three parts viz. proximal, middle and distal and inoculated on MS medium supplemented with BA (0, 2.50, 5.0 mg/l) and NAA (4.5, 6.5, 8.5 mg/l). The abaxial surface of the explants was kept down on the culture medium. The effect of hormones was observed with respect to different explants types in five genotypes and data on percent organogenic response in terms of callusing and organ formation was recorded. The maximum of 86% response was obtained in GO-MN genotype, whereas the combinations of 2.5mg/l BA+ 6.5 mg/l NAA reported to produce maximum of 95% callus (Table 4; Fig 4). Varied response of organ formation was noticed in different genotypes depending upon different concentration of growth hormones. In the interaction study, the maximum shoot formation was obtained in 5 mg/l BA and 4.5 mg/l NAA in GO-MN genotype which was statistically significant to other genotype and hormonal doses (Table 5; Fig 5). Thus, the PGR concentrations had significant impact on shoot regeneration. Similar to the callus formation, the effect of hormones and genotypes on shoot formation was noticed to be non-significant. In the interaction study, the maximum rooting (66%) was obtained in 2.5mg/l BA and 8.5mg/l NAA in GO-MN genotype (Fig 6), which was significantly different from other genotype and hormonal doses (Table 6).

Effect of basal media on shoot multiplication in five genotypes:

The effect of basal media on shoot multiplication in five genotypes was recorded. The single nodal segment of each genotype was inoculated on MS, Whites and WPM medium supplemented with 2 mg/l BA. The observation recorded was node number, shoot number and shoot length.

Initiation of multiple shoot regeneration and elongation of shoot primordia started after two weeks of culture and data was recorded after six week of inoculation. Nodal segment explants from established cultures of five genotypes of *Rauvolfia serpentina* were cultured on MS, WPM and Whites medium supplemented with 2.0 mg/l BAP. From the perusal of data from Table 7, the best and rapid multiple shoot potentiality was observed on MS medium, in which highest number of shoot (6.10) was observed within six weeks (Fig. 7). Among the five genotypes, GO-MN was reported to produce maximum shoot number (4.33) and maximum shoot length (3.75 cm) (Table 8).

Studies on variations with respect to *in vitro* azadirachtin production in selected high yielding populations of *Azadirachta indica* A. Juss.

Surveys were conducted and twenty neem trees each were selected from three different populations in M.P., viz., Shahdol, Chhindwara and Gwalior and two populations in Chhattisgarh, viz., Raigarh and Bilaspur. Plant material (seeds and cuttings) were collected from each tree. Data on 100 seed weight, percentage kernel in seed and percentage neem oil in seed was recorded and tabulated. 100 seed weight was found to be in the range of 18.61g – 26.43 g, percent kernel in the range of 57.80 % - 20.88 % and percent neem oil (kernel weight basis) in the range of 16.70 % – 21.20 % among the different populations. Aseptic *in vitro* culture establishment of all the collected populations was completed using nodal segments. Shoot cultures were multiplied and maintained on MS medium supplemented on 0.5 µM BA and 0.5 µM GA_3. Variation with respect to bud break and shoot multiplication was studied in different populations and significantly maximum number of shoots per nodal segment and maximum number of nodes per shoot were obtained in cultures of Khandawa. The effect of BA and kinetin on shoot number, number of nodes per shoot and total number of nodes was investigated and BA had highly significant effect on number of nodes per shoot and in 15 days time interval (from 15 to 30 days) it doubled the number of nodes per shoot (1.49 to 3.16). Leaves from *in vitro* generated shoots were used for organogenesis. Experiments were conducted to study the effect of BA and 2, 4 D on regeneration of callus and shoots from leaf explants and to study the effect of different plant growth regulators BA and auxins (IAA, IBA and NAA) for shoot initiation in callus regenerated from leaf explants. BA alone was found to be effective in inducing callus and 2, 4 D was found to have detrimental effect on callus and shoot formation. Shoot formation was obtained on 4.44 µM BA and 1.42 µM IBA. Significant effect of auxins was found for number of nodules on leaf explants and maximum nodule formation (10.97) was observed on MS medium containing 1.42 µM NAA. Isolation of azadirachtin from seeds and shoot cultures of different populations was carried out and azadirachtin content was quantified through HPLC. Variation with respect to azadirachtin content was observed within populations and between populations in the samples.

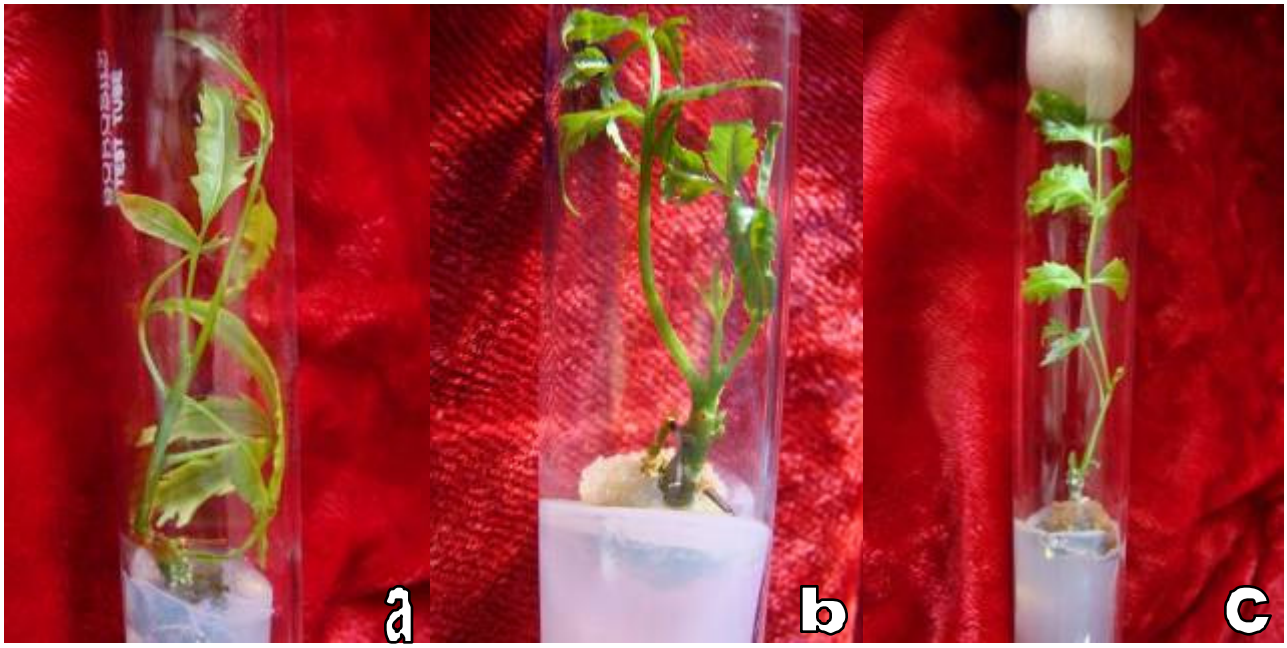


Fig. 1: Variation in sprouting response of different populations of *Azadirachta indica* after 30 days of inoculation: (a) Sihore, (b) Khandawa, (c) Bargi.

Fig. 2: Variation in shoot multiplication in different populations of *Azadirachta indica* after 30 days of inoculation: (a) Sihore, (b) Khandawa, (c) Bargi.

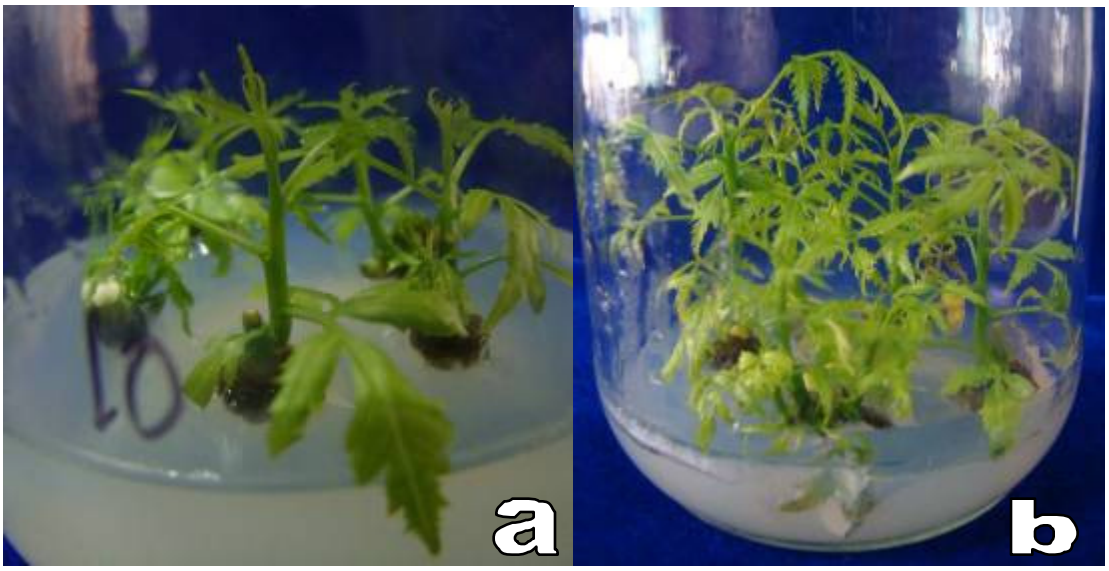


Fig. 3: Effect of 0.08 µM BA and 0.5 µM kinetin on shoot formation in *Azadirachta indica* after (a) 15 days of inoculation and (b) 30 days of inoculation.

Fig. 4: Organogenesis in the callus generated from leaf explant after 30 days of inoculation on the MS medium containing (a, b) 4.44 µ M BA and 1.42 µM IBA and (c) 4.44 µ M BA and 1.42 µM NAA.

Development Methodology and parameters for selection of superior genetic plants of five NTFP species

Selection criteria for many timber species have already been developed, but in case of NTFPs no selection criterion has been developed so far. Therefore, in view of the economic importance of these species project has been initiated.

Data has been recorded on *P. pinnata, A. marmelos*; *P. marsupium*, *Nux-vomica and S. suaveolens* for number of traits i.e. Plant height, girth, number of primary branches, 100-seed weight, Crown diameter, clear bole height, crown height, crown volume, 100-pod weight etc. Recorded data is under the process of statistical analysis to find the correlation between the traits as well as to find out the traits having direct effect on yield leading to the development of selection criteria for superior genetic plants.

TFRI Staff along with Maharashtra Forest Official during field visit

Superior Plant of *S. Suaveolens* (Padal) in Chandrapur

2.3.3 Tree Improvement

Technology to regenerate/multiply mahul patta (*Bauhinia vahlii*) for getting higher production

Localities for collection of planting materials were selected at Korba (Range: Kartala), Marvahi (Range: Keonchi and Achanakmar), Katghora (Range: Pali), Raigarh (Range: Manora and Kansabel) and Dhamtari (Range: Dugli and Nagri). The Localities were divided into the best and degraded sites based on the population density. Four quadrates were laid out in each site. the size of each quadrate was 100m×100m. From each quadrate, five climbers were randomly selected for collection of five leaf samples and twenty cuttings. The soil samples from each quadrate were collected. GPS data for each climber in the quadrate were also recorded. Cuttings were prepared and pretreated with 1000 ppm IAA for 1 hr and planted in polythene bags (Fig.1). Analysis of data revealed that locality and site alone had significant effect on various leaf parameters, but their interaction was not significant. Locality Achanakmar significantly enhanced leaf area, which was 27% higher than that in Locality Keonchi. On the other hand, Locality Keonchi significantly proved superior to Locality Achanakmar with respect to leaf number and dry weight/ leaf area ratio, which were increased by 32% and 25% respectively. There was no significant difference regarding dry weight /leaf and total leaf area as far as both localities were concerned. Further the best site significantly excelled in all leaf parameters,

except dry weight/leaf area ratio and increased leaf number by 42.6%, leaf area by 30.3%, and total leaf area / plant by 85.2% in comparison to the degraded site. However, dry weight / leaf area was significantly higher in degraded sites than the best sites (Table 1). The soil samples of Keonchi and Achanakmar were analyzed. No significant difference in soil pH across localities and sites was observed (Table 2). Soil pH had significant correlations with all leaf parameters, except total leaf area. Of the parameters, leaf number, leaf area and dry weight/ leaf had negative correlations and dry weight/ leaf area exhibited a positive correlation. In contrast, there was no significant correlation of EC with leaf parameters (Table 3).

Table 1: Leaf parameters recorded for production of Mahul patta (*B.vahlii*) in two localities and sites

Parameters		Leaf number	Leaf Area (cm^2)	Dry Weight/ Leaf (gm)	Dry Weight/ Leaf Area	Total Leaf Area/Plant (cm^2)
Localities	Achanakmar	164.97*b*	417.14*a*	2.30*a*	.0055*b*	70695.57(NS)
	Keonchi	217.75*a*	328.31*b*	2.26*a*	.0069*a*	72813.88(NS)
Site	Best	224.95*x*	421.79*x*	2.49*x*	.0059*y*	93193.17*x*
	Degraded	157.77*y*	323.56*y*	2.08*y*	.0064*x*	50316.28*y*

Data bearing different alphabets in a series within the same column are significantly ($p \leq 0.05$) different from each other. (Duncan's multiple range test)

Table 2: Effect of localities and site on soil characteristics

Parameters		**pH**
Localities	Achanakmar	6.25*a*
	Keonchi	6.90*a*
Site	Best	6.30*x*
	Degraded	6.85*x*

Data bearing different alphabets in a series within the same column are significantly ($p = \leq 0.05$) different from each other. (Duncan's multiple range test)

Table 3: Effect of pH and EC on different leaf parameters

Soil characteristics	Correlation Coefficient(r)				
	Leaf area	Leaf number	Dry weight	Dry wt./Area	Total leaf area
pH	-0.67**	-0.06(NS)	-0.62**	+0.70**	-0.39(NS)
EC	-0.01(NS)	-0.03(NS)	-0.38(NS)	-0.47(NS)	-0.04(NS)

* Significant at $p < 0.01$(**) or $p < 0.05$(*), NS=Non Significant

Fig 1: Field survey, Field collection of *Bauhinia vahlii* vegetative propagule: (a) Climber in the forest, (b) Collection and preparation shoot cuttings, (c) Shoot cuttings planted in the polybags in shadehouse and (d) Sprouted shoot cuttings.

Selection and cloning of superior germ plasm of Diospyros melanoxylon from Chhattisgarh.

Selection of sites: The sites were selected and marked for collection of plant materials. These sites were Lohattar (Bhanupratappur), Litipara (Gariaband), Kotadol (Korea) and Madanpur (Katghora). Collection of plant material and field data: The areas selected were divided into best and degraded sites. Quadrate wise GPS data and plant materials (root suckers) were collected from these localities. Other field data viz., reference data of leaves and five leaf samples were also collected (Fig 1). Maintenance of germplasm: The germplasm collected from the above sites were maintained at Genetics and Plant Propagation nursery of the institute (Fig 1).

Measurement of leaf area and total dry weight: The leaf area and total dry weight of the leaves collected from these localities were measured in order to screen superior germplasm.

Statistical Analysis of data: The data collected were analyzed using software package Systat and tables were prepared. On perusal of analyzed data of leaf area (cm^2) and leaf number, two sites, viz., Litipara and Lohattar were found to be the best sites and Kotadol was screened out as the most degraded site. Significant differences were also observed between localities and sites for dry weight (mg) of leaves.

2.

Fig.: Collection of germplasm of *Diospyros melanoxylon* (a) demarcation of area for germplasm collection (b) collection of leaf samples from the field (c) collection of root suckers from the field (d) pretreatment of root suckers in the nursery of TFRI (e) planted root suckers in the polythene bags (f) sprouted root suckers.

Genetic variation for *in vitro* morphogenetic potential of *Dalbergia sissoo* Roxb clones and evaluation of their field performance.

Experiments on rhizogenesis in five clones (GBW 4, JB 1, FZB 1, FZK 1, RSK 1) was concluded. The shoot cultures of only GBW 4 clone was used for rhizogenesis on WP medium supplemented with graded doses i.e, 0.1, 0.5, 1.0, 1.50 mg/l of IBA. The maximum of 44% rooting was obtained on medium with 1.5 mg/l IBA. For studies on organogenesis from callus culture the experiments were laid out with MS semi solid medium with a range putrescine (0.1,

0.2, 0.3, 0.4 and 0.5 mM). Among different treatments 0.5 mM putrescine resulted with 58% organogenic callus formation. One field trial has been established comprising 5 clones following RBD and 81% survival has been recorded with good growth of the plants and the maximum height (79.57 cm) was recorded in FZB 1 clone.

In vitro rhizogenesis and hardening in five clones

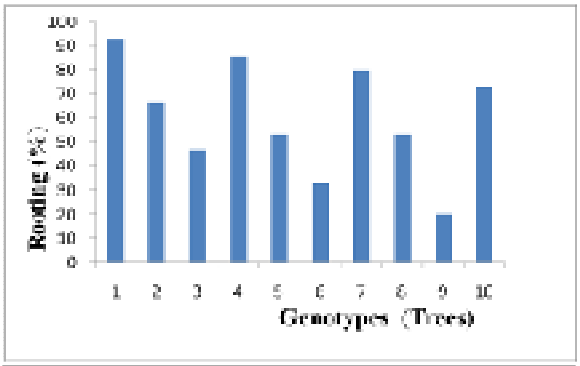
Establishment of field trial of five clones of

Studies on endogenous auxin level and its relationship with adventitious rooting potential in *Dalbergia latifolia* Roxb.

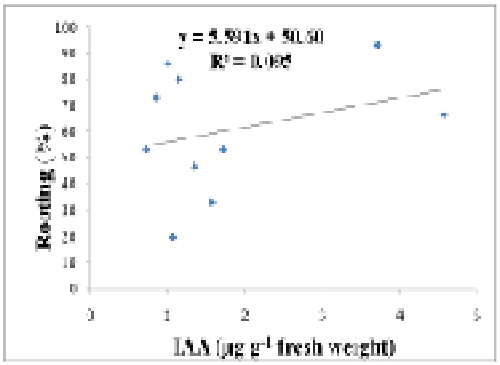
Extension of the project granted for the year 2011-12 to make a comparative study by selecting *D. sissoo* trees with the objective of holistic approach to find out the relationship between endogenous auxin (IAA) and rooting potential. Cuttings were collected from the 10 selected trees of *Dalbergia sissoo* trees and conducted experiments after rainy season and at winter dormancy and at the emergence of new sprouts. Experiments were factorial with randomization of cuttings. Data on sprouting and rooting potential recorded and analysed. Simultaneously endogenous auxin (IAA) was estimated in selected trees at the time of experiments. Significant seasonal/genotypic variation was recorded in endogenous auxin (IAA) and in rooting potential of selected trees. Selected trees exhibited maximum rooting potential just after rainy season. Maximum adventitious rooting (93.2%) was recorded in tree 1 and minimum adventitious rooting (20%) in tree 9. Maximum endogenous IAA (4.571 µg g^{-1} fresh weight) was in tree 2 and minimum (0.722 µg g^{-1} fresh weight) in tree 8. However, the results on rooting potential of selected trees do not correspond with their endogenous IAA level. Results indicate that the adventitious rooting potential varies from tree to tree independent of endogenous auxin (IAA) level within a species. A non significant relationship observed between endogenous IAA and adventitious rooting in selected trees. Exogenous IAA treatment helps in expression of the inherent rooting potential by way of local redistribution and lateral supply of endogenous IAA to the target cells in the pericycle region.

Experiment on rooting potential of selected trees of *Dalbergia sissoo*

Adventitious rooting in *Dalbergia sissoo*



Rooting ability of selected trees



Relationship between endogenous IAA and adventitious rooting

Studies on development of *in vitro* regeneration system for *Albizia procera* (Roxb.) Benth

Two experiments were conducted for induction of callus using 2,4-D (0, 5 ,10 and 20 µM) and BA (0, 2.5 and 5.0µM) and differentiation of callus into *in vitro* adventitious shoots using a combination BA and IBA (0, 0.25, 0.50, 0.75 and1.0 µM). The MS medium was used and leaflet from already established shoot culture were taken as explants. The callus was produced in 3odays and the differentiation of callus into shoot took additional 60 days (Fig. 1).

The further work is in progress for in vitro induction and growth of adventitious roots for recovery of whole plantlets.

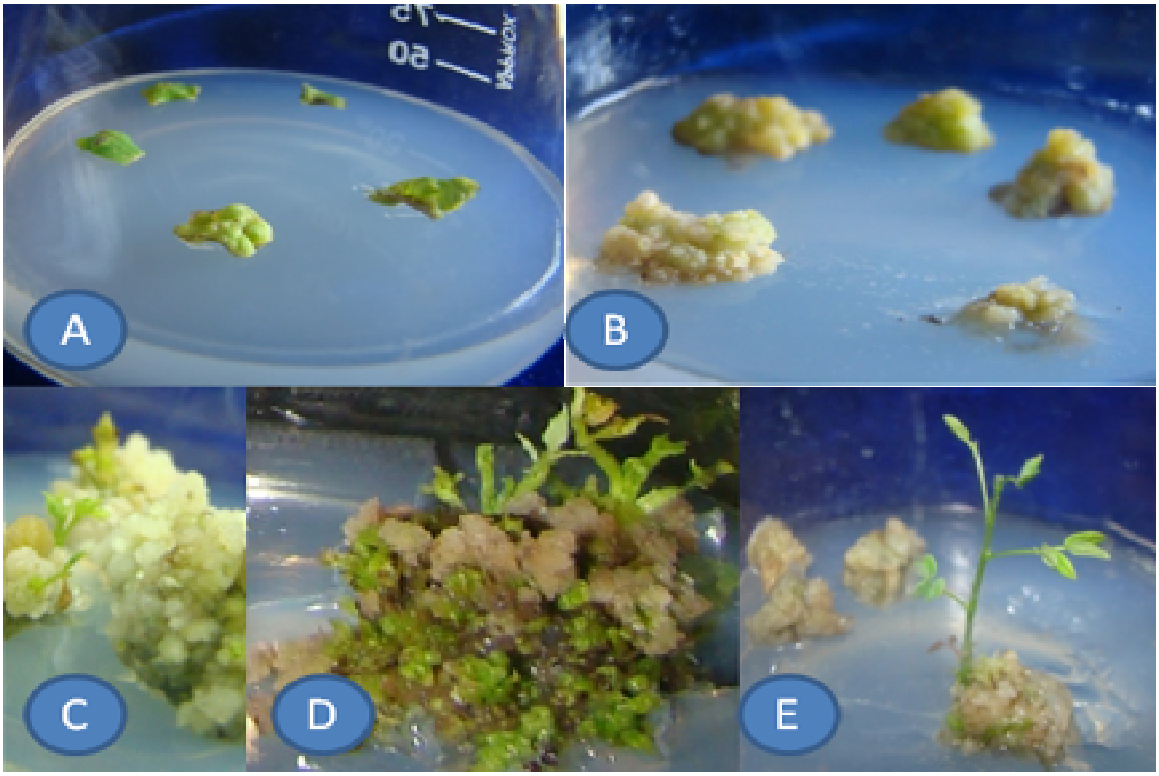


Fig: The in vitro regeneration of adventitious shoots from leaflet explants of Albizia procera; (A) Leaflet explants, (B) Callus induction and growth from leaflet explants at 3o days after inoculation on MS medium supplemented with 5 µM 2,4-D and (C-E) induction and growth of in vitro adventitious shoots from callus on half MS medium supplemented with BA and IBA.

2.4 Forest Management

2.4.1 Overview

Studies on Information and Communication Technology (ICT) are being conducted at the institute.

2.4.1.1 Summary of the achievements under the Theme

Developed package *INSPAK* for compiling information on insect pests associated with important forestry species of central India and provide it in the form of information system, using ICT (information communication technology). the data has been collected for the insect pests associated with *Shorea robusta, Dalbergia sissoo, Dalbergia latifolia, Acacia catechu, Acacia nilotica, Albizia lebbek, Ailanthus excelsa, Bamboo, Tectona grandis, Butea monosperma* based on scientific name, common name, distinguishing characters, nature of damage, host range,

natural enemy and control measures technique. The system provides various combination of key strokes viz Tree species, Insect pest, Insect pest Category, Insect Pest sub Category for data retrieval.

2.4.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	1	-	-
Externally Aided	-	-	-

2.4.7 Information and Communication Technology (ICT)

Development of an information system for forest tree species associated insects and their management

The developed package INSPAK is an attempt to compile information on insect pests and diseases associated with important forestry species of central India and provide it in the form of information system, using ICT (Information Communication Technology). Under this project data has been collected for the insect pests and diseases associated with *Shorea robusta, Dalbergia sissoo, Dalbergia latifolia, Acacia catechu, Acacia nilotica, Albizia lebbek, Ailanthus excelsa, Bamboo, Tectona grandis, Butea monosperma Shorea robusta, Dalbergia sissoo, Dalbergia latifolia, Acacia catechu, Acacia nilotica, Albizia lebbek, Ailanthus excelsa, Bamboo, Tectona grandis* and *Butea monosperma* . For insect pests, the data has been collected based on scientific name, common name, distinguishing characters, nature of damage, host range, natural enemy and different control measures for insect pests. For diseases, data has been collected based on, seed, nursery, plantation/natural forest and wood diseases, type of pathogen and different remedial measures. The system provides various combinations of key strokes viz. Tree species, Insect pest, Insect pest category, Insect pest sub category, Disease type for data retrieval. The developed package is a one point source of information on insect pests and diseases of forestry species as well as their control measures. The photographs of insects and diseases occurring on different selected forest species are also uploaded in the package.

2.6 Non-wood and Forest Products (NWFPs)

2.6.1 Overview

Studies on resource development of biofuel species *Jatropha curcas* and *Pongamia pinnata*, sustainable harvesting practices of some NWFP species including medicinal plants in

JFM areas, chemistry, value addition and utilization of NWFP species including medicinal plants and bamboo species are being conducted at the institute.

The centre is conducting research on chemistry of NWFP's, value addition and its utilization of *Withania somnifera, Gymnema sylvestre, Stevia rebaudiana, Moringa oleifera and Madhuca indica.*

2.6.1.1 Summary of the achievements under the Theme

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

Experiments initiated to standardize the various means of sustainable harvesting methods such as strip harvesting, alternate harvesting and opposite harvesting of barks from tree trunk, branch, twig, leaves, flowers, roots, etc. of *Bauhinia veriegata*, *Holorrhena antidyrentrica, Oroxylum indicum, Saraca asoka* and *Terminalia arjuna.* Phytochemical analysis of various plant parts revealed that the trunk bark contained maximum amount of active ingredients but branch bark and leaves can also be used in place of trunk bark. Original bark contains higher amount of phytochemical constituents than regenerated bark. Antioxidant activity assay was also done in bark samples of above species and *T. arjuna* was found to possess maximum antioxidant activity.

Polysaccharides from *Curcuma angustifolia*, *C. pseudomantana*, *Dioscorea bulbifera*, *D. hispida and Hyptis suaveolens* were isolated. Polysaccharides modified by chemical modifications and starch-polyols polymers and adhesives were prepared. Physico-chemical properties of products were evaluated.

For integrated development of Jatropha and Karanj, 175 CPTs of Jatropha and 81 CPTs of Karanja were selected from different agroclimatic regions of Madhya Pradesh and progeny trials were established. In case of Jatropha, TFRI-1& 2, IGAU-1, TNMC-22, PDKV-1 & 2, TNMC-7, Palampur-I, RJ-92, JCP-2, NRCJ-17 and TNJC-19 accessions were performing better on the basis of growth performances, fruits yield, seed characters and oil content in national trial. In zonal trial, TFRI-1, TFRI-2, PDKV-1, IGAU-2, PDKV-2 and PDKV-1 performing better. In case of Karanja, TNMP-14 and RAK-5 accessions were performing better in national trial. In zonal trials IGAU-1, CCSHAU-1, IGAU-5, NRCAF-2, JNKVV-29 and JNKVV-15 were performing better.

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

A national multilocation trial comprising of 36 accessions of *Jatropha* were established at the institute. Accession TFRI-2 performed better with respect to growth, number and size of fruits.

Experiments were laid out to standardize sustainable harvesting of *Phyllanthus amarus, Desmodium gangeticum* and *Dioscorea hispida* in Chhattisgarh. Further study is under progress.

Bael fruits of different maturity were processed by different methods for the extraction of pulp and drying. The effect of different processing methods on physico-chemical quality (moisture%, edible portion, carbohydrates, protein, minerals carotene, riboflavin, fat, and fibre %) of pulp were assessed.

Stevia rebaudiana and *Moringa oleifera* leaves were found to contain rich source of antioxidants and can serve as a potential source of nutraceuticals.

Technology was developed for preparation of three value added food products viz. mahua jam, squash and chutneys from *Madhuca indica* (mahua) dried flowers. Mahua flowers can be effectively utilized for development of mahua based food products industry at cottage level in tribal/rural areas where it is found in abundance.

Developed 100 women master trainers of Chhindwara region for preparation of three value added food products of Dried mahua flowers in the direction of poverty alleviation of rural masses.

2.6.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	3	-	2
Externally Aided	5	3	3

2.6.3 Sustainable Harvesting and Management

Population dynamics of selected threatened medicinal plant species and conservation management through community participation in buffer and transition zone of Achanakmar-Amarkantak Biosphere Reserve, Madhya Pradesh

The project activity being undertaken presently includes mapping the populations of threatened selected medicinal species, namely *Celastrus paniculata* (Malkangani), *Embelia tsjeriam-cottam* (Baibidang), *Rubia cordifolia* (Pilia), *Thalictrum foliolosum* (Mamira) and *Peucedanum nagpurens* (Tejraj) in Amarkantak Range, Anuppur Forest Division, Anuppur (M.P.) and Karanjia Range, Dindori Forest Division, Dindori (M.P.) of Achanakmar-Amarkantak Biosphere Reserve. Marking of plots with tagged plants have been done for recording of demographic observations in the next season. The envisaged target of awareness generation amongst forest villagers for sustainable harvesting of medicinal plants targeted under

the project has been initiated. The physical-chemical properties of soil from population sites were analysed for comparison among varied habitat.

Studies on developing alternative methods of sustainable harvesting of medicinal plants

Sustainable harvesting practices of *Bauhinia veriegata* (Kachnar), *Holarrhena antidysenterica* (Kutaj), *Oroxylum indicum* (Sheonak), *Saraca asoka* (Ashoka) and *Terminalia arjuna* (Arjuna) have been standardized. The experiments were laid out in the forest areas of Jabalpur, Balaghat, Rewa, (M.P.); Chandrapur, Tadgaon, Allapally, Tadoba, Nasik (Maharashtra); Keonchi, Marvahi, Bilaspur, Kavardha, Raigarh, Gariyaband (Chhattisgarh); Harishankar, Champagarh, Khurd (Odisha). Various harvesting methods such as ⅓, ¼ blaze size and longitudinal strip (alternate and opposite strips) harvesting were experimented. Different plant parts i.e. trunk bark, branch bark, twig bark, root bark, leaves, flowers etc. were collected and analyzed for their phytochemical constituents (tannins, total alkaloids, flavonoids, total phenols, phenolic acids, arjunic acid, baicalein). Regenerated bark was also collected and evaluated for major active ingredients. Regular observations were recorded on bark regeneration. Results revealed that longitudinal strip harvesting method is superior to other harvesting methods in all designated species. In Kutaj and Sheonak bark recovery was faster in trees having GBH <40cm and completely recovered in 12 months; Arjuna bark recovery was faster in trees having GBH <90cm and completely recovered in 18 months, Kachnar and Ashoka bark recovery was faster in trees having GBH <35cm and completely recovered in 24 months. Minimum harvestable girth varies from species to species. There was significant variation in bark recovery among different girth classes of targeted species. Among all selected species Kutaj and Sheonak have faster; Arjuna has medium; Kachnar and Ashok have slower bark recovery. Bark can be harvested from the previously harvested trees after two years from opposite side of previously harvested part. Phytochemical analysis of various plant parts revealed that the trunk bark contained maximum amount of active ingredients but branch bark and leaves can also be used in place of trunk bark. Original bark contains higher amount of phytochemical constituents than regenerated bark. In case of Sheonak, maximum amount (327.8±1.26%) of baicalein was observed in root bark which is at par with stem bark (307.29 ±1.67). In Arjuna, arjunic acid content was varied from 10.120 to 49.087 mg/100g and also increased with increase in GBH. Arjunic acid varied significantly in original and regenerated bark. *T. arjuna* was found to possess maximum antioxidant activity among all the studied species. The adoption of above harvesting practices will be helpful in sustainable management of above studied species and also provide quality raw material to pharmaceutical industries on sustainable basis.

Fig.1. *Terminalia arjuna* tree showing a blaze on the trunk

Fig. 2. *Terminalia arjuna* tree showing regeneration of bark

Standardization of sustainable harvesting practices of Arjuna (*Terminalia arjuna*) bark

Sustainable harvesting practices of *Terminalia arjuna* (Arjuna) bark have been standardized. The study was carried out in the forest areas of Keonchi, Pendra, Bhairosang, Khodri, Marvahi, Gariyaband and Raigarh in Chhattisgarh. Three harvesting methods such as ⅓, ¼ blaze size and longitudinal strip harvesting were experimented. Different growth regulators and plant extracts e.g., IAA, IBA, bordeaux mixture, leaf extracts of Neem, Aak, Karanja etc. were applied on harvested surface of tree trunk in order to study their influence on bark regeneration. Different plant parts i.e. trunk bark, branch bark, twig bark, leaves etc. were collected and analyzed for their phytochemical constituents (tannins, flavonoids, phenols, phenolic acids and arjunic acid). Plant samples were also evaluated for their antioxidant activity. Regenerated bark was also collected and evaluated for their major active ingredients- arjunic acid. Bark regrowth results revealed that longitudinal strip harvesting method is superior to other harvesting methods. The bark regrowth was faster in younger trees having GBH <90 cm and bark recovered completely in 18 months. Minimum harvestable girth should be >60 cm. The trees having GBH more that 120 cm, the bark may be harvested from ¼ of tree girth by removing outer and middle bark (longitudinal blaze) leaving inner bark for regeneration. Bark can be harvested from the previously harvested trees after two years from opposite side of the previously harvested part. Results on different growth regulator treatment did not show any significant variation in bark recovery. Phytochemical analysis of original and regenerated bark revealed that original bark contains higher amount of active ingredients than regenerated bark. Stem bark possess maximum amount of active ingredients than other plant parts. Trunk bark exhibited maximum antioxidant activity. Arjunic acid content varied from 10.120 to 49.087 mg/100g and also increased with increase in GBH. Arjunic acid content showed significant variation in original and regenerated barks. There were no adverse effects on the overall growth of the tree. The adoption of above harvesting practices will be helpful in sustainable management

of *T. arjuna* and also provide quality raw material to pharmaceutical industries on sustainable basis.

Standardization of sustainable harvesting practices of Bhui-aonla (*Phyllanthus amarus*), Sal-parni (*Desmodium gangeticum*) and Baichandi (*Dioscorea hispida*)

Sustainable harvesting practices for Bhui aonla (*Phyllanthus amarus*), Sal Parni (*Desmodium gangeticum*) and Baichandi (*Dioscorea hispida*) have been standardized for tropical climate of Chhattisgarh. Experiments were laid out in six different sites of three forest divisions of Chhattisgarh *viz.* Marwahi, Gariyaband and Dhamtari. Periodical regeneration surveys were conducted to evaluate the regeneration status in the experimental areas. Regeneration index of the studied species was determined. Plant samples were collected at different maturity stages for assessment of quality of produce. *P. amarus* should be harvested in the month of October at the time of initiation of fruiting. 80% plants can be harvested to maintain sustainability. Maximum phyllanthin content (0.384%) was found at fruiting stage (October) on dry weight basis. For sustainable harvest plants should be cut from the collar part and not uprooted. In *Desmodium gangeticum* only 40% plants should be harvested (uprooted) in the month of December. Maximum (0.113%) total alkaloids content was found the roots harvested in the month of December. In *Dioscorea hispida* 10% tuber should be left for regeneration while harvesting. If more bulbs are present one bulb should be left for maintaining sustainability. Maximum diosgenin (0.7748 %) and starch (17.56%) content were found in the tubers harvested in the month of January.

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

A study has been initiated to standardize sustainable harvesting practices of Mahul leaves (*Bauhinia vahlii*). Experiments pertaining to harvesting intensities and time were also laid out in the forest areas of Keochi, Pendra Road (Marvahi); Saplawa Pahadi, Pali (Katghora) and Futka Pahad, Balco (Korba) in Chhattisgarh. In each study site 10x10m quadrates (0.1h) were laid out in randomized design with five replications. Each quadrate was sampled initially for Mahul populations before harvesting. To standardize sustainable harvesting limits leaves were harvested as per different treatments [T_0 (No harvest/control), T_1 (50% harvest), T_2 (60% harvest), T_3 (70% harvest) and T_4 (80% harvest)] in each site. Mahul leaves were also harvested in different months of the year to evaluate effect of harvesting time on quality of leaves. Quarterly observations were recorded. Maximum plant population was found in Futka Pahad, Korba followed by Keochi, Pendra. It was observed that the time of harvesting affects the quality of leaves. Data revealed that best quality Mahul leaves with respect to leaf length, width and area, were found in Korba. Moisture content was found higher (68%) in the small sized leaves harvested from Korba. Further quality analysis on leaf strength is under progress.

Quality standardization of some important medicinal plants of Madhya Pradesh

The project started in January 2012. Surveys are being conducted in different agroclimatic zones of Madhya Pradesh for collection of plant samples. Giloe and Gudmar samples were collected from Rewa and Chhindwara districts. The samples were dried and processed for further analysis. Phytochemical screening of the plant samples of Giloe showed the presence of different constituents *viz.* carbohydrate, proteins, phenols, flavonoids, terpenoids, saponins, cardiac glycoside and steroids. Qualitative analysis for various constituents is under progress. Giloe satva (starch) has also been extracted from the samples.

Harvesting time of some selected medicinal plants for their natural antioxidants constituents

Survey was conducted in Tamia and Delakhari natural forest and Medicinal Plants Conservation Area, Delakhari for the availability of the selected species under study. *Gymnema sylvestre* species was available in Rainikheda beat, compartment no. P-36, Jhirpa range. *W. somnifera* and *Stevia rebaudiana* experimental beds were established in CFRHRD nursery and are being maintained. *M. oleifera, G. sylvestre, W. somnifera & S. rebaudiana* leaves samples were collected from existing plantations of the centre & natural forest at monthly time intervals. Method was standardized and estimated antioxidant constituents viz. ascorbic acid, total phenols, phenolic acids, elements and flavonoids. Phenol content was highest in *S. rebaudiana & M. oleifera* leaves which can serve as a potential source of nutraceuticals. Vanillic acid and caffeic acid were the two dominant phenolic acids found in *G. sylvestre* leaves. Results were disseminated through various training programmes of the centre.

Identification of Extent of Forest lands in Forest Fringe Villages

Study has been initiated for identification of extent of forest lands in forest fringe villages of Madhya Pradesh. Socioeconomic survey in 34 forest fringe villages of Jabalpur district has been completed. Ecological survey has also been initiated.

2.6.4 Chemistry of NWFPs, Value Addition and Utilization

Determination of polysaccharides for the development of bioproducts:

Polysaccharides from different species viz.,*Curcuma angustifolia*, *C. pseudomantana*, *Dioscorea bulbifera*, *D. hispida and Hyptis suaveolens* were isolated and modified by acetylation, hydroxyl-propylation and carboxy methylation. Physical and chemical properties of polysaccharides –starch and mucilage i.e. morphology, size, solubility, viscosity, extraction temperature, amylose, cellulose, oil% were determined. Degree of substitution of modified

starches were found to be varied 0.040 to 1.30. The introduction of different chemical groups and their charecterization were performed by FTIR spectra.

Compatibility of starches with mucilage, polyvinyl alcohol, chitosan and bentonite and their effect on properties of polyfilms were evaluated. The value of tensile strength of unmodified polyfilms was found to be 9.1 MPa, while significant variation i.e. 12.5 to 45 MPa were observed in modified polyfilm with different additives.

Bio chemicals like alkaloids, triterpenes, phenols, tannins, flavanoids, and saponins were detected and quantified in mucilage.

Starch- based bioadhesive has been prepared through chemical modification. The changes in physical and chemical properties of adhesives were assessed. Binding ability of adhesives with different substrate were evaluated. Properties of adhesives i.e. setting time, water resistivity, solubility in water and organic solvents were assessed. Comparative efficiency of bio adhesives and synthetic adhesives were also screened.

Processing techniques of *Aegle marmelos* (Bael) Fruits

Experiments were laid out for standardization of processing techniques (extraction of pulp and drying) *Aegle marmelos* (bael). Traditional as well as indirect heating methods were applied for pulp extraction. It was observed that traditional methods of pulp extraction were found to be severely affecting quantity as well as quality of pulp.

The different drying modes were applied for drying of pulp. The effect of drying on physico-chemical properties of bael pulp samples i.e. colour, moisture, carbohydrate, protein, minerals, fat, fiber, carotenoids , phenolic acids and riboflavin were assessed.

Mini portable solar drier for direct and indirect drying were designed for efficient drying of pulp samples utilizing solar energy which was found to be less time consuming in comparison to traditional methods of drying and retain quality of the pulp.

Drying method had significant effect on carbohydrates percentage with different drying methods, quantity ranged 15.7 -26.7%. Riboflavin concentration i.e. 20.04 µg/g was recorded in sun-dried samples. Solar drying in solar cooker, direct and indirect solar drier resulted in 0.01 µg/g,22.03 µg/g and 92.02 µg/g, respectively. The samples dried in shade gave 21.03 µg/g riboflavin value. Tannin concentration varied from 0.05-1.40%. Lower tannin percentage was recorded in sun drying and direct solar drying samples. The HPLC analysis of phenolics isolated from pulp samples, processed by different methods, revealed the presence of phenolic acids i.e. chlorogenic acid ,vanillic acid, caeffic acid, elagic acid and gallic acid. Chlorogenic acid was identified as major component varied 0.001- 0.006%. Maximum percentage was detected in shade dried Bael pulp samples. Gallic acid was ranged from 0.002-0.004%.

Bael samples were also collected from Kawardha and Pendra of Chhattisgarh, processed by the villagers and quality of pulp samples were evaluated. Samples were found to be damaged by fungal attack due to destructive processing practices.

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

Seeds of *Jatropha curcas,Sapindus mukrossi and Pongamia pinnata* were collected, processed and seed chemicals were extracted. Physico-chemical properties of oil i.e. specific gravity, saponification value and free fatty acids were evaluated. Seed oil and protein concentrates of *Jatropha curcas* , *Sapindus mukrossi* were modified by sulphation, saponification and dietanolamine reactions. The properties of developed products viz., solubility, surface tension, viscosity, wetting time and foaming power were assessed. The viscosity, wetting time and foaming power of different dilutions varied from 0.58-1.60mPa.s, 9-60sec and 2.9-7cm, respectively. Pesticidal activities were assessed against forest pest i.e. insects (*Triboleum castaneum*), fungi (*Fusarium oxysporum*, *Penicillium crysogenum*, *Alternaria alternate,Flavodon flavus , Ganoderma lucidum, Tramatis cingulated*, *Stachylidia spp.*) and weed (*Echinocloa colanum)* at different dilutions (0.5-15%) under laboratory conditions.

Chemo-profiling of some Dashmoola species (*Solanum indicum, Solanum xanthcarpum* and *Uraria picta*) in Madhya Pradesh

A study has been initiated to quantify the active ingredients of three Dashmoola species (*Solanum indicum, Solanum xanthcarpum* and *Uraria picta*) collected from different agroclimatic regions of Madhya Pradesh **to locate the best areas/populations for getting the quality raw material**. Under the above said study, forest area was surveyed and the different plant parts of *Solanum xanthocarpum* were collected from four agroclimatic regions i.e. Kymore Plateau & Satpura Hills, Satpura Plateau, Chhattisgarh plains & Central Narmada Valley. The plant material of *Solanum indicum* were collected from two agroclimatic regions i.e. Kymore Plateau & Satpura Hills and Chhattisgarh plains. The plant material of *Uraria picta* was collected from Satpura Plateau agroclimatic region. The collected plant materials were shade dried & processed. The preliminary phytochemical screening (alkaloids, terpenoids, flavonoids, carbohydrates, phenols, saponins, cardiac glycosides, steroids & tannins) of different plant parts of *Solanum indicum, Solanum xanthocarpum* and *Uraria picta* were carried out. Standardization of HPLC method for quantification of active ingredients (Alpha – Solanine in case of *Solanum indicum* & *Solanum xanthcarpum* & Rhoifoilin in case of *Uraria picta*) is under progress.

Development of food products from *Madhuca indica* flowers for the upliftment of the Tribal/Rural Communities of Central India

Collection of *Madhuca indica* flowers from available source was done. Method standardization for extraction and quantitative estimation of *M. indica* flowers for their nutritional constituents was done. Quantitative estimation of mahua flowers for their nutritional constituents was done. Three value added food products viz. mahua jam, squash and chutneys

were developed using dried mahua flowers in collaboration with Department of Food Technology, RashtraSant Tukdoji Maharaj Nagpur University, Nagpur. Consumer acceptability tests were conducted. All the three products were accepted by the consumers and were consistent with the Food Products Order (FPO) specifications. Results were disseminated by conducting two training –cum-workshops of two days duration. Target groups were Women Van Samiti members of various forest ranges of Chhindwara District. Practical demonstrations were given for preparation of three value added food products and feedbacks were obtained. Raw material could be effectively utilized for development of cottage scale mahua based food products industry in tribal/rural areas.

2.6.5 Biofuels and Bioenergy

National network on integrated development of Jatropha and Karanj

Jatropha: 175 CPTs of Jatropha were selected from Jabalpur, Chhindwara, Seoni, Balaghat, Dindori, Mandla, Betul, Katni, Shahdol, Satna, Rewa, Panna, Gwalior, Shivpuri, Sagar, Damoh and Sheopur-Kala district of Madhya Pradesh. The selected CPTs were used for establishment of progeny trials at Chhindwara and Baraha comprising of 20 progenies each. Kherwani; Chhindwara, Timarikala; Chindwara, Rakala; Panna, Chapara; Seoni, Bizoli Janarpura; Gwalior-4, Gesani Shivpuri-2, Gesani Shivpuri-3, Bilara Pahori Road Shivpuri-2 and Bizoli Janarpura Gwalior -3 was found performing better than other progenies. Multilocational trials in the form of national and zonal trials comprising of 36 accessions in national trials and of 14 accessions in zonal trial of Jatropha were established at Institute's campus, Jabalpur. Data on growth performance, fruit yield and seed characters were recorded at regular intervals and oil yield estimation of fruits was also done. TNMC – 22, TFRI – I, TFRI – 2, IGAU –2, PDKV -1, PDKV-2, TNMC–7 Palmpur–I, Palmpur-II, CSFER, RJ-92, TR-4, JCP-2, NRCJ-17 and TNJC-19 accessions performed better than other on the basis of growth, seed yield and oil

content. Seed yield was observed maximum in IGAU-1 (157.06 kg/ha) followed by TFRI-2 (155.22kg/ha). The oil content ranged from 32.17 to 39.43%. In zonal trial TFRI-1, TFRI–2, PDKV-1 and PDKV–2 performed better among all accessions. Seed yield was observed maximum in TFRI-1 (101.25 kg/ha) followed by RRL-1 (85.52kg/ha) accessions. Oil percentage varied from 31.80 to 39.50%.

Karanja: 81 CPTs of Karanja were selected from Jabalpur, Satna, Panna, Katni, Seoni, Chhindwara, Balaghat, Mandla, Dindori, Shivpuri, Gwalior, Muraina and Damoh districts of Madhya Pradesh. The selected CPTs were used for establishment of Progeny trial. 20 progenies were used for establishing the progeny trial at Balaghat in 2005. Kusmeli; Chhindwara, Sikharpur; Chhindwara and Lalpur; Satna were found most promising progenies among all other progenies. National trial of Karanja comprising of 5 accessions, zonal trial comprising of 17 accessions were established at Institute's campus. In national trial TNMP-14 and RAK-5 accessions performed better, in zonal trial IGAU-1, CCSHAU–1, IGAU–5, NRCAF–2, JNKVV-29 and JNKVV-15 performed better. Fruit bearing progenies are Kusmeli; Chhindwara (90 fruits), Sikharpur; Chhindwara (80fruits), Lalpur; Satna (63 fruits) and Chandangoan; Chhindwara (55fruits). In zonal trial accessions CCSHAU, Bawal–1 (82 fruits); NRCAF–2, Jhashi (81 fruits); IGAU-1, Raipur (55 fruits); TFRI-2, Jabalpur (52 fruits) and TFRI-3, Jabalpur (51 fruits) showed fruiting. However, the amount of fruits were less. The trials are maintained with regular weeding and hoeing practices and irrigation as and when required.

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

Multilocational trial comprising of nine superior accessions of *Jatropha curcas* and half sib progeny trial comprising of nineteen accessions were established in October 2008 and July 2009 respectively at institute's campus. The trials are performing well and survival is more than 82%. Regular observations on growth attributes like height, collar diameter, number of branches, flowering, incidence of pests and diseases has been recorded on quarterly basis and data has been sent to Biotech Park, Lucknow for compilation. Minimal irrigation and maintenance was provided to the trials as and when required. In multilocational trial two accessions HAP 41 and HAP 44 (HNB, Garhwal) have produced higher number of branches Fruiting was observed in all accessions: JA-9, NBRI, Lucknow, JA-126, NBRI, Lucknow, JA-139, NBRI, Lucknow, BTP-U, BTP, Lucknow, HAP 41, HNB, Garhwal, HAP 42, HNB Garhwal and HAP 44, HNB Garhwal (74 fruits).Oil percentage in different accessions varied from 25% to 38%. In half sib progeny trial flowering has been observed in September-October 2011 in following accessions: JA-9, JA-18 (NBRI, Lucknow), MSSRF-10, MSSRF- 16, MSSRF- 51(MSSRF, Chennai), HAP- 41 and HAP-44 (HNB, Garhwal). However, less fruiting was observed. The experimental trials are being maintained.

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

Multilocational trial comprising of 100 superior accessions of *Jatropha curcas* received from network partners was established in July-August 2010 at GRC farm house, Sita Pahad, Jabalpur. The experiment was established following Randomized Block design (RBD) with four replications. The experimental field was divided in 400 equal sized plots and 9 plants were planted per plot at a spacing of 3m x 3m. The trial is performing well and the survival is more than 78%. Regular observations on growth attributes like height, collar diameter, number of branches, flowering, incidence of pests and diseases has been recorded on quarterly basis and data sent to Biotech Park, Lucknow for compilation. Best performing accession are JA-128 (IC-471346), HP-16 (IC -569356), TJS-18 (IC-561291), TJS-07 (IC-569342), TJS-07 (IC-566612), RU-1 (IC-566601), RU-101 (IC-565667), RU-18 (IC-564020), RU-5 (IC-564013) and DBT-20 (569131) on the basis of statistical analysis. The trial is being maintained properly.

2.7 Forest Protection

2.7.1 Overview

The institute is engaged in research on identification of insects, pathogens, beneficial microbes and protection of forest seeds, seedlings, saplings, trees in plantation, stored wood depots from insect and pathogen pests.

2.7.1.1 Summary of the achievements under the Theme

Integrated management package on white grubs in teak nursery at Kanchangaon, Mohagaon Project Division, Mandla (Madhya Pradesh Forest Development Corporation Ltd.) was developed. In this package different activities like installation of light trap unit, different dates of sowing of teak seeds, pruning of host trees around the nurseries, application of biopesticides cakes (neem and jatropha) and prophylactic / curative treatment of phorate 100 gm per bed (size 10x1m) were applied.

2.7.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	2+3(dropped)=5	5	3+1(initiated & dropped)=4
Externally Aided	-	2+1(subproject)	1

2.7.2 Insects pests, diseases and control

Development of Entomopathogenic Nematode based strategy for the management of termites and white grub pests of major forest tree species

Laboratory culture of greater waxmoth maintained round the year was used to obtain larvae as fictitious host for EPNs. Comparative potentiality of the 6 native isolates has been determined against the target pests. It required maintenance of laboratory culture of all the collected native isolates round the year and their identification. The laboratory culture of one exotic and six unidentified (native) populations of EPNs native to central India, was maintained *in vivo*, round the year. One of the EPN isolate (*Steinernema dharnaii* n. sp.) has been identified (at molecular level) as new-to-science by CABI, Kew, UK. Process for the identification of other unidentified native EPN populations is in progress in collaboration with the Zoological Survey of India, Dehradun. Different stages of the EPNs have been collected, fixed and two have been sent for identification by nematode taxonomist, collaborating from ZSI, Dehradun. We investigated improved parameters for economical and successful mass-multiplication of the not only native EPN populations/ isolates, but also the fictitious host, as it was linked with the economics of the EPN multiplication. The determination of best effective combination/formulation of the selected EPN and its efficacy with regards to the stages and time of application against the target pests investigated. Work is in progress.

Biological control of teak leaf skeletonizer *Eutectona machaeralis*

A total of 2.5 crores of egg parasitiod, *Trichogramma raoi* was released for management of teak defoliator and skeletonizer in selected sites (300 hectares in plantation and 300 hectares in natural forests of teak) at Maharajpur range of Mandla Forest Division, Madhya Pradesh. To assess and demonstrate the biological potential of *T raoi* in field, observations on damage impact (defoliation intensity) of target insect pests and tree growth in released and non released sites are being recorded.

Damage assessment of gall making insect species of eucalyptus and its management by pesticides

Procured seeds of eucalypts, carried out showing and developed nursery (insectary) of eucalypts. Maintained nursery/insectary of eucalypts for experimental work to study the gall insect and its subsequent management in seedling stage. Conducted survey of forest nurseries/plantations in field and road side to collect gall making insect species of eucalypts and its natural enemies (parasites, predators and pathogens). Assessed damage impact of gall insect of eucalypts in nurseries/ plantations and found to be a major pest in nursery stage. Collected gall insect, prepared slides, studied morphology of gall making insect species and galls. Laidout three experiments with biopesticide and five experiments with chemical pesticides against gall insect

in nursery stage. Carried out periodical data collection on development of galls in laid out experiments. Recorded two lymantriid insect defoliator for the first time feeding on eucalypts in nursery stage.

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

Target species of medicinal plants were raised in experimental plot in forest entomology division. Multiplication of *Trichogramma* and *Chrysoperla* was done. Seasonal history of key insect pests was worked out. Sampling of natural enemies was done. Different doses of biopesticides were tested in laboratory condition. The insect pests of target spp. of medicinal plants were identified in different localities, Egg parasitiod *Trichogramma* and predator *Chrysoperla* was tested against key insect pests (Defoliator & shoot borer). The work is in progress.

Studies on larval parasitoids, *Apanteles* spp. (Hymenoptera: Braconidae) of major defoliators of teak and sal forests of Orissa

Surveyed teak and sal forests of five districts of Orissa (Bargarh, Balangir, Boudh, Sambalpur and Sonepur) for the collection of larvae and pupae of insects defoliating teak and sal forests. Collected 152 samples of larvae and pupae of teak and sal defoliators from field and by laboratory rearing recovered 34 specimens belonging to *Apanteles* spp. Identified10 species of *Apanteles* (*A. asmeadi, A.coleman, A.deliodis, A.endymion , A. erionotae, A. hyblaea, A. lakhaensis, A.philoeampus, A. prodiniae, A. rudius)* (Fig. 1) on defoliators of teak and sal. All these *Apanteles* spp. are indigenous and these are being recorded for the first time from Orissa. Worked out natural field parasitisation of these 10 species of *Apanteles*, parasitising the defoliators of teak and sal. Studied biology of *Apanteles machaeralis* on teak skletonizer.

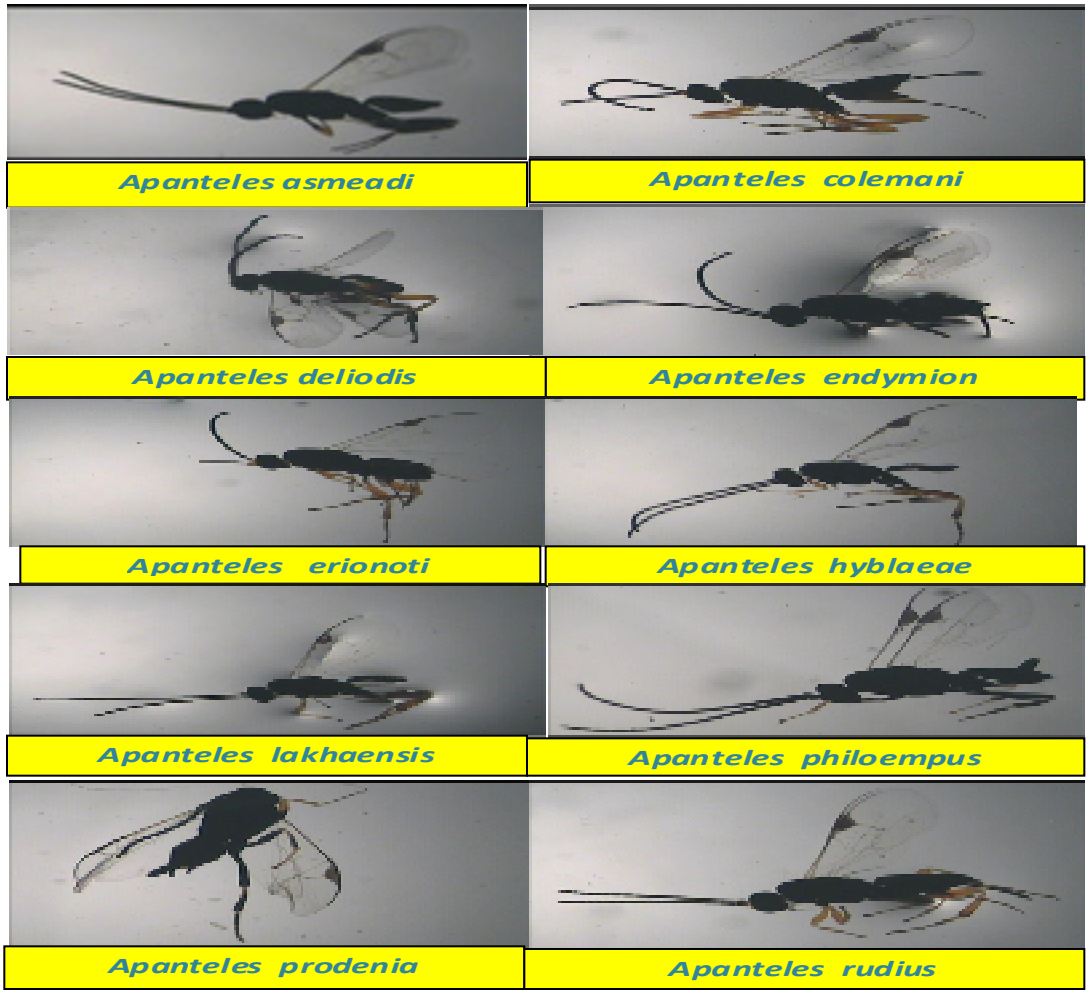


Fig.1. Identified *Apanteles* speceies on teak and sal defoliators from Orissa

Standardization of management practices for leaf gall forming insect and diseases

Efficacy of different insecticides, biopesticides and fungicides were evaluated against tendu gall forming insect and diseases. Observations were recorded on the incidence of gall insect and foliar diseases in experimental areas.

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

Surveyed sal forest areas of Madhya Pradesh and Chhattisgarh for monitoring of sal borer, collection of information on borer incidence, natural enemies and abiotic and biotic factors. Identified natural enemy. Laidout sample plots in sal forest areas of Mandla, Dindori and Anuppur Forest Divisions. Investigated sal borer problem in Chhattisgarh and conducted training programme on sal borer and its management.

Fields evaluation of indigenous species of *Trichogramma* against teak skeletonizer *Eutectona machaeralies*

Population of teak skeletonizer, *Eutectona machaeralis* was observed in experimental areas. *Trichogramma* species was released against teak skeletonizer, *Eutectona machaeralis* in the field condition. Field evalution have been intiated in three different localities Moiyanala, Udaipur and Tikariya in Mandla Forest Division, Mandla and observations recorded.

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

Biocontrol potential of 6 native isolates has been determined against the teak skeletonizer using the laboratory culture of one exotic and six unidentified (native) populations of EPNs native to central India, maintained *in vivo*, round the year. The improved method for field applications of entomopathogenic nematodes and related parameters affecting field applications were also experimented. The determination of best effective formulation of the selected EPN and its efficacy with regards to the stages and time of application against the target pests investigated. Work is in progress.

Studies on diseases of important medicinal plants and their bio control

Disease survey on medicinal plants was conducted in Madhya Pradesh and Chhattisgarh forest nurseries, plantations and farmers field. The disease incidences in various localities were assessed. The study revealed that *Rauvolfia serpentina* infected from leaf spot, inflorescence top dying and wilt diseases caused by *Mycosphaerella rauvolfiae*, *Cercospora rauvolfiae*, *Phoma jolyana*, *Phomopsis sethii, Cladosporium oxysporum*, *Macrophomina phaseolina*, *Alternaria alternata*, *A. tenuis*, *A. tenuissima*, *Colletotrichun dematium*, *Lasiodiplodia theobromae*, *Fusarium oxysporum* f. sp. *ruavolfiae* and *Corynespora cassicola*. Similarly different pathogens viz. *Pseudocercospora withaniae, Fusarium oxysporum Sclerotium rolfsii*, *Cladosporium cladosporioides* and *Meloidogyne incognita* were recorded from *W. somnifera.* The leaves of *Chlorophytum borivillianum* were found to be infected with *Colletotrichum capsici*, *C. graminicola*, *C. chlorophytum, Macrophomina phaseolina* and root rot disease caused by *Fusarium oxysporum.* The *in vitro* test showed that the antagonistic activity of *Bacillus amyloliquefaciens* and *Streptomyces* sp. was very effective against the pathogens. Antifungal activity of biopesticide revealed that 33% concentration was effective for the control of major pathogens. The field experiment for management of *R. serpentina* reveals that Bavistin 0.05% + *Streptomyces* sp. (10^6 spores/ml) is significant treatment among the other treatments, while *Streptomyces* sp. (10^6 spores/ml) was best for the control of leaf spot and root rot disease of *C. borivillianum*. Root knot diseases of *W. somnifera* caused by *Meloidogyne incognita* were effectively managed by adding 50% neem cake in the potting mixture.

Integrated management of vascular wilt disease in Neem (*Azadirachta indica*), Aonla (*Emblica officinalis*) and Khamer (*Gmelina arborea*) in forest nurseries

Vascular wilt disease is a major problem in forest nurseries of central India. Occurrence of wilt disease of Aonla Neem and Khamer in different forest Research and Extension nurseries of Betul, Chhindwara, Seoni, Balaghat and Pandarkaura have been recorded. Wilt causing pathogens viz. *Fusarium solani, F. oxysporum, F. concolor, Verticillium* sp. and *Rhizoctonia solani* have been isolated and identified. Seedlings of Neem, Aonla and Khamer's have been raised to study various aspects of disease epidemology caused by soil borne fungal pathogens. In this study incidence of vascular wilt disease in ten different provenances of Neem have been recorded. The disease predominated during the month of Jul- Aug. The average incidence of the disease ranged between 3.75 to 26%. Out of ten provenances, Bargi was found more susceptible as compared to other provenance, while Shahdol and Raigarh provenances showed resistance to disease. The Kanchan variety of aonla was found more susceptible in both nurseries at Balaghat and Seoni. The grafted saplings of Kanchan, Chakaiya, Francis and Desi (wild) varieties at Balaghat nursery has shown comparatively more incidence of disease, may be due to over shade effect of broad leaved tree cover over the agronet shade of the nursery. To minimize the incidence of disease *in vivo* tests were performed using three fungicides: Bavistin (carbendenzim 50%), ridomil (carbendazim 4% + mancozeb 64%) and Indofil- 45 (mancozeb 74%) at 0.1 % and 0.2%. Out of these ridomil (carbendazim 4% + mancozeb 64%) was found more effective against *Fusarium solani* in nursery.

Studies on wood decay and its control in stored tropical timber

Forest wood depots of Madhya Pradesh (18), Chhattisgarh (13) Maharashtra (12) and Orissa (25) were surveyed for collection of wood decay fungi, 1159 specimens of wood decay fungi were collected on 34 hosts (timber). 83 species of 47 genera, under 15 families were studied and identified. 4 species were reported for the first time from India, namely, *Australohydnum dregeanum, Hjortstamia friesii, Schizopora flavipora* and *Hapalopilus nidulans*. Toxicity and decay resistance test by using *Daedalea flavida, Sterium hirsutum* and *Trametes cingulata* was conducted. 3 wood species namely bijasal, teak and sal were treated with 2% mix of 4:3:1combinations of K2CO3, KHCO3 and K2CrO7. After incubation period of 8 to 16 week the decay fungi causes wood decay ranging from 16-37% in control with same incubation, the treatment reduces the rate of decay up to 5 %. Wood depots of MP and CG were selected for expt., 2 treatments on an interval of 1 month with above chemical combination were given. For biological control of wood decaying fungi 6 *Trichoderma* spp., 2 *Aspergillus* and 1 *Penicillium* sp. (hyper parasites) were isolated, purified & identified. Experiment was laid out by using two biocontrol agent *Aspergillus niger* and *Trichoderma viride* against ten white rot and one brown rot fungus by dual culture technique. The result showed that both *A. niger* and *T. viride* inhibit growth of all decay fungi tested. Although the percentage inhibition of radial growth values of *T. viride* and *A. niger* are almost the same (ranging from 29.2 to 66.7%) but the average mean value

of *T. viride* (51.7%) is 13.3% more than that of *A. niger* (45.5%). Under this project 6 research papers were published and one is accepted for publication.

Taxonomy and documentation of wood decay fungi of Chhattisgarh and Orissa (CSIR Project)

Three hundred fourty three specimens were collected from Kawardha, Bilashpur, Marwahi, Dhamtari, Ambikapur, Manendragarh and East Raipur of Chhattisgarh region. Out of 343 specimen, 31 genera and 41 species of wood decaying fungi, collected from 35 host tree species were identified.Taxonomy and documentation of 38 wood decaying fungi were done, in which 25 new documents (*Australohydnum dregeanum, Hjorstamia freisii, Schizopora flavipora, Coriolopsis flocossa, Ganoderma colossus, Lenzites elegans, Helvella latispora, Necteria cinnabarina, Gloeophyllum striatum, Hapalopilus nidulans, Xylaria* sp., *Pycnoporus sanguineus, Phellinus ostricolor, P. dingleyae, P. lamaoensis, P. linteus, P. portoricensis, Trichoderma longibrachiatum, T. parceramosum, Navisporus floccosus*, *Trametes leonina*, *Phlyctaeniella* sp., *Mycena rosella*, *Leucocoprinus birnbaumii* and *Hypoxylon* sp., were prepared and 13 already prepared document (*Ganoderma lucidum, G.applanatum, Daedalea flavida, Trametes cingulata, T.cubensis, Microporus xanthopus M.vernicipens Phellinus gilvus, P. rimosus, Trichoderma harzianum , Polyporus gramocepahlus, Flavodon flavus and S. commune*) were amended.

Studies on root rot and stem decay diseases in *Acacia catechu* and their control

The following fungi were identified from samples of Acacia catechu collected from MP and HP: *Auricularia, Deadalea, Fladom flavus, Ganoderma lucidum, Lanzites pulisoti, Monodictys, P. pachyphloeus, Phellunus badius*, *Stachylidun, Schizophyllium commune, Torula herbarum, Trarmetes cingulata* and *Polyporus gilvus*. Nine fungi namely, *Aspergillus flavus, A. niger, A. fumigatus, Fusarium concolar, Alternaria alternata, Fusarium solani, F. moniliforme, Cladosporium cladosporioides* and *Curvularia* sp. were isolated from seed microflora of *A. catechu*. Cultures and fruit bodies of wood decay fungi were maintained. *In-vitro* test for the evaluation of different fungicide against *Ganoderma lucidum* has been carried out. Out of four tested fungicides, Bavistn 0.2% has proved successful to control the growth of *Ganoderma lucidum*. Isolation of hyper parasite and control of wood decay fungi through *Trichoderma viride, A. niger, A.fumigatus, A.flavus and Penicillium notatum* were conducted. Control of wood decay fungi by oil extract of sapindus has also been tried in laboratory conditions.

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

Spermoplane mycoflora of *Tectona grandis* were recorded from the inflorescence, young fruits and mature fruits collected from Mandla and Jabalpur forest division. The fungi associated with inflorescence and immature fruits were recorded as *Absidia* sp., *Alternaria raphani. Ampulliferina fagi*, *Aspergillus flavus, A.niger, Cladosporium cladosporioides, Curvularia*

lunata, *Fusarium oxysporum*, *Helminthosporium* sp., *Humicola grisea*, *Phialophora lagerbergii, Rhizoctonia solani, R. bataticola, Septonema* sp., *Trichoderma pseudokoningii* and *T.harzianum*. The fungal flora associated with weathered seeds was also recorded as *Rhizopus stolonifer, F.oxysporum* and *A.flavus* while the unweathered seeds have shown the presence of *A.flavus, F.equiseti* and *F.solani. Bacillus amyloliquefaciens* an antagonistic bacterium was isolated from the rhizosphere soil of *Rauvolfia serpentina* from nursery of institute campus. The bacterium inhibited the mycelial growth of spermoplane mycoflora of teak. The teak seeds extracted from the hard nuts treated with 11 days old broth culture of *B.amyloliquefaciens* showed inhibition of the seed borne fungal flora.

2.7.3 Mycorrhizae, rhizobia and other useful microbes

Studies on the dynamics of litter decomposition in sal forest of central India and its impact on the nutrient status of soil

Litter decomposition in five different sites of sal forests of Madhya Pradesh Chhattishgarh and Orissa was studied. Overall recorded 63 different fungal species involved in litter decomposition. The influence of carbon flux, nitrogen, phosphorous, and potassium at different stages of decomposition were estimated. Total five potentialy beneficial fungi were screened for their ability to enhance the decomposition rate and nutrient release. 09 mycorrhizae forming fungi (*Astraeus hygrometricus, Geastrum triplex, Boletus* sp. *Mycena* sp. *Boletus fallax., Russula* sp., *Scleroderma verrucossum, Scleroderma geaster, Scleroderma bovista)* were identified from different sites of sal forest. Two ectomycorrhizal fungi were multiplied for their capability of mycorrhization. Experimentation on sal seed germination have been carried out, which revealed that nursery beds containing solarised soil + FYM + mycorrhizae infested soil shown 47% germination whereas in case of unsolarised soil with same treatment germination was 20.50 %. Eleven documents of important litter decomposing as well as mycorrhizae contributing fungi have been prepared. A new species, *Asterostomella shoreae* collected from Achanakmar biosphere reserve in Chhattishgarh, on fresh fallen leaves of *Shorea robusta* has been reported. Three new fungal records viz *Astraeus hygrometricus*, *Helicosporium phragmitis* and *Boletus fallax* have been recorded so far from India out of which two i.e. *Astraeus hygrometricus* and *Boletus fallax* is a new mycorrhizal records for sal.

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

For product development of different microbial inoculants, microbes including *Azatobacter*, *Azospirillum*, *Rhizobium*, AM fungi (*Glomus mosseae, Acaulospora scrobiculata, Gigaspora* sp.) were isolated from M.P. (adjoining areas of Chitrakut, Sanawad, Badvaah and Khandwa) and Chhattisgarh (Bilaspur). Microbial samples of bel, tinsa, mahua and beeja-sal are maintained in pot cultures. Pot experiments on bel has been conducted by using combination of

AM fungi, *Azatobacter* and *Azosprillum*. After 3 months of interval, biomass production was found superior in the treatment of *Azospirillum* + AM fungi.

2.8 Seed Science and Technology

2.8.1 Overview

Seeds are valuale asset for continuation of afforestation and regeneration. The research work on seed collection, seed storage and viability extension are of paramount importance procuring sturdy seedlings in requisite numbers to sustain various plantation programmes. The institute is devoted to conduct R & D investigations on these aspects for tropical forests of central India.

2.8.1.1 Summary of the achievements under the Theme

During the tenure of the report, Silviculture and JFM Division conducted investgations on determination of seed germinability, storage protocol and environmental conditions for securing optimum regeneration of important forestry speciues of central India. The work has been briefly presented below:

2.8.1.2 Projects under the Theme

Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	-	1	-
Externally Aided	-	-	-

Germination ecophysiology of two important tropical forest tree species : *Schleichera oleosa* and *Pterocarpus marsupium*

The project aimed at studying germination ecophysiology of *Pterocarpus marsupium* and *Schleichera oleosa.* Mature seeds were collected from Jabalpur (MP), Chindwara (MP) and Korba (Chattisgarh). Studies on germination phenology was continued on *Pterocarpus marsupium* and *Schleichera oleosa* for better understanding of the process of germination under natural condition. Effect of light and temperature on germination of these two species was completed. Sampling is continued on ex-situ and in-situ stored seeds of *Schleichera oleosa* at regular intervals.

3. *EDUCATION VISTAS /ACTIVITIES*

3.1. FRI University - Not related to TFRI

3.2. Trainings organized/Lecture delivered

Dr. A.K. Bhowmik, Scientist C delivered 2 lectures to Ph.D. students of FRI university as a part of Compulsory Basic Forestry Course during 15 September 2011 – 30 November 2011.

Dr. A.K. Bhowmik, Scientist C delivered a lecture on 'Methodologies of soil sample analysis' under three weeks training programme for M.Sc. (Forestry) students of Guru Ghasidas University, Bilaspur during 12.3.2012 – 31.3.2012 at TFRI Jabalpur.

Dr. Avinash Jain, Scientist E delivered a lecture on 'Forests and climate change' under three weeks training programme for M.Sc. (Forestry) students of Guru Ghasidas University, Bilaspur during 12.3.2012 – 31.3.2012 at TFRI Jabalpur.

Dr. Avinash Jain, Scientist E, delivered 6 lectures to Ph.D. students of FRI university as a part of Compulsory Basic Forestry Course during 15 September 2011 – 30 November 2011.

Dr. Avinash Jain, Scientist E, organized a 3-days training – cum – workshop on 'Environment and Afforestation' for NTPC officials during 27-29 February 2012 at Pench Tiger Reserve, Pench (M.P.).

Dr. Girish Chandra, Scientist C, delivered lectures to Ph.D. students of FRI university on forestry Statistics.

Dr. M. Kundu delivered lecture on Seed Technology in Compulsory Basic Forestry Course for Ph. D students of FRI University.

Dr. M. Kundu delivered lecture on Seed Technology in the course-work for the M.Sc. (Forestry) students of Guru Ghasidas University, Bilaspur on Tree Seed Technology on 15-03-2012.

Dr. M. Kundu delivered lecture on laboratory management under ICFRE HRD plan for the training programme at TFRI Jabalpur from 5th to 9th September, 2011.

Dr. M. Kundu delivered lecture on One week training programme for Forest officials of Maharashtra State Forest Research Institute from 31st October to 4th November, 2011 on Seed Technology.

Dr. N. Roychoudhury and Dr. N. Kulkarni, Scientist – F, organized and attended sal borer training/workshop and delivered lecture on "Sal vano me sal borer ka prakop and iska prabandhan" at Raipur on 30.11.2011.

Dr. N. Roychoudhury and Dr. N. Kulkarni, Scientist – F, organized and attended sal borer training/ workshop and delivered lecture on "Sal vano me sal borer ka prakop and iska prabandhan" at Jagdalpur (C.G.) on 24.02.2012.

Dr. N. Roychoudhury, Scientist-F and Dr. N. Kulkarni, Scientist- F Shri Anand Kumar Das, Research Associate and Shri Alok Thawait, Field Asst. organized and attended training on Sal heart borer and its management to chhattisgarh State Forest Department Officer and Staff on 24 February 2012 at Jagadalpur.

Dr. Nanita Berry, acted as resource person and delivered a lecture on " Promising Agroforestry Systems for Central India" to the two groups of forest gaurds of Vanvidhyalaya, Shivpuri(M.P.) during 99th training course of Forest gaurds of Shivpuri held on 20/06/11 and 23/06/11 respectively at TFRI, Jabalpur(M.P.).

Dr. Nanita Berry, acted as resource person and delivered a lecture on " Agroforestry and its Systems for Central India" to the group of forest gaurds of Vanvidyalaya, Rewa (M.P.)

during training course of Forest gaurds of Rewa held on 23/06/11 respectively at TFRI, Jabalpur(M.P.).

Dr. Nanita Berry, acted as resource person and delivered lecture on "Agroforestry and its systems" during educational tour of final year B.Sc (Forestry) students of the Forestry College, Ponampet, Kodagu (University of Agriculture Science,Banglore(Karnataka) on 9th June,2011 at TFRI, Jabalpur.

Dr. Nanita Berry, acted as resource person and delivered lecture on "Agroforestry systems" to the farmers of Jamtara village during the "International Biodiversity day" held on 22nd may, 2011 at jamtara village of Jabalpur.

Dr. Nanita Berry, acted as resource person and delivered lecture on "Agroforestry systems" to the farmers of Jamtara village during the "International Biodiversity day" held on 22nd may, 2011 at jamtara village of Jabalpur.

Dr. Nanita Berry, acted as resource person and delivered two lectures on "Youth Adivasi ke liye rojgarunnomukhi vyavasthaye" at newly elected National Youth Congress groups of Mahakaushal Region " held at 11th November, 2011 at Jabalpur .

Dr. Nanita Berry, as resource person , delivered two lectures on *Gmelina* based agroforestry system to the 5 villages of Jabalpur during Ministers programme and SFRI- VVK training programme held on 25th May , 29th June and 27th August,2011 at SFRI, Jabalpur (M.P.).

Dr. Nanita Berry, as resource person and training and demonstrated scientific cultivation of turmeric to the farmers of Jamtara and Barha farmers during extension activities of demo villages on 5th July, 2011

Dr. Nanita Berry, as resource person, delivered lecture on Agroforestry during training programme on "Laboratory Management" under ICFRE -HRD plan for technical staff of ICFRE Institutions.

Dr. Nanita Berry, as resource person, delivered lecture on Lac cultivation : an viable option for extra income generation at State Forest Research Institute, Jabalpur (M.P.)on 29th May, 2011.

Dr. Nanita Berry, as resource person, delivered two lectures during training course on "Basic Forestry" for Ph.D. students of FRI, Deemed University, Dehradun on 14th November, 2011 at TFRI.

Dr. Nanita Berry, organised and conducted one day quiz programme on Hindi for the Research and ministrial staff of TFRI on 5th September,2011 at TFRI.

Dr. Nitin Kulkarni, Scientist – F, delivered lecture as Resource Person, organized by the Extension Division of TFRI for senior forest officials of Maharashtra State Forest Department, entitled "वन रोपणियों में पौधों को नुकसान पहुँचाने वाले कीट एवं उनके प्रबंधन की आधुनिक विधियाँ" on 4th Nov., 2011.

12 trainings were organized by the centre. Target groups were farmers/Non Government Organizations/Women Self Help groups/Women Van Samiti members.

Details are given below-

S.No.	Topics	Date
1.	Cultivation of medicinal plants	26..4.2011
2.	Soil conservation and watershed management	08.06.2011
3	Agro-forestry with reference to medicinal plants	14.07.2011

4	Cultivation of medicinal and aromatic plants	10.08.2011
5	Bird watching campaign	2-4.10.2011
6	Bio-fertilizers and bio-pesticides	23.11.2011
7	Office procedures and general laws	27.12.2011
8	Nursery techniques and environmental issues	7.2.2012
9	Identification of medicinal plants and their uses	24.2.12
10	NWFP value addition, processing and marketing with special reference to chironji	21.3.2012
11	Development of value added food products and processing of mahua flowers	2.3.2012 & 3.3.2012
12	Development of value added food products and processing of mahua flowers	22.3.2012 & 23.3.2012

3.3 Visits Abroad – NIL

3.4 Participation in Seminars/Symposia/Workshops/Trainings/Conference/Meetings Etc.

a) Conferences

Name of the participant	Confernce (National/International)	Title of the paper	Attended /Presented	During	venue
Dr. Nanita Berry	Pre-Indian Forestry Conference		A	Jul 05, 2011	TFRI
Dr. Girish Chandra	Indian Forestry Congress	Estimation of location and scale parameters using ranked set sampling	P	Nov 22-25, 2011	ICAR, New Delhi
Sulochna Boudha and Y. Mishra	International conference on non wood forest produce for sustained livelihood (I)	Genotypic variation for *in vitro* propagation of high reserpine yielding genotypes of R*auvolfia serpentina* Benth	P(Poster)	Dec, 17-19, 2011	Bhopal
Nimisha Chaturvedi	Forest, Environment and Climate change: Issues and Challenges (N)	Development of germinability, desiccation tolerance and hardseededness in developing seeds of Abelmoscus moscatus (L) Medic	P	Jan 30-31, 2012	Guru Ghasidas Vishwavidyalaya Bilaspur
Dr. N. Kulkarni, Dr. P.B. Meshram Mr Sanjay Paunikar and Mr Vinod Kumar Mishra	-do-		P	Jan 30-31, 2012	-do-
Dr. R.K. Verma	-do-		A	Jan 30-31, 2012	
Dr. R.K. Verma	Mycology and Plant Pathology Biotechnological Approaches (I)	Biodiversity and Conservation of Forest Fungi of Central India	P	Feb 27-29, 2012	Banaras Hindu University, Varanasi
N. D. Khobragade	1st Biennial International Congress on Urban Green Spaces (I)		A	Mar 5-7, 2012	New Delhi, India

b. Workshops

Name of the participant	Workshop	Title of the lecture	Attended/ Given	During	Venue
Dr. P. K. Khatri	Consultative Meeting Cum Workshop of SLEM project		P	May 10-11, 2011	ICFRE, Dehradun
Dr. Suneesh Buxy	Wlidlife and Biodiversity Conservation	Biodiversity Conservation	G	Jun 27, 2011	Chhindwara
Dr. Suneesh Buxy	Snake Identification, Conservation and Training	Snake Identification	G	Jul 5, 2011	Samvad Sadan, Chhindwara
Shri. Har Prasad, Dr. A.C. Surya Prabha and Dr. Vishakha Kumbhare	-do-		A	Jul 5, 2011	-do-
Dr. Suneesh Buxy	CDM Afforestation and Reforestation in MP	Climate Change and Clean Development Mechanism (CDM)	G	Jul 26, 2011	Chhindwara on
Dr. Nanita Berry	Forests and livelihood		A	Jul 27, 2011	IIFM, Bhopal
Dr. Nanita Berry	Satat Ajiwika ke liye Unnatsheel Krishivaniki Padhattiya	Promising Agroforestry system for Central India	G	Sep 28, 2011	TFRI
Dr. R. K. Verma	-do-	कृषिवानिकी पद्धति मध्य भारत के वृक्षों में अरबस्कुलर कवकमूल ;।डद्ध कवकों की सम्बद्धता को बढ़ाता है	G	Sep 28, 2011	-do-
Dr. K. K. Soni	-do-	ृषिवानिकी प्रजातियों में होने वाले रोग एवं उनका निदान	G	Sep 28, 2011	-do-
Dr. Vishakha kumbhare	Sustainable harvesting and uses of medicinal plants of Chhindwara District	Cultivation techniques of *Cissus quadrangularis* and sustainable harvesting of some important medicinal plants	G	Oct 10, 2011	Nagar alika Sabhagraha, Chhindwara.
Dr. Suneesh	*Gmelina arborea* and	Germination	G	Mar 27,	Chhind

Buxy	their Uses	percentage of *Gmelina arborea* by Goats		2012	wara
CFRHRD, Chhinddwara	Eco-tourism festival		P	Nov 07-15, 2011	Eco-Tourism Development Board, M.P at Tamia
R.K. Verma	Providing the Scientific Basis for Fungal Conservation	Journals for fungal conservation, an internet opportunity	G	Nov 21-23, 2011	KFI, Peechi

c. Seminar/Symposia

Name of the participant	**Seminar/Symposia**	**Title of the talk**	**Attended/Presented**	**During**	**venue**
Dr. R.K. Verma	Recent Advances in Fungal Biotechnology	Diversity of Forest Fungi in Central India	P	Sep 22-23, 2011	FRI, Dehradun
Dr. K.K. Soni	-do-	Some hyperparasitic fungi of powdery mildew disease of teak in Madhya Pradesh	P	Sep 22-23, 2011	-do-
-do-	-do-	Occurrence of *Aloe vera* rust (*Uromyces aloes*) : a new record from Madhya Pradesh (Poster)	P	Sep 22-23, 2011	-do-
Shri. N. D. Khobragade	Transfer of Biotechnology for sustainable development and environment protection		P	Jan 21-22, 2012	Guna, Madhya Pradesh
Dr. Suneesh Buxy	Biodiversity Conservation & Wild Life Management	Biodiversity Conservation & Role of Medicinal and NWFPs	P	Feb 25, 2012	Pench National Park
Suresh Rahangdale	Assessment and conservation of forest genetic resources through biotechnological interventions	Organogenic response of five selected genotypes of Rauvolfia serpentina Benth	P	Dec 19-20, 2011	Ranchi

d. Trainings Participated/Lecture delivered

Name of the participant	Training	Title of the lecture	Attended/delivered	During	venue
Shri. A.J.K. Asaiya	10 weeks induction training programme		A	Mar 19–May 28 2011	ICFRE
Dr. Girish Chandra	-do-		A	-do-	-do-
Shri. N.D. Khobragade	-do-		A	-do-	-do-
Dr. Vishakha Kumbhare	21 Days summer school on Advances in Bioprocessing/Bioengineering and quality assessment techniques		A	Jun 01-21, 2011	CIPHET, Ludhiyana
Dr. Vishakha Kumbhare	21 days Advance training course on "Wild and Underutilized Fruits"	"*Cissus quadrangularis* Linn.: An important wild edible plant of the future"	D & A	Nov 2-22, 2011	Y.S. Parmar University of Horticulture and Forestry, HP
Shri. A.J.K. Asaiya	1 week training programme on "Environmentai Impact Assessment"		A	Mar 12-16, 2012	ICFRE
Dr. Suneesh Buxy, Shri. Har Prasad, Dr. Vishakha Kumbhare, Shri. N. D. Khobragade, Shri. J.S. Chouhan and Shri. A.J.K. Asaiya	training on Soil and Water Conservation for frontier staff of Forest department and beneficiaries under SLEM		A	Oct 18-20 2011	CFRHRD
Dr. A.K. Bhowmik	Climate change and forests		A	Jan 31-Feb 04, 2012	ICFRE
Dr. A.K. Bhowmik	Environment Impact Assessment		A	Mar 12-16. 2012	FRI Dehradun
Shri. Ram	support Scientific Staff		A	Sep 5-9,	TFRI,

Bhajan Singh	(Technical) of ICFRE on Laboratory Management			2011	Jabalpur
Dr. N. Roychoudhury	support Scientific Staff (Technical) of ICFRE on Laboratory Management	daily routines of laboratory to the Support Scientific Staff (Technical) of ICFRE on Laboratory Management	D	Sep 06, 2011	TFRI, Jabalpur
Dr. P.B. Meshram	-do-	laboratory management and purchase rule and procedure to the Support Scientific Staff (Technical) of ICFRE	D	Sep 08, 2011	TFRI, Jabalpur
Dr. N. Roychoudhury	training programme for officials of Maharashtra Forest Department	Insect pests of plantations and natural forests and their management	D	Nov 04, 2011	TFRI, Jabalpur
Dr. Nitin Kulkarni	state level training programme	"वन रोपणियों के प्रमुख नाषीकीटों की जानकारी एवं उनका प्रबंधनष ंदक ष्एकीकृत कीट्नाषी प्रबन्धन के अन्तर्गत नाषीकीटों के नियंत्रण के संबंध में कुछ नये आयाम ".	D & Participated as resource person	Feb 27-28, 2012	Van Vigyan Kendra, Raipur
Dr. N. Roychoudhury	training programme for the officials of NTPC	Forest insect pest management in nurseries and plantations	D	Feb 28, 2012	Pench National Park, Seoni
Dr. N. Roychoudhury	training programme organized for M.Sc. (Forestry) students of Guru Ghasidas University, Bilaspur	Forest insect pest management	D	Mar 13, 2012	TFRI, Jabalpur
Dr. N. Kulkarni	-do-	Role of entomopathogenic nematodes in the	D	Mar 13, 2012	-do-

		management of forest insect pests			

e. Meetings attended

Name of the participant	Meeting	During	venue
Dr. Avinash Jain, Dr. N. Roychoudhury, Dr. Neelu Singh and Dr. N. Kulkarni	stakeholder's consultation meet	Apr 30, 2011	Bhopal
Dr. N. Kulkarni, Dr. Avinash Jain and Dr. Meshram	-do-	Jun 20, 2011	Nagpur
Dr. Roychoudhury	meeting of Indian National the Man and the Biosphere (MAB) Committee	Jun 23, 2011	MOEF, New Delhi
Dr. N. Roychoudhury and Dr. Nanita Berry	-do-	Jun 27, 2011	Raipur
Dr. Md. Yousuf	Rashtriya Sangosthi at Commission for Scientist and Technical Terminology	Apr 27-29, 2011	

EXTENSION PANORAMA/ACTIVITIES

4.1 Report on Van Vigyan Kendra (VVK) and Demo Village (DV)

Dr. N. Roychoudhury, Scientist-F planted teak of Madhya Pradesh origin in Demo Village, Moiyanala for demonstrating existence of relative resistance aganst teak defoliator and leaf skeletonizer.

Three VVK and one demo village were maintained by the institute, which carried out various activities viz. training, development and maintenance of model nursery and publication of publicity material on various forestry activities. During the period under consideration, Van Vigyan Kendras of the respective states organized training programmes for the farmers, frontline forest officials, NGOs and other stakeholders. Besides, a Demo Village was maintained at Moiyanala with the purpose of demonstrating the technologies developed on use of VAM fungi and resistant teak clones, by the institute. The institute also took up extension activities at nearby villages, Jamtara and Barha, for promoting use of vermicompost and other technologies in the field of NWFP and Agroforestry, under the model developed in the Workshop on Promising Agroforestry system for Central India, organized on 26th September, 2011.

4.2 Technology transferred

Technologies developed in the institute were demonstrated to the farmers, frontline forest officials, NGOs and other stakeholders, by the institute, VVKs and Demo Villages under it. Besides the above, the technologies were also transferred through participation in Kissan Mela, Science Mela and at other allied forums, organized by other agencies, time to time. The activities of the institute were also demonstrated to the distinguished visitors, trainee foresters of different states, University, College and school students, other visiting group's foresters and others from different places. In all, eleven demonstration programmes were organized by the institute during the current year.

Package of practices of turmeric with high yielding variety transferred through demonstration and training programme to the farmers of Jamtara-Paraswara village and Barha village on 5th July, 2011 during training programme at their field only.

Plate 1: Transfer of technology through field demonstration at Demo village - Barha of Jabalpur district(M.P.)

Plate 2: Transfer of technology through field demonstration at Demo village - Jamtara of Jabalpur district(M.P.)

Farmers were motivated through training and demonstrations to adopt the bamboo based Silvi-Agri, *Sissoo-mays* Silvi-Agri system and teak-turmeric Silvi–Medicinal

4.3 Research Publications

Book/Booklet Chapters

Berry, N; Vishwnath, S; Dilraj, ITK, Pal,RS and Mandal, AK (2011). Evaluation of *Dendrocalamus asper* based agroforestry system for tropics. **In Advances in Bamboo Plantation,Management and Utilization : 174-182pp.** Eds.- Arya,ID, Rathore,T.S., Arya,Sarita and Tarun Kant. AFRI Publication, Jodhpur (Rajasthan) .

Berry, Nanita (2011). " Krishi-vaniki Padhattiyon Dwara Satat Ajiwika ". In "Satat Ajiwika Ke liye Unnatsheel Krishiwaniki Padhatti" . Eds- Berry, Nanita and Negi,M.S. 20-27pp, TFRI Publication, Jabalpur(M.P.).

Berry, Nanita and Dilraj, ITK (2011). Asinchit Bhumi Ke liye Babul-Dhan Krishivaniki Padhhatti. In "Satat Ajiwika Ke Liye Unnatsheel Krishivaniki padhatti". Eds. Berry, N. and Negi,M.S. ,TFRI Publication, Jabalpur (M.P.)pp.34-36.

Kulkarni, N, Sanjay Paunikar and Vinod Mishra (2012). Pathogenicity of entomopathogenic *Heterorhabditis indica* poinar against defoliator, *Spirama retorta* Cramer (Lepidoptera: Noctuidae). In : *Insect Pest Management - A Current Scenario* (Ed. Ambrose, Dunston P.), pp. 312-315. Entomology Research Unit, St. Xavier's College, Palayamkottai, Tamil Nadu.

Pramod Kumar, Sanjay Singh and S.A.Ansari (2011) Conservation and improvement of Bamboo through Macro-propagation pp.142-149. In : Productivity Enhancement and Value Addition of Bamboos. eds. Sanjay Singh & R.Das Excel India Publishers, New Delhi.

Roychoudhury, N. (2011). Spinosad – a potential biopesticide for management of greater bamboo leaf roller, *Crypsiptya coclesalis* (Walker) (Lepidoptera: Pyralidae). In : *Productivity Enhancement and Value Addition of Bamboos* (Eds. S. Singh and R. Das), pp. 53-59. Excel India Publishers, New Delhi.

Sett, R. & Kundu, M. (2011). Biodiversity in India: Loss & Conservation. In: Environmental threat-Resource Depletion and Sustainable development. Avishkar Publishing and Distribution, Jaipur, India.

Suman Yadav and S.A.Ansari (2011) Changes in soluble sugar and phenols during *in vitro* rhizogenesis in *Bambusa nutans*. pp.196-202 In : Productivity Enhancement and Value Addition of Bamboos. eds. Sanjay Singh & R.Das Excel India Publishers, New Delhi.

Suman Yadav, Pradeep Patel and S.A.Ansari (2011) Effect of medium concentration on *in vitr*o rhizogenesis in *Bambusa nutans*. pp.169-173 In : Productivity Enhancement and Value Addition of Bamboos. eds. Sanjay Singh & R.Das Excel India Publishers, New Delhi.

Proceedings (National & International)

Archana Chaturvedi, Pramod Kumar and S.A. Ansari (2012) Endogenous IAA vis-à-vis Adventitious rooting in *Dalbargia sissoo* Roxb. In Abstract of "National Conference on Forest, Environment and Climate change: Issues and Challenges." 30-31 January, 2012, Guru Ghasidas Vishwadidyalaya, Bilaspur, pp 158-159.

Asaiya, AJK, S. Buxy and Shailendra Kumar 2012. Research paper abstract entitled, "Biofertilizer as input nutrient management in agro forestry" was published in Souvenir of National Seminar organized by Department of Agronomy, Janta College, Etawah, UP.

Berry, N (2011). Evaluation of bamboo based silvi-agri system in tropics. In Proceedings on management of Sporadic Flowering of Bamboo in Madhya Pradsh" held on 17th-18th August,2011 at State Forest Research Institute, Jabalpur (M.P.).38pp.

Berry, N. and Neelu Singh (2011). Contribution of Women in Livelihood Security through Agroforestry System." Abstract accepted for publishing in proceedings of the "Madhya Pradesh Mahila Vigyan Sammelan II" on Role of women on Sustainable Development of Madhya Pradesh" to be held from 22-23 December,2011 at Science College, Ujjain, M.P.

Berry, Nanita and Singh, Neelu (2012). Empowering Women Self Help Groups: an innovative approach towards livelihood Security. In proceedings on National Conference on " Forest, Environment and Climate Change: issues and challenges" held from 30-31,January,2012 at Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.) .39pp.

Buxy, S., Khobragade, N. D., Meshram, M., and Chouhan, J. S. (2012). Effect of organic fertilizer on production of tuber of *Asparagus racemosus* – An important medicinal plant. Paper published in Proceedings of National Seminar on Transfer of Biotechnology for Sustainable Development and Environment Protection, pg. 25-28 on 21-22 January 2012, sponsored by UGC (CRO) Bhopal organized by Department of Zoology, Govt. College, Aron, District, Guna (Madhya Pradesh).

Chaturvedi, N, Kundu, M. and Sett, R. (2012). Development of germinability, desiccation tolerance and hardseededness in developing seeds of *Abelmoscus moscatus* (L) Medic. Abstract published in Proceedings of National conference on "Forest, Environment and Climate change: Issues and Challenges' to be held in January 30-31, 2012 at Bilaspur, Chattisgarh.

Khobragade, N. D. and Buxy, S. (2012), Ex-situ conservation and mass multiplication of important medicinal plants of Satpura plateau of Madhya Pradesh. Abstract published in Souvenir of National Symposium on Assessment & Conservation of Forest Genetic Resources through Biotechnological Interventions on 19-20 December 2011 at Institute of Forest Productivity, Ranchi (Jharkhand).

Kundu, M. and Sett, R. (2011). Advances in *ex-situ* conservation of genetic resources (seed): ultra-dry technology for storage. Abstract published in Proceedings of National Symposium on "Assessment & Conservation of Forest Genetic Resources through

Biotechnological Interventions" held at Institute of Forest Productivity, Ranchi in 19-20 December, 2011.

Kundu, M. (2011). Seed quality in relation to stage of maturation and seed dry weight during development in *Hardwickia binata.* Abstract published in Proceedings of 1st Indian Forest Congress 2011held at New Delhi 22nd to 25th November 2011. Pp 149.

Pramod Kumar and S.A. Ansari (2011) Auxillary role of endogenous IAA in adventitious rhizogenesis in *Dalbergia latifolia* Roxb. In Abstract of "National Symposium on Assessment and Conservation of Forest Genetic Resources through biotechnological Interventions." 19-20 December, 2011, Institute of Forest Productivity, Ranchi, pp 97.

Saxena, H.O., Pandey, A.K. and Tripathi, Y.C. (2011). Ecological implifications of bamboo flowering in Northeast region of India. In: *Productivity Enhancement and Value addition of Bamboos*. S. Singh and R. Das (eds.) pp 27 – 39. Excel India Publishers, New Delhi, India.

Singh, Archana, Berry, N. and Pandey,A.K.(2012). Assessment of flavonoids content in the bark of *Saraca asoka.* In proceedings of National Conference on " Forest, Environment and Climate Change: issues and challenges" held from 30-31,January,2012 at Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.) .112pp.

Journals (National)

Bhowmik, A. K. (2011) Changes in ground flora diversity in relation to microclimate and physico chemical properties of soil under different natural forests cover of Jagdalpur Forest Division (C.G.), Environment & Ecology 29(4-A) 2106-2112.

Bhowmik, A. K. (2011) Phenological changes reflect the microclimate of the Ecotone Area of Jagdalpur Division. (C.G.). Environment & Ecology 29(4) : 1779-1788.

Bhowmik, A. K. and Avinash Jain (2011). Effect of biofertilizers on growth and biomass production of *Albizia procera* in limestone mine spoil. *Indian Agriculturist* **55**(3&4) : 183-187.

Chandra, G. and Tiwari, N. (2011). Estimation of Location and Scale parameters of Lognormal Distribution using Ranked Set Sampling Theory. In proceeding of Indian Forest Congress, Nov 22-*25, 2011.*

Chandra, G. and Tiwari, N. (2012). Ranked Set Sampling Theory for Large Set Size with Probability Proportional to Rank Size Matrix. In proceeding of *Interface between Statistics, Mathematics and Allied Sciences*, Publishers: Excel India Publishers, New Delhi, 38–49.

Dadwal, V.S. and Savitri Bhartiya (2011). A New Damping-off Disease of *Withania somnifera* Caused by *Sclerotium rolfsii. Journal of Mycology & Plant Pathology,* **41** (I) : 134-136.

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Meshram, P.B. and Soni, K.K. (2011). Application of Delivery Methods for Fungal Pathogens and Insecticides against Chironji (*Buchanania lanza*n) Stem borer, *Plocaederus obesus* Gahn. *Asian J. Exp. Biol. Sci.* **2(1)** : 53-57.

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Roychoudhary, N., Baipai, R. and Singh, B.P. (2011). Tropical Tasar Silk: A Potential NTFP for forest dwelliers of Central India. *Indian Forester* **137**(11): 1280-1288.

Soni, K.K., Pyasi Abhishek and Verma, R.K. (2011). A new record of *Helicosporium phragmitis* from India, *J. Mycol. Plant Pathol.* **41(2)** : 330-331.

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Tiple, A.D., Joshi, K.C. and Kulkarni, N. (2011). Diversity of Odonata in Kanha National Park, Madhya Pradesh, India. *Indian Journal of Forestry* **33(3)**: 329-332.

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Verma, R.K. (2010). *Nitschkia tectonae* – a new ascomycete on teak from central India. *Indian Phytopath*. **63**(4) : 430-432.

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Fatima Shirin, Nitish Parihar, P.K. Rana and S.A. Ansari (2011) *In vitro* shoot regeneration from embryonic axis of a multipurpose vulnerable leguminous tree, *Saraca indica* L. Tree and Forestry Science and Biotechnology 5: 45-48.

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Kundu, M & Sett, R. (2011). Effect of maturation on seed quality in *Holoptelea integrifolia*. Seed Science & Technology, 39:402-411.

Neelu Singh (2011). Wild edible plants: a potential source of nutraceuticals. *International Journal of Pharma Sciences and Research* (IJPSR) Vol.2(12), 2011,216-225

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Surya Prabha, A.C., T.M. Thiyagarajan and M. Senthivelu. (2011) System of Rice Intensification principles on growth parameters, yield attributes and yields of rice (*Oryza sativa* L.) *Journal of Agronomy*. 10 (1): 27-33.

Technical Bulletins

Buxy, S., and Chouhan, J.S. 2012. One bulletin on औशधि पौधा सतावर : परिचय एवं खेती was published in hindi

Pandey, A.K. and Gupta, Nivedika (2011). Karanja (*Pongamia pinnata)*, Tropical Forest Research Institute, (Indian Council of Forestry Research and Education) Jabalpur (Hindi).

4.4 Seminar/Symposia/Workshop Organized

Organized a workshop on '"Energy-Mass exchange in vegetative systems" including scientists of ISRO, MPCST, CAZRI, FRI, and TFRI and officers from SFDs and national parks of M.P" during 9-10 June 2011 at TFRI Jabalpur.

Organized a workshop on " Satat Ajiwika Ke liye Unnatsheel Krishiwaniki Padhatti" during 28th September, 2011.

Oganized one day workshop-cum-training programme on "Sal heart borer and its management" on 30 November 2011 at Raipur.

Oganized one workshop-cum-training programme on "Sal heart borer and its management" on 24 February 2012 at Jagadalpur.

Organized one day workshop on "Achanakmar-Amarkantak Biosphere Reserve" on 3 March 2012 at Bilaspur.

Two training–cum-workshops of two days duration on "Development of Value added food products and processing of Mahua flowers" was organized at our centre on 2nd -3rd March and 22nd - 23rd March 2012. Target groups were women self help groups from different Van Samitis of Chhindwara District.

4.5 Consultancies

The institute has been extending services in the form of consultancies to its stakeholders. During the period the services have been provided to NTPC on their request on formulation of Environment policy, strategy and guidelines and are given below.

1) Assessment of green cover and its tangible and intangible benefits and tree cover management plan for NCPP-Dadri Project.
2) Assessment of green cover and its tangible and intangible benefits and tree cover management plan for STPP-Korba Project.
3) Consultancy was taken from Department of Food Technology, RashtraSant Tukdoji Maharaj Nagpur University, Nagpur for development of three value added food products of dried *Madhuca indica* flowers.

4.6 Technical Services

The institute has been providing technical services to various stakeholders, viz., state forest departments, forest development corporations and others of Madhya Pradesh, Chhattisgarh and Maharashtra, relating to the technical advisory services required. During the period advisory services were provided to Madhya Pradesh and Chhattisgarh State Forest Departments on monitoring and management of Sal Borer and sal mortality in general, as per their request, time to time. These are given below:

Dr. N. Roychoudhury, Scientist-F and Dr. Nitin Kulkarni, Scientist-F visited Jagadalpur Forest Division for investigation of sal borer affected areas, from 15-17 October 2011.

Dr. N. Roychoudhury, Scientist-F, Shri. Subhash Chandra Scientist-B, Shri. Ram Bhajan Singh. R.A.I (SG) and Shri. N. Chourasia, JRF visited Kanha Tiger Reserve in Mandla Forest Division, during the period 8-10 November 2011 to investigate problem of sal defolioation.

Dr. N. Roychoudhury, Scientist-F and Dr. Nitin Kulkarni, Scientist-F, Shri Anand Kumar Das, Research Associate, Ms. Ranjeeta Patel, Field Asst, Shri Alok Thawait, Field Asst. visited Lamni Range in Marwahi Forest Division., Bilaspur during the period 12- 13 January 2012 to investigate the problem of sal borer oncidence and mortality of sal trees.

Dr. N. Kulkarni, N. Scientist-F intiated the survey on Sal mortality in various compartment of Khuriya Forest range of Achanakmar Tiger Reserve, Bilaspur (CG) on sal mortality problems during the period 29 January 2012 to 1 February 2012.

Dr. N. Roychoudhury, Scientist-F conducted survey on sal mortality in Khudia Forest Range of Bilaspur Forest Division, Chhattisgarh, on sal mortality during the period 20- 22 March 2012.

Dr. Nanita Berry, Scientist 'D' , demonstrated On Station Research (OSR) and On Farm Research (OFR) field of developed technology on Silvi-medicinal system, Bamboo based silvi-agri system and horti-silvi-agri system to a group of Forest guard/ Farmers/ Scientist/ Students of VanVidhyalaya, Betul.

1. A Group of Farmers of demo village viz. Barha and Jamtara villages of Jabalpur district were visited during 9th April, 2011.
2. Group of forest officials of Rewa on 20th, June, 2011.
3. Group of forest guards of Chandrapur on 1/11/11.
4. Group of Forest guards of Shivpuri on 22 and 23/06/11.
5. Group of students of B.Sc.(Forestry) final year students of College of Forestry, Ponnampet,Kodagu under University of Agricultutre Sciences, Bangluru on 9th June,2011.
6. A group of M.Sc. (Forestry) students of Jawaharlal Agricultural University, Jabalpur District.

Plate 3: Field demonstration to the forest guard of Shivpuri Ranger's College (M.P.) at Silvi-horti-agri plot, TFRI (Jabalpur, M.P.)

Plate 4: Training to the group of students of Model School of Jabalpur during educational tour at agro-forestry experimental plot, TFRI Jabalpur(M.P.)

Plate5:Organised one day workshop on "Agroforestry" held at TFRI on 28th September, 2011

Plate 6: Particiapants during the workshop held on 28th September, 2011 at TFRI, Jabalpur (M.P.).

4.7 Activities of Rajbhasa

संस्थान द्वारा राजभाषा के प्रचार प्रसार के लिए की जा रही गतिविधियॉ एवं वार्षिक कार्यक्रमः–

1.हिन्दी पखवाड़े का आयोजन : राजभाषा विभाग, भारत सरकार द्वारा जारी दिशा निर्देशों की अनुपालन में उष्णकटिबंधीय वन अनुसंधान संस्थान, जबलपुर में दिनांक 05 सितम्बर 2011 से 19 सितम्बर 2011 के दौरान ''हिन्दी पखवाड़ा'' मनाया गया जिसमें हिन्दी को बढ़ावा देने के उद्देश्य से विभिन्न प्रतियोगिताओं का आयोजन किया गया – हिन्दी प्रश्न मंच प्रतियोगिता, प्रशासनिक हिन्दी भाषा ज्ञान प्रतियोगिता, वैज्ञानिक तथा तकनीकी शव्दावली का हिन्दी ज्ञान प्रतियोगिता, हिन्दी टंकण प्रतियोगिता, हिन्दी भाषण प्रतियोगिता, हिन्दी निबन्ध प्रतियोगिता, हिन्दी व्यवहार प्रतियोगिता, हिन्दी में तकनीकी लेखन प्रतियोगिता तथा हिन्दी कविता पाठ प्रतियोगिता । हिन्दी पखवाड़े के समापन समारोह दिनांक 19 सितम्बर 2011 को आयोजित किया गया जिसमें काव्य पाठ प्रतियोगिता का आयोजन किया गया था जिसमें संस्थान के अधिकारियों, कर्मचारियों एवं अनुसंधान अध्येयताओं ने बढ़ चढ़ कर भाग लिया

2.राजभाषा विभाग की हिन्दी में कार्य करने हेतु प्रोत्साहन योजना – संस्थान में राज भाषा विभाग की हिन्दी में कार्य करने वाले कर्मचारियों के लिए नकद पुरूस्कार योजना भी लागू की जा रही है। इस योजना के अन्तर्गत प्रतिवर्ष हिन्दी में किए गए कार्यों के लिए 10 कर्मचारियों को प्रथम, द्वितीय एवं तृतीय पुरूस्कार एवं 5 सांत्वना पुरूस्कार दिए गए हैं। वर्ष 2010–11 के दौरन हिन्दी में किये गये कार्यों के मूल्यांकन के आधार पर कर्मचारियों को नकद राशि के राज भाषा प्रोत्साहन पुरूस्कार प्रदान किये गये ।

3.हिन्दी कार्यशालाओं का आयोजन – संस्थान में दिनांक 15.03.2012 को कार्यशाला का आयोजन किया गया था जिस विषय **''शोध पत्रों में हिन्दी तकनीकी शब्दावली की आनेवाली कठिनाईयॉ एवं उनका समाधान ''** था इस कार्यशाला के माध्यम से मुख्य वक्ता ने अपने व्याख्यान में यह भी बताया कि अनुसंधान में आने वाले तकनीकी शब्दों को लिप्यांतर कर हूबहू हिन्दी में लिखा जा सकता है । कार्यशाला में उपस्थित वैज्ञानिकों / तकनीकी कार्यों से जुडे कर्मचारियों द्वारा हिन्दी के प्रयोग में आने वाली समस्याओं से जुडे, पूछे गये प्रश्नों का उत्तर मुख्य वक्ता न तर्क संगत जवाब दिये

4.8 Awards and Honours

Dr. S. A. Ansari awarded 'Senior Scientist Award' for the year 2011-12 by 'Foundation for Scientific Forestry India', Institute of Forest Productivity, Ranchi.

Shri. N. D. Khobragade, Scientist –B received best paper presentation award for the research paper entitled "Effect of organic fertilizer on production of tubers of *Asparagus racemosus* –An important medicinal plant" in National Seminar on Transfer of Biotechnology for Sustainable Development and Environment Protection on 21-22 January 2012, Sponsored by UGC (CRO) Bhopal Organized by Department of Zoology Govt. College, Aron, District Guna (Madhya Pradesh).

Eco -tourism award**, a** certificate and a cash reward of Rs.25,000/- in the field of individual innovative works in Tamia & Patalkot has been awarded to Dr. Suneesh Buxy,IFS Director, CFRHRD, Chhindwara by His Excellency Governor Shri Ram Prasad Yadav at Bhopal ,M.P.

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

Celebrated the following at TFRI campus-

Van Mahotsava, World Environment day, World Forestry day, Independence Day, Republic day, Annual sports, Sadbhawana Deevas etc at TFRI Jabalpur and CFRHRD, Chhinddwara.

TFRI celebrated World Biodiversity Day on 23 May 2011 at Jamtara village to create awareness about biodiversity among the local people. Van Mahotsava celebrated on 5th July 2011 in collaboration with ITB personnel and KV TFRI. TFRI also celebrated Sadbhawna Pakhwara and Hindi Pakhwara as directed by GOI.

Photo: Celebration of International Biodiversity Day

हिन्दी पखवाडा पुरस्कार वितरण

हिन्दी कार्यशाला का आयोजन

Oragnization of Gramsabha at Village Jamtara for technology dissimination

Radio talks

Dr Suneesh Buxy, delivered radio talk on cultivation and production of medicinal and aromatic plants at Akashwani Kendra, Chhindwara in the programme "Hello Chhindwara" on 1.3.2012 at 7.20 PM

Shri. N. D. Khobragade, Scientist –B delivered radio talk on Cultivation and production of Aonla (*Embilica officinales*) and Chironji (*Buchnania lanzan*) at Akashwani Kendra, Chhindwara in the programme "Hello Chhindwara" on 1.3.2012 at 7.20 PM

5 *ADMINISTRATION AND INFORMATION TECHNOLOGY*

5.1 Information Technology

The 100 MBPS fast Ethernet fiber optic backbone LAN is functional at TFRI and is working smoothly. The system is being successfully used for Internet access and other online activity. Many new computers with UPS were procured and installed during the year. Video Conferencing facility also been used through out the year. Under IFRIS project various modules including Personal Information System, Research Information System, Payroll Management System, Electronic Document Management System and Financial Accounting System have been implemented and are functional. Institutes website is time to time updated to extend various activities of the institute.

5.2 Sevottam

Activities related to the Citizen/Client Charter are mentioned as under-

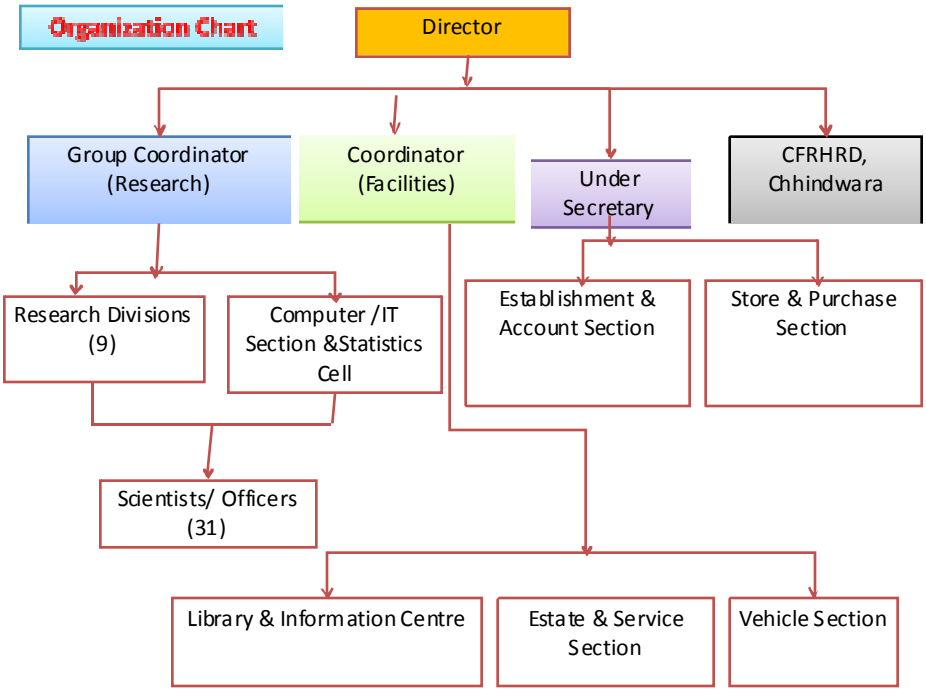
5.2.1 Action taken to formulate the Charter for the Institute and its subordinate formation.

Citizen's Charter is prepared by the Institute.

CITIZEN'S CHARTER

i. BACKGROUND

Tropical Forest Research Institute, Jabalpur is one of the eight regional institutes under the Indian Council of Forestry Research & Education, Dehradun. The Institute came into existence in April 1988, although its origin goes back to 1973 when a Regional Forest Research Centre, was established at Jabalpur under the Forest Research Institute, Dehradun, to provide research support to the problems of forest management in central India. The institute has not only steadily advanced in terms of infrastructure but also specialized itself as a major nucleus for research on forestry and ecology related problems of tropical forests of the central region comprising of the states of Madhya Pradesh, Chhattisgarh, Orrisa and Maharashtra. The hierarchical tree/ organization chart of the institute is as given below –



ii. VISION

To develop Tropical Forest Research Institute as a focal institution for providing strong research support to sustainable development of forests and forestry sectors in central India comprising of the states of Madhya Pradesh, Maharashtra, Chhattisgarh and Orrisa.

iii. MANDATE

a. To conduct research on:

- Eco-restoration of Vindhyan, Satpura and Maikal hills and Western Ghats
- Rehabilitation of mined areas
- Development and demonstration in agro-forestry models
- Forest protection
- Bio-fertilizers and bio-pesticides
- Non-wood forest products
- Planting stock improvement

We fulfill the objectives of our services through researches on the research/ technical problems indicated by the stakeholders in annual stakeholders' meet with the senior forest officers, academicians, NGOs, forest industries and progressive farmers of Madhya Pradesh, Chhattisgarh and Maharashtra falling under the related thrust areas and corresponding themes as given by ICFRE -

THRUST AREAS OF RESEARCH

- Managing forests and forest products for livelihood support and economic growth.
- Biodiversity conservation and ecological security.
- Forests and Climate Change.
- Forest genetic resource management and tree improvement
- Forestry education and policy research to meet emerging challenges.
- Forestry Extension for taking research to people.

THEMES

1. Climate Change
2. Ecology & Environment
3. Biodiversity
4. Forest Botany
5. Tribal's and Traditional Knowledge System
6. Silviculture
7. Social Forestry, Agro-Forestry/Farm Forestry
8. Forest Soils and Land Reclamation
9. Watershed Management
10. Conservation of Forest Genetic Resources
11. Tree Improvement
12. Vegetative Propagation
13. Biotechnology
14. Sustainable Forest Management (SFM)
15. Forest Economics
16. Forest Biometrics
17. Participatory Forest Management
18. Policy and Legal Issues
19. Information and Communication Technology (ICT)
20. Wood and other Lignocelluloses Composites
21. Wood Processing
22. Value Addition and Utilization
23. Wood Chemistry
24. Pulp and Paper
25. Resource Development of NWFPs
26. Sustainable Harvesting and Management
27. Chemistry of NWFPs, Value Addition and Utilization
28. Biofuels and Bioenergy
29. Insects pests, diseases and control
30. Mycorrhizae, rhizobia and other useful microbes

31. Weeds and Invasive species
32. Forest Fire and Grazing

The projects falling under the above thrust areas and themes are submitted for funding by intra-mural or National/ International Funding Agencies.

b. Extension

The forestry extension is the main focal activity of the institute, bridging the gap between researchers and the end users for lab to land transfer of technology, time to time. The institute has a fully functional forest extension division, which full-fills this objective through short-term training programmes, conferences, workshops, Kisan melas, demonstrations, etc, for the senior state forest officers, frontline staff of the SFDs, trainees from State Forest Services, ICFRE technical staff, forestry based industries, NGOs, villagers, farmers awareness programmes for students.

c. Education

The institute has well equipped research laboratory, which attracts students from universities for carrying out their dissertations/ thesis as a partial fulfillment for obtaining degrees of M.Sc. / M.Phil/ Ph.D.

iv. GRIEVANCE REDRESSAL MECHANISM

A Grievances Cell has been constituted to attend the grievances related to the mandate of the institute. An officer of the rank of Scientist - C has been nominated as Public Grievance Officer of this Institute, the contact details of the officer as below:

Name	Designation	Tel. Office	E-Mail
Dr. Girish Chandra	Scientist - C	4044006 (o) 2744171(o)	gchandra23@yahoo.com

- ❖ Public Grievance Officer will be available to receive and hear grievances of the public.
- ❖ Visitors to our office will be treated with courtesy and heard patiently to facilitate solving their problems.

⇒ For addressing the issues related to the working women in the Institute a Women Sexual Harassment Complaint Redresal Committee under the presidency ship of officer of the rank of scientist E has been constituted, the contact details of the officer as below:

Name	Designation	Tel. Office	E-mail
Dr. Neelu Singh	Scientist "E" President, TFRI	2840483 (O) 2840751 (o)	singhn@icfre.org
Dr. S.A. Ansari	Scientist "F" Member, TFRI	4044009 (o) 09425410792 (Mo)	ansarisa@icfre.org
Dr. Nanita Berry	Scientist "D" Member, TFRI	2840799 (o) 09425156667 (Mo)	berryn@icfre.org
Dr. Geeta Sharad Tiwari	Secretary, All India Women Sammelen	Mb. 9301213344	–
Dr. Sushma Dubey	Head, Hindi Division, Rani Durgawati University, Jabalpur	Ph. 0761-2600120	–

⇒ For addressing and verifying the compliance and issues related to the roaster of scheduled caste/ scheduled tribe/ OBCs and related reservation matters an officer has been appointed as liaison officer, whose contact details are as below:-

Name	Designation	Tel. Office	E-mail
Dr. P. B. Meshram	Scientist, "F"	0761 - 2744150 (o) 09425871072 (Mo)	pbmeshram@rediffmail.com

⇒ For addressing and verifying the reservation policies of the government of India, and to address the insecurity feeling in employees of Scheduled Caste/ Scheduled Tribe/ OBCs and related reservation matters, Grievance Redressal Cell has been constituted under the Chief Liaison Officer. The details of the cell is as given below –

S.No	Name of the Officer	Status/ Responsibility	Contact	E-mail
1.	Dr. P. B. Meshram, Scientist – E, Liaison Officer (G.R. Cell), Nodal Officer (Roster), Forest Entomology Division, TFRI, Jabalpur	Chief Liaison Officer	0761 - 2840627 (O) 09425871072 (Mo)	pbmeshram@rediffmail.com
2	Shri Dhirendra Kumar, Controller	Member	4044010, 2744107 (O)	tewarid@icfre.org
3.	Dr. (Ms.) Vishakha Kumbhare, Scientist – B, CFRHRD, Chindwara (M.P.)	Liaison Officer for Scheduled Tribes	0716-2254463	-

5.	Shri Rakesh Kumar Vishwakarma, UDC, Account Section, TFRI, Jabalpur	Liaison Officer for other backward classes	0761-2744107 (O)	-
6.	Shri Alfred Francis, RA – II, Biodiversity and Sustainable Management Division, TFRI, Jabalpur	Liaison Officer for Scheduled Tribe	0761-2744107 (O)	-

⇒ In case of non-fulfillment of the commitments by the above committees, cells, users should approach the following officer:

Name	Designation	Tel. Office	E-Mail
Dr. U. Prakasham	Director, TFRI, Jabalpur	+91-761- 2840483, 4044002 (O)	dir_tfri@icfre.org

v. Stakeholders/clients

The agencies and individuals in Madhya Pradesh, Maharashtra and Chhattisgarh involved in forestry related operations including production trading and utilization of forest resources are the stakeholders /clients of the Institute.

- State Forest Departments
- Forest Development Corporations
- Non Government Organizations
- Forest-based Industries
- Universities and Research Organizations
- Farmers
- Villagers
- Forest Dwellers
- Tribals

FUNCTIONS

The institute implements its mandate of research programme through highly qualified scientists, forest officers and trained technical personnel placed in eight research divisions viz., Agro-forestry, Biodiversity and Sustainable Management, Forest Ecology and Rehabilitation, Forest Entomology, Forest Pathology, Genetics and Plant Propagation, Non-Wood Forest Produce, Silviculture and Joint Forest Management and an Extension division, each headed by a senior scientist/forester. It caters to the overall research needs of forests of three central Indian

states, viz. Chhattisgarh, Madhya Pradesh and Maharashtra, in particular, and specific issues of forests and forestry sector confronting India, in general. The central region extending from Bay of Bengal in the east to Arabian Sea in the west is well endured with natural tropical forests which are rich in floristic wealth.

The extension division acts as an interface between the institute and the outside, including ICFRE institutes, government organization, farmers, industries and NGOs for dissemination of information and technologies developed at the institute. It organizes seminars, training courses and exhibitions at different places, besides publishing technical bulletins, brochures, pamphlets, posters, etc.

RESEARCH DIVISIONS

Agro-forestry Division

The division conducts research on development of suitable agro-forestry modals for different agro-climatic zones for optimization of land use and reduction dependence of rural communities on natural forest of the region**.**

Bio-diversity and Sustainable Management Division

The division is responsible for documentation and assessment of floral diversity of forests; enlist rare and endangered species for their conservation and sustainable use. Ethno-botanical surveys are also carried out to document patterns of utilization of rich biological diversity in the Indian region by various ethnic communities, including the primitive tribes.

Forest Ecology and Rehabilitation Division

The division deals with technologies for restoration of wastelands, degraded forests and mined over burdens and screens suitable species exhibiting great tolerance to air pollutants in and around limekins, coalmines, thermal power projects.

Forest Entomology Division

The division is devoted to survey and identification of forest insect pests and their chemo-biological measures. It is also engaged with the screening of insect pest resistant genotypes of forest tree species, especially in central Indian conditions.

Forest Pathology Division

The division aims at identification and chemo-biological control measures of nursery and plantation diseases caused by phyto-pathogens. It also conducts studies for production and use of bio-fertilizers such as vesicular arbuscular mycorrhizae (VAM), phosphate solubilizing bacteria,

dinitrogen fixing bacteria, etc. for boosting growth of nursery seedlings and their initial field establishment.

Genetics and Plant Propagation Division

The division deals with selection and breeding of improved genotypes and their cloning for augmenting productivity and quality as well as for enhancement of forest covers. The investigation relates to quantitative genetics, clonal propagation, and molecular cataloguing of forest trees and other species, as well as selection of biochemical marker of productivity in trees.

Non Wood Forest Produce Division:

The division surveys and identifies herb and trees as source of food, medicines, natural dyes, edible and industrial oils etc. from various forest trees and other vegetation of the region. The cultivation techniques for these valuable plants are also standardized for their adaption as agriculture/horticulture crops for generation of additional income. besides , efforts are made for ex-situ conservation of rare and endangered medicinal plants as well as for development of efficient extraction procedure for natural dyes and oils.

Silviculture and JFM Division:

The division conducts research on silvicultural aspects of management of natural forests and plantation including standardization of nursery packages for production of quality seedlings , in addition to operation of a pilot unit for commercial production of composed from grass and leaf litter of various forestry species. Research is also conducted to participatory role of tribal/rural folks for sustainable management of local forests for poverty alleviation and environmental rejuvenation.

Extension Division:

The division act as interface between the institute and the outsides, including ICFRE institutes, government organizations, farmers, industries and NGOs for dissemination of information and technologies developed at the institute. It organized seminars, training courses and exhibitions at different places, besides pushing technical bulletins, brochures pamphlets, posters etc.

For more information visit: http://tfri.icfre.gov.in

Details of the Officers

Division	NAME	Designation	Subject Area	E-MAIL Address	Phone/Mobile (STD Code 0761)
Administration	**Dr. U Prakasham**	Director	-	dir_tfri@icfre.org	2840483, 4044002 (O) 4044011 (R) Fax: 2840484, 4044002
	Dr. S. A. Ansari	Group Coordinator (Research)	-	groupco_tfri@icfre.org	4044003, 2840799, 2744115 (O)
	Shri Dhirendra Kumar	Under Secretary	Establishment works	tewarid@icfre.org dhirendra_afri@rediffmail.com	4044010, 2744107 (O)
	Shri A. K. Chattopadhyay	Dy CF and Demand & Disbursing Officer	Accounts works	chattopadhyayak@icfre.org	
Agro-forestry Division	**Dr. A. K. Pandey**	Scientist "F" and Head	Medicinal & aromatic plants. Chemistry of natural products	akpandey@icfre.org akpandey10@rediffmail.com	2840751 (o) 09424685773 (Mo)
Bio-diversity and Sustainable Management Division	**Dr. P.B. Meshram**	Scientist, "E" & Head	Biodiversity conservation and Ethno-botany		4044008 (o)
Computer & I. T. Section	**Dr. Girish Chandra**	Scientist "C" and In-charge	-	-	4044006 (o) 2744171(o)
Ecology and Rehabilitation Division	**Dr. Avinash Jain**	Scientist, "E" & Head	Climate change, Carbon sequestration, Rehabilitation of degraded lands and	jaina@icfre.org, jainavi@yahoo.com	4044005 (o) 09826563036 (Mo)

			Impact assessment studies		
Forest Entomology Division	**Dr. N. Roychoudhury**	Scientist, "F" & Head	Dynamics of insect-tree interaction with special emphasis on tree resistance and bio-pesticides	roychoudhary@icfre.org, choudhury_nr@yahoo.com	2840634 (o)
Forest Pathology Division	**Dr. R. K. Verma**	Scientist, "E" and Head	Mycology, Forest Pathology and Bio-fertilizers	vermaramk@icfre.org, rkverma28@rediffmail.com	2840746 (o)
Genetics and Plant Propagation Division	**Dr. S. A. Ansari**	Scientist, "F" & Head	Tree Physiology & Clonal Propagation	ansarisa@icfre.org, shamimansari_1@yahoo.co.uk	4044009 (o) 09425410792 (Mo)
Non Wood Forest Produce Division	**Dr. A. K. Pandey**	Scientist "F" and Head	Medicinal & aromatic plants. Chemistry of natural products	akpandey@icfre.org akpandey10@rediffmail.com	2840751 (o) 09424685773 (Mo)
Silviculture Division	**Dr. M. Kundu**	Scientist "E" & Head	Soil-vegetation correlation, Nursery and plantation management, Bio-reclamation of mine over burden and degraded lands.	-	4044007 (o)
Extension Division	**Dr. N. Kulkarni**	Scientist, "F"	Forest insect ecology,	kulkarni_n27@hotmail.com	2840634 (o) 09425325430 (Mo)

			biology and control under IPM program		
Library and Information Centre	**Shri S. K. Das**	Dy.C.F and Co-ordinator(Facilities)	-	-	2744139 (o)
Hindi Section	**Shri Dhirendra Kumar**	Hindi Officer	हिन्दीसाहित्य	tewarid@icfre.org dhirendra_afri@rediffmail.com	4044010, 2744107 (O)
Estate/Service Section	**Dr. P.K. Khatri**	Scientist, "D"	Estate works /Maintenance of scientific equipments and Forest operational works	-	4044004 (o)
Store/Purchase Section	**Shri S. K. Das**	Dy.C.F and Co-ordinator(Facilities)	-	-	2744137(o)
Vehicle Section	**Dr. Pramod Tiwari**	Research Officer	Maintenance of vehicles	pramodk@icfre.org, pramod_kt@rediffmail.com	2840627 (o) 09425410791 (Mo)

FUTURE PLAN

- Field demonstration of technologies developed by the Institute.
- Establishment of more VVK's for demonstration and transfer of technologies and research to stakeholders.
- Production and demonstration of Vermicompost and Bio-fertilizers.
- Medicinal plants-value addition techniques for upliftment of rural economy.
- Biological control of Insect pests and diseases.
- Raising of tissue culture plants particularly bamboos.
- Eco-restoration of mined over areas.
- Phyto-diversity assessment of forests particularly in protected areas.
- Standardization of nursery and plantation techniques.
- Refresher courses for Rangers, Dy. Rangers and Foresters.

Provision for Annual Review of the Charter

- The Services provided by the Institute as per the charter will be reviewed annually.

- The timely redressal of public grievances is being monitored by the Public Grievance Officer.
- Grievances received in the institute and their follow-up will be reviewed. Steps will be undertaken to take remedial measures for quick disposal of complaints, specifically on those, which are of repetitive nature.

CENTRE FOR FORESTRY RESEARCH AND HUMAN RESOURCE DEVELOPMENT CHHINDWARA

Any ambitious programme of afforestation and sustainable forest resource management needs a cadre of motivated well trained personnel who should be able to take new challenges in forestry sector. This would necessitate sufficient infrastructure training facilities and resource personnel. Such an endeavour would entail the development of modern facilities. Up to date technology in plantation management imparts forest resource utilization skills and cost effective management practices to users of different level. The availability of trained personnel in forestry is very low in the country at present. The apathy amongst people towards sector is primarily due to low awareness about the problems of forest resource management. An independent centre for human resource development attending to specialized practical training in forestry sector with special emphasis on excellence in nursery and plantation technology was therefore an urgent necessity.

Situated in Madhya Pradesh, heart land of India, Centre for Forestry Research and Human Resource Development established at Chhindwara is one of the centre of Indian Council of Forestry Research and Education, Dehradun. It has unique distinction of being the first centre of its kind in Asia for the development of human resource in forestry sector leading towards the poverty alleviation. Central plateau of India is dominated by tribal population who are mainly dependent on forestry resource. Shortage of water, energy, employment and climatic change due to deforestation is resulting into environmental degradation and causing great concern in this area. To cater the specific needs of central India in relation to development of specialized human resource through training in different advanced forestry technology, the centre has been located in the most representative district of Chhindwara. Honourable Minister of Environment and Forest, Government of India has laid the foundation stone of the institute on 30th March 1995.

The centre is located on Chhindwara-Panchmari state highway, 8 kms from Chhindwara town at Poama village. Chhindwara is well connected by road, Nagpur (125 km), Jabalpur (215 km) and Bhopal (280km). In additional it has rail linkage also. A functional air strip along with helipad is also located at Chhindwara.

MANDATE

- Eco-restoration of Vindhyan, Satpura and Maikal hills and Western Ghats
- Poverty alleviation through human resource development

- Research and demonstration in agroforestry models
- Research in non-wood forest products
- Identification of seed production areas and plus trees, establishment of seed orchards; and production of quality planting material of selected species for improving forest productivity
- Provenance trials of teak, bamboo, neem, sissoo, safed siris etc.
- Research on biofertilizers and biopesticides

Jurisdiction: Forests & forestry sectors in central India comprising of the states of Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa.

Details of the Officers

NAME	Designation	Subject Area	Phone Number	E-MAIL Address
Shri Har Prasad	Head	Forestry	+91-7162-254463 +91-7162-282444	dir_cfrhrd@rediffmail.com head_cfrhrd@icfre.org prasadh@icfre.org
Dr. Vishakha Kumbhare	Scientist 'C'	Bio-chemistry	09826884168	kumbharev@icfre.org vishakha15@rediffmail.com
Shri Jitendra Chouhan	Research Officer	Botany	+91-7162-282444	chouhanjs@icfre.org

5.2.2 Action taken to implement the Charter

Action is being taken for implementing the Charter.

5.2.3 Details of Training Programmes, Workshops, etc. held for proper implementation of Charter

Workshops

Workshop	During	Venue	Remarks
21st Research Advisory Group meeting	October 12-13, 2011	TFRI	
Achanakmar-Amarkantak Biosphere Reserve	Mar 03, 2012	Bilaspur	
Economic Valuation of plantation raised by NTPC, Dadri	January 12, 2012	NTPC Dadri	NTPC officials, farmers, tree growers and surrounding

			villagers were present
Energy-Mass exchange in vegetative systems	Jun 09-10, 2011	TFRI	scientists of ISRO, MPCST, CAZRI, FRI, and TFRI and officers from SFDs and national parks of M.P were included
Environment and Afforestation	February 27-29, 2012.	Pench National Park	for the officers of NTPC
Mass Production of Improved Planting Stock	Dec 08, 2011	Hotel Heritage, Nagpur	
Pre-Indian Forest Congress Workshop on "Forests in Society"	July 05, 2011	TFRI	Later facilitated the presentations and discussions under the theme "Forests in Society" assigned to TFRI, Jabalpur in Indian Forest Congress-2011 at New Delhi during Nov.2011.
Sal heart borer and its management	Nov 30, 2011	Raipur	
Sal heart borer and its management	Feb 24, 2012	Jagadalpur	

Trainings

Training	**During**	**Venue**
Agro-forestry with reference to medicinal plants	Jul 14, 2011	CFRHRD
Bio-fertilizers and bio-pesticides	Nov 23, 2011	CFRHRD
Bird watching campaign	Oct 02-04, 2011	CFRHRD
Cultivation of medicinal and aromatic plants	Oct 10, 2011	CFRHRD
Cultivation of medicinal plants	Apr 26, 2011	CFRHRD
Development of value added food products and processing of	Mar 02-03,2012	CFRHR

mahua flowers		D
Development of value added food products and processing of mahua flowers	Mar 22-23,2012	CFRHRD
forestry related issues in Hindi	Oct 31-Nov 04, 2011	TFRI
Identification of medicinal plants and their uses	Feb 24, 2012	CFRHRD
Nursery techniques and environmental issues	Feb 07, 2012	CFRHRD
NWFP value addition, processing and marketing with special reference to chironji	Mar 21, 2012	CFRHRD
Office procedures and general laws	Dec 27, 2011	CFRHRD
Promising Agroforestry Systems for Sustainable Livelihood	Sep 28, 2011	TFRI
Soil conservation and watershed management	Jun 08, 2011	CFRHRD
Support Scientific staff of ICFRE on Lab Management	One week	TFRI
training programme for 2 batches of B.Sc. Biotechnology students of Government Model Science College, Jabalpur	Jan 17-31, 2012	TFRI
training programme for 2 batches of B.Sc. Biotechnology students of Government Model Science College, Jabalpur	Feb 01-17, 2012	TFRI
training programme for B.Sc. Biotechnology students of Government Model Science College, Jabalpur	26-30 March 2012	TFRI
training programme for M.Sc. Forestry students of Guru Ghasidas University, Bilaspur	Mar 12-31, 2012	TFRI
training programme under SLEM project on Soil and water conservation	Oct 18-20, 2011	CFRHRD

5.2.4 Details of publicity efforts made and awareness campaigns organized on Charter for the Citizen/Clients

Publicity and awareness campaigns on charter for the citizen/clients were made by holding slogans on notice boards and other areas to motivate citizens. General lectures on the awareness were also organized at the institute.

5.2.5 Details if internal and external evaluation of implementation of Charter in the Organization and assessment of the level of satisfaction among Citizen/Clients

Evaluation of implementation of Charter is to be initiated.

5.3 Welfare measures for the SC/ST/Backward/minority communities - **Nil**

6. ANNEXURES

1. RTI

Names and Addresses of Public Information Officers and Appellate Authorities under the Right to Information Act 2005 in the Institute

Headquarter / Institute	Appellate Authority	Public Information Officer	Subject matter(s) allocated
Tropical Forest Research Institute, Jabalpur	Dr. U. Prakasham, Director, TFRI, Jabalpur	Dr. Rupnarayan Sett, Scientist 'D'	As per provision and guidlines provided under RTI Act, 2005.

2. Email and Postal addresses

TROPICAL FOREST RESEARCH INSTITUTE
(*Indian Council of Forestry Research & Education*)
(An Autonomous Council under the Ministry of Environment & Forests, Govt. of India)
P.O. – R.F.R.C, Mandla Road, Jabalpur – 482021 (M.P), India
Phones: 0761 – 4044002, 2840483(O)
Fax: 0761 – 4044002, 2840484
e-mail – dir_tfri@icfre.org

3. Intellectual Property

3.1 Patents Granted – Nil