Annual Report 2014-15

TROPICAL FOREST RESEARCH INSTITUTE
(Indian Council of Forestry Research and Education)
P.O. RFRC, Mandla Road
Jabalpur – 482021 (M.P.)

EXECUTIVE SUMMARY

Executive Summary of the Report

Successfully established Silvi-agri-medicinal system in both the study sites i.e. OSR at TFRI, Jabalpur (M.P.) and OFR at farmer's field at Katoli- Bahmni village of Chandrapur district, Vidharbh region of Maharashtra, consisting of *Gmelina arborea* (silvi component*), Ravoulfia serpentina* and *Withania somenifera (*medicinal components*)* and *Cajanus cajan* (agri crop) and in Agri-medicinal system *, Acorus calamus* intercropped with *Oryza sativa*. The basic aim of the study was to create awareness and educate the farmers of Vidharbh region of Maharashtra about the various economically viable agroforestry models.

Revived lac cultivation in the selected sites i.e. Sohad, Devri, Chokhda and Narai villages of Jabalpur district and Tikariya and Ranipur villages of Mandla district of M.P. There lac crop of two seasons was inoculated on the host trees i.e. during July, 2014 (ketki) and October 2014(Baisakhi) in these sites. Yield data of rangini lac was assessed and data revealed that new lac crop had spread on the host trees i.e. *Butea monosperma* , existing in the farmers field.

Standardized *Flemingia* (a non-conventional lac host) based silvi-agri-lac system as an alternate income generation activity with low inputs, where traditional lac host tree species i.e. *Butea monosperma* and *Zizyphus mauritiana* was not existing in farmer's field. Experiments were conducted to evaluate the tree-crop interactions. Recorded yield data of both the agriculture crop and lac crop. Results indicate that there was no negative effect of companion crops, and a positive impact on soil productivity along with agricultural crop productivity under the system.

Under MPCST funded Project 207./TFRI /JBP/HOO. Study was conducted to document folk- medicines prevalent in tribal pockets of Chhatarpur, Panna , Satna , Jabalpur and Seoni in Madhya Pradesh from 67 Vaidrajs using various plant parts and their formulations**.**

In the project information was documented on species of herbs , shrubs, climbers and trees distributed in clusters and overexploited due to their uses in pharmacy , herbal uses, value in export and periodically collected from forest areas.

The market survey was conducted to study the fluctuations in prices over a period of time.

The studies on population dynamics of endangered species helps in devising effective conservation strategies. Matrices has emerged as an important tool to study stage structured populations, simulation and elasticity analysis for population and projection matrices help us predict the fate of populations. Studies on the population dynamics of *Uraria picta* and *Andrographis paniculata* growing in the Buffer zone of Tadoba –Andheri Tiger Reserve is in progress.

Survey was conducted in TATR buffer zone. A total of 714 species were recorded of which 98 species were documented to be used by the traditional healers for preparation of various herbal formulations during the study. It was found in the survey with the traditional healers, VFC members of the villages in buffer zone of TATR, that *Uraria picta* and *Andrographis paniculata* were once found in abundance in the study area however there is a gradual decline in population of these species. Thus these species were selected for the current study. Density and distribution of the species was determined in the buffer region of the TATR, populations of both the species were identified, and permanent quadrats were established to study the population dynamics. The study is in progress.

The correct method for optimal harvest without impairing the vigor of the bamboo clump is one discipline in which our knowledge is far from complete. Methods for working ordinarily consist removal of either all the old culms, that is, culms more than one year old or a certain number or proportion of them at definite intervals of time. Factors that could well be taken into consideration for the improvement of the harvesting technique are age, desired quality, end use etc. Thus by and large, a satisfactory and systematic harvesting technique of wild bamboo is yet to be fully validated and hence there is need for a rapid assessment of the effect of prevailing systems of harvesting and their impact on regeneration/health of the clumps in Madhya Pradesh. Study was under taken for rapid assessment of the status of regeneration of the Bamboo clumps in Madhya Pradesh.

The number of Karla produced was found to be highly ($p<0.01$) correlated to the clump girth. A significantly high correlation was also observed between the number of Karla produced to number of Mahila and number of Pakia.

There was no significant difference in the number of new shoots produced in the managed and unmanaged bamboo plantation, but the survival of the new culms was more in managed plantations when compared to unmanaged plantations. The quality of culms produced in managed plantations was better than those produced in unmanaged plantations in terms of girth, height and straightness.

Pruning of tendu seedlings of medium girth (2 – 4 cm) at ground level every year maximized the leaf surface area thereby enhancing the quality of leaves.

Application of 100 kg/ha nitrogen and 25 kg/ha phosphorus to the nitrogen and phosphorus deficient rhizosphere soils of Chhattisgarh after rainy season (having high moisture content) increased Specific Leaf Area of tendu leaves.

Use of 500 g neem granules per 5m x 5m size plot in nitrogen deficient soil and 500 g neem granules and 1000 g VAM per plot in nitrogen and phosphorus deficient soil enhanced SLA and increased the quality of tendu leaves.

Foliar spray of a combination of 2% nitrogen and 1% phosphorus to tendu plants found in nitrogen and phosphorus deficient soils of Chhattisgarh during 2nd or 3rd week of April, when tendu leaves attain maximum size, enhanced the quality of tendu leaves.

Density and vegetation diversity of Satpuda Tiger Reserve was found maximum, followed by Pench and Panna Tiger Reserves (M.P.).

Carbon stock per ha was found maximum in Pench, followed by Satpuda and Panna, while annual sequestration was found maximum in Satpuda followed by Pench and Panna Tiger Reserves.

The soil of Rourkela Steel plant (Odisha) was found to contain 32.19 t Carbon/ha with 1.2 soil density and 0.88% organic carbon.

A new 3 year project sanctioned from MPSFD has been initiated in Forest Ecology & Rehabilitation Division entitled "Establishing Arachnarium at TFRI, Jabalpur, M.P."

A new project titled 'Livelihood enhancement of forest dependent communities through eco-restoration of degraded forests' submitted to DST is recommended in the Expert Committee Meeting and final approval letter is pending.

Genetics and Plant Propagation Division of the institute is engaged in genetic improvement of forestry species, encompassing conservation of genetic resources of various tree species like, *Boswellia serrata, Tectona grandis, Pterocarpus marsupium, Dalbergia latifolia, Litsea glutinosa* and various NTFP species like *Rauvolfia serpentina, Diospyros melanoxylon* and *Madhuca indica* through collection of diverse germplasm across the Central Indian part and their propagation and screening of improved genotypes through biotechnological interventions, including molecular marker assisted evaluation of germplasm for future performance of these species.

In *Boswellia serrata* DNA purity index and wood fibre length were analysed for 12 populations collected from M.P. Field trial of *Rauvolfia serpentina* was raised comprising five accessions of *in vitro* and *ex vitro* raised plantlets in the campus of TFRI. Selected phenotypically superior trees of *Pterocarpus marsupium* from seven diverse areas of Chhattisgarh. Field data were collected for GBH, clear bole and bark dry weight. Pods were collected from these localities for raising seedlings. The growth data of seedlings were also recorded. The project on genetic improvement of bamboo has been initiated as coordinated project. TFRI has been assigned for selection and improvement of four bamboo species viz, *Bambusa vulgaris, B.bambos, B. tulda* and *D. strictus.* The germplasm of these four bamboo species has been collected from assembled the 169 rhizomes of these species.

For collection of critically endangered *L. glutinosa* germplasm, survey was conducted in the Chhindwara (West), Balaghat (South) Forest division and adjoining villages of TFRI. Total 60 trees have been located in the surveyed area and detailed morpho-metric data has been recorded on all trees along with GPS location. Survey and selection of Mahua trees was carried out at Balod, Bilaspur, Jashpur, Kanker and Jagdalpur under the project funded by ICFRE, Dehra Dun. Mahua trees were selected from five girth classes, viz., 61-90 cm, 91-120 cm, 121-150 cm, 151-180 cm and over 181cm. Around 1-2 kg flowers and seeds per tree were collected. Under AICP on *D. latifolia,* twelve trees were selected at different locations in Kalpi, three trees at Seoni and 7 trees at Udaypur. The morphological data on total height, clear bole height, GBH,

crown diameter, number of primary branches, status of flowering and fruiting was noted. GPS data was also noted down. Half-sib seeds were collected from the trees.

The centre has a rich collection of medicinal and aromatic plants consisting of 70 species approximately which are being maintained.

Thirteen training programmes were conducted during the year on various topics related to forestry. Target groups were farmers from gram Khapakala, Bhajipani, Chhindwara District, Baargi, Harrai Development block, Chhindwara, Gangiwada, Moadei and Manegaon villages, State forest department officials (SFDs) from Bichhua, Kanhan, Lavaghoghri, Sillewani, Pandhurna and Ambada Range, South Division, Chhindwara and Tamia, Sangakheda, Delakhari and Jhirpa Range, West Division, Chhindwara / students from Kendriya Vidyalaya No.-2, Chhindwara, Govt. Girls Higher Secondary School, Chhindwara and college students from Jawaharlal Nehru Krishi Vishwavidyalaya (JNKVV), Jabalpur and women.

Total 1823 samples received from Forest Survey of India (FSI), Nagpur were analyzed for organic carbon content which includes soil samples (1332) and forest floor samples (491) and a revenue of Rs. 91,150/- was generated for ICFRE, Dehradun.

One externally funded [Madhya Pradesh State Biodiversity Board (MPSBB), Bhopal] project was ongoing entitled "Comparative field performance of seedling and clonal planting stock of *Buchnania lanzan* Spreng." *Buchanania lanzan* (Chironji) seeds were collected from thirteen selected candidate plus trees (CPTs). Nursery techniques of *Buchanania lanzan* seeds were standardized. Maximum germination of 75% and minimum 50% was recorded for candidate plus trees (CPTs) No. 12 and 7 respectively. *B. lanzan* seeds kept in polyhouse under shade was found suitable for germination. Oil percentage in CPT no. 8 (56.2%) and CPT no. 5 (55.75%) were found to contain maximum oil content among all the thirteen CPTs analyzed.

The plantations and nurseries of the centre were protected against insects and diseases.

Production of vermi-compost was done and revenue was generated.

All the existing plantations viz. *Phyllanthus emblica* (Aonla), *Buchanania lanzan* (Chironji), *Tectona grandis* (Teak) and *Gmelina arborea* (Khamer) of the centre are being maintained.

The information about the existing SPAs, CSOs & SSOs has been collected from State Forest Departments of MP, CG & MH, and have been compiled.

Regarding the renovation of existing nursery facilities for teak, a proposal has already been submitted.

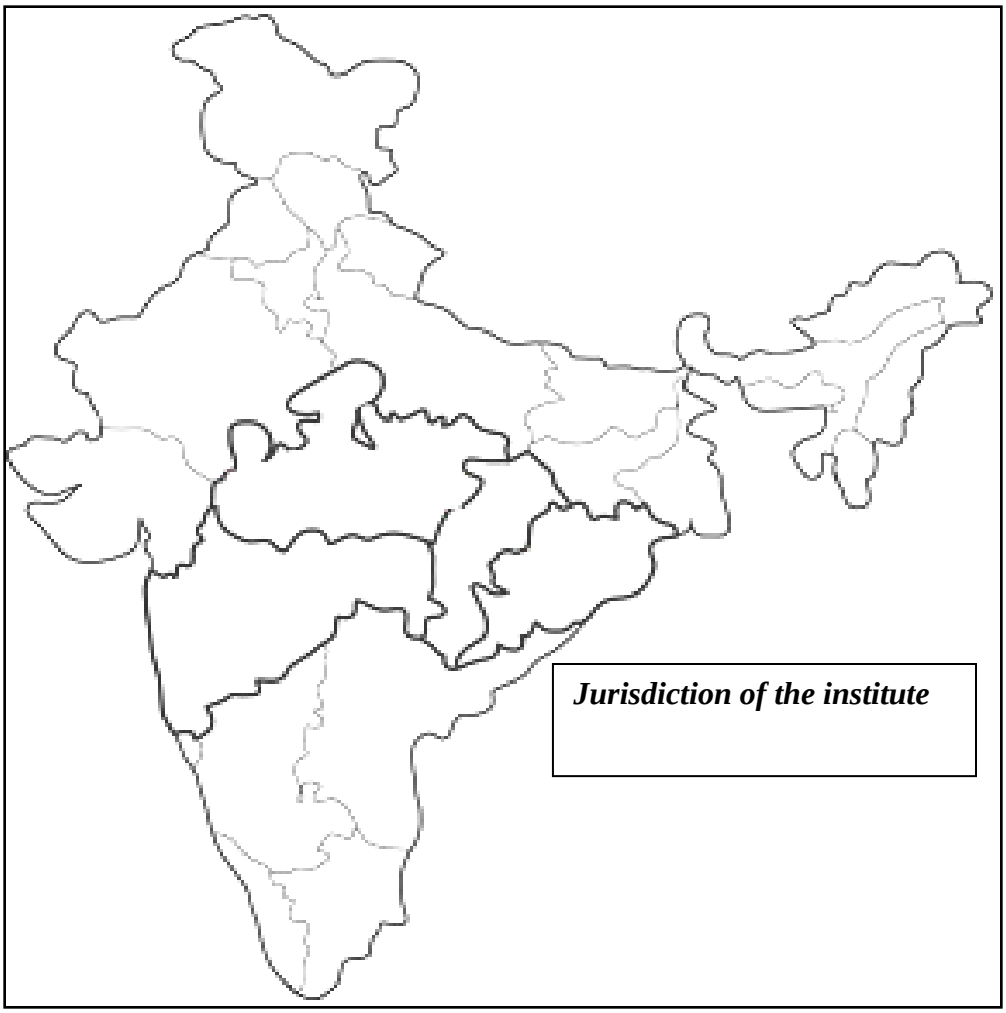
A SPA has been identified at Kaladehi, Range Bargi, Division Jabalpur, for pursuance of trial on fertilizer management and the proposal has been submitted and is under process.

Summary of the Projects

Project type	**Completed projects**	**Ongoing projects**	**New projects initiated during the year**
Plan	7	11	Nil
Externally Aided	5	11	5

1. INTRODUCTION

Tropical Forest Research Institute (TFRI) Jabalpur, situated on the bank of Gour River on Mandla Road, is a premier R&D set up under Indian Council of Forestry Research & Education (ICFRE). The institute is headed by Director and has staff strength of about 200 including 33 Scientists and 7 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 maintains 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 need of forestry research of four states of central India, viz., Madhya Pradesh, Chhattisgarh, Odisha and Maharashtra. Thrust areas of research of 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. Managing Forest and Forest Products for Livelihood Support and Economic Growth

(i) Development of Lac based Agroforestry (Silvi- Agri-Lac) system

Standardized *Flemingia* based silvi-agri-lac system by intercropping of *C.cajan* with *Flemingia semialata* and *F.macrophylla.* *Flemingia semialata* could be an important alternate lac host for income generation of women and youth in this region. *F.semialata* is a bushy lac host which produces kusumi strain of lac which fetches high market rate @ Rs.400 - 600/ kg depending upon the market rate. Experiments were conducted to assess the effect of this host on the grain production of pulse and growth of crop vice-versa during subsequent years i.e. 2013 and 2014. Maximum yield of grain was recorded in treatment T3 (*F.semialata* + agri crop + lac) followed by T5 (*F.macrophylla* + agri crop + lac) and T8 (control) as compared to intercrops. No negative effects were recorded on the grain yield and nutrient level under the system during study period.

Plate1: *Fleminigia* based silvi-agri-lac system at TFRI, Jabalpur (M. P.)

Plate: Lac crop on *Flemingia semialata* at TFRI, Jabalpur (M.P.)

(ii) Development of Silvi-agri-medicinal and agri-medicinal system in Vidharbh region of Maharashtra.

Established Silvi-agri-medicinal and agri – medicinal system in two study sites i.e. farmer's field, at Katoli-Bahmni village of Chandrpur as an OFR and experimental area of agroforestry division as an OSR under the project. The aim of the project was to create awareness and extend the technical knowhow about the tree species, medicinal plants and agroforestry systems among the farmers of Vidharbh region of Maharashtra. Under the Silvi-agri-medicinal system, after 2 years recorded growth data of all the components and data indicates that maximum height of plants (360 cm) was found in T1 i.e. in intercropping as compared to T4 (245cm) i.e. sole crop in *G.arborea*.

Similarly in case of *R.serpentina,* recorded data on its above ground parameters like maximum fruits 30.15g/plant and minimum 20.25g/plant under shade condition and maximum root weight 25g/plant as compared to control 18.34g/plant which attains maximum height 84 cm and minimum 64cm at 18 months old crop. While *W.somenifera* attained maximum height of 35cm and minimum height of 26 cm with root biomass of 9.14g and minimum 5.00g/plant in sole crop in both the fields. As far as the agriculture crop component *C.cajan* performed best with the yield of 80g/plant in intercrop as compared to yield of 65 g/plant in sole crop. No negative effect on yield of a crop was noticed.

In agri-medicinal system, rhizomes of *A.calamus* crop performing well, data revealed the maximum height of 47cm and minimum 38cm with root weight of 28.82g/plant and minimum of 22.02g/plant and maximum root length 34cm and minimum of 25cm in 45 x 45cm spacing as compared to 30x30cm spacing. Paddy crop was harvested and paddy yield was recorded. Maximum yield of 100g/plant in T1 to minimum 75g/plant in T2 as compared to control 85-90g/plant was obtained. Growth data of *A.calamus* was recorded periodically. Similar trends were also observed in the OFR field, sole crop of *Gmelina* plants attained maximum height of 290cm and minimum of 148cm as compared to control which attained maximum height of 282cm and minimum of 140 cm, during December,2014.

Plate: Silvi-agri-medicinal system at TFRI, Jabalpur

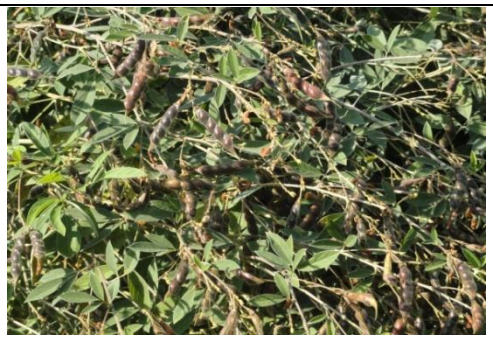


Plate: Matured pods of *Cajanus cajan* under Silvi-agri-medicinal system at TFRI, Jabalpur

Plate: Agri-medicinal system at TFRI,Jabalpur (M.P.)

Plate: Harvested agri produces (Bach+paddy)from Agri-medicinal system at TFRI, Jabalpur (M.P.)

(iii) Empowering Tribal Community Through Lac Cultivation in Madhya Pradesh

Constant interactions and motivation through charts and posters used as training tools for the selected farmers of selected sites viz., Sohad, Devri, Ranipur, Narai and Bahmnoda of Jabalpur district showed positive result during the period. Good quality broodlac (seedlac) was procured from the farmer of Balaghat (Madhya Pradesh and ketki crop was inoculated on the selected lac host i.e. *Butea monosperma* during July,2014 . Experiment was conducted to cultivate baisakhi crop of rangini strain of lac after the pruning of lac host trees i.e. *Butea monosperma and Zizyphus mauritiana e*xisting in farmer's field. The data on growth of plants were recorded and phunki removed. The lac was scrapped and the crop maintained. Simultaneously, broodlac of kusumi strain was also cut and inoculated on the remaining branches of *S.oleosa* as aghani crop in study site. Both the crops are maintained and monitored closely to revive the lac cultivation as income generation activity for rural poor. A group of master trainers of IIFM, Bhopal visited the farmer's field on 27th November, 2014 and the activities involved in cultivation of lac crop during the year were demonstrated to them.

Plate:1. Training of inoculation of lac on host trees at farmer's field, Devri village of Jabalpur district (M.P.)

Plate2: A group of Master trainers of IIFM, Bhopal at farmer's field, Sohad village, Jabalpur district during training on Lac cultivation .

Plate 3: Kundilal Patel , who has adopted lac cultivation in his field at Devri village, Jabalpur district (M.P.).

Plate 4 : Dashrath Patel , who has adopted lac cultivation in his field at Sohad village, Jabalpur district (M.P.).

Plate 5: Ketki crop is growing in a trial at Sohad village

(iv) Assessment of Impact of the Harvesting Practices on the Regeneration of Bamboo Forest in Madhya Pradesh

The project aims to study the status of regeneration of Bamboo in Madhya Pradesh under following objectives.

Objectives

- To record the prevailing harvesting methods of Bamboo
- To make a preliminary assessment on the impact of the prevailing harvesting methods on regeneration of Bamboo
- To undertake a preliminary comparative study of status of regeneration in unmanaged and managed bamboo forests

Achievements

Literature survey was undertaken for documentation of prevalent harvesting practice of Bamboos

Survey was also undertaken with Bamboo growers and Forest fringe village of 8 districts of Madhya Pradesh to document the prevalent harvesting methods of bamboo harvesting.

The number of Karla produced was found to be highly ($p<0.01$) correlated to the clump girth. A significantly high correlation was also observed between the number of Karla produced to number of Mahila and number of Pakia in both the experiments.

Removal of half of the total number of pakia and all the pakia had encouraging effects on the regeneration of the clumps

There was no significant difference in the number of new shoots produced in the managed and unmanaged bamboo plantation,

Survival of Karla was higher in managed as compared to unmanaged plantations.

The quality of culms in terms of girth, height and straightness is better in managed plantation.

Impact of research

- The status of regeneration under different prevalent management/harvesting practices was determined
- The status of regeneration in unmanaged bamboo forest was determined.
- The experiments will help in identifying the ideal management practices for sustainable production of culms; facilitate regeneration and economic production of bamboo culms for various end uses.

(v) Standardization of technique to enhance the quality and sustainable production of *Diospyros melanoxylon* leaves in Chhattisgarh.

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

Theme : Sustainable Forest Management (SFM)

Surveyed and selected three sites in Chhattisgarh state, namely (i) Morga, Katghora division, (ii) Kotadol, Baikunthpur division and (iii) Litipara, East Raipur division, having good quality and high production of tendu in consultation with the officers of C.G. MFP Federation.

Experiments on foliar spray of chemical fertilizers were conducted at the selected sites using different doses (0.5%, 1% and 2%) of nitrogen and phosphorus and their combinations in 5 m x 5 m sized quadrats of tendu. Foliar spray of a combination of 2% nitrogen and 1% phosphorus to tendu plants found in nitrogen and phosphorus deficient soils of Chhattisgarh during 2nd or 3rd week of April, when tendu leaves attain maximum size, enhanced the quality of tendu leaves.

To observe the effect of chemical and biofertilizers, different doses of urea, single super phosphate (chemical fertilizers), vermicompost and neem based biofertilizer were applied after soil working to the rhizosphere of tendu in 5m x 5m sized quadrats. Application of 100 kg/ha nitrogen and 25 kg/ha phosphorus or 500 g neem granules and 1000 g VAM per quadrat after rainy season (having high moisture content) increased Specific Leaf Area and thereby quality of tendu leaves.

Experiments on pruning practices of tendu were conducted considering three sets of treatments including 18 combinations *viz.* time interval of pruning, height of pruning and girth classes. Results showed that pruning of tendu seedlings of medium girth (2 – 4 cm) at ground level every year maximized the leaf surface area and minimized the leaf weight or enhanced the quality of leaves.

The project was completed on 30th September 2014 and final report has been submitted.

(vi) Status of sal heartwood borer, *Hoplocerambyx spinicornis* Newman and its management.

Objectives:

1. To monitor sal borer population in sal forest areas with special emphasis on areas of maximum incidence during last epidemic.
2. To investigate natural enemies of the sal borer.
3. To determine the effects of biorational and ecofriendly management strategies under IPM.

Achievements:

Surveyed sal forest areas of M.P. and C.G. for monitoring of sal borer and collection of information on borer incidence, and abiotic and biotic factors. Identified sal borer incidence in Bajag, East and West Karanjia, South and North Samnapur ranges of Dindori Forest Division, Baihar range of North Balaghat Forest Division, Mawai and Motinala ranges of East Mandla Forest Division. Collected information on sal borer incidence in core and buffer zones of Kanha Tiger Reserve, Mandla and Satpura Tiger Reserve, Hoshangabad. Demonstrated categorization of borer affected sal trees and trap tree operation to the front line staff of Forest Department. Collected a hymenopteran ichneumonid larval-pupal parasitoid. Collected seven grubs of predator of sal borer, *Alaus sordidus* (Coleoptera : Elateridae), out of 30 exposed one meter logs in Shahpur timber depot, Dindori Forest Division, during the month of May-June. Recorded ant as a predator found feeding on grubs of borer inside the sal tree. Collected mature grubs and wood dust from attacked trees. Carried out trap tree operation for collection of borer beetles and pesticidal experiments were conducted against borer beetles in captivity, tree traps in sal forests and logs in timber depot. Worked out intensity of borer beetles, which varied from 313-733/cmt in logs in Shahpur timber depot, Dindori Forest Division. Imparted two trainings on sal heartwood borer and its management to front line staff of MP forest department at VVK, State Forest Research Institute, Jabalpur, on 27.8.2014 and 17.10.2014.

Distributed leaflet on sal heartwood borer, categorization of borer affected trees and trap tree operation to front line staff of Forest Department.

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

Objectives

1. To assess the impact of damage caused by bark eating caterpillar, *Indarbela quadrinotata* on *Emblica officinalis* in plantations.
2. To screen the resistant varieties of *E. officinalis* against the bark eating caterpillar.
3. To study the efficacy of selected bio-pesticides (microbial and botanicals) against the bark eating caterpillar

Achievements

Seasonal incidence of bark eating caterpillar, *Indarbela quadrinotata* was studied. Maximum incidence (75%) was recorded in the month of August. Monthwise details of incidence for other months is April-70%; May-45%; June-50%; July-60%; September-65%; October-66.66%; November-63%; December-55% and January-55% .

Three Entomopathogenic fungi were isolated, purified and identified as *Fusarium oxysporum, F. monaliformae* and *Aspergillus niger*.

Thirteen different varieties of aonla *E.officinalis* viz., Kanchan, Krishna, NA-7, Hathijhola, NA-6, Chakaiya, NA-10, Francis, Banarasi, BSR-1, Anand-1, Anand-2 and Wild variety of *E. officinalis* were screened against *I. quadrinotata* in Clonal Seed Orchards and Gene Bank in five different localities- (Badwaha, Seoni, Balaghat, Betul and Indore) of Madhya Pradesh. Chakaiya followed by Kanchan and NA-7 varieties were found to be least preferred and thus resistant against bark eating caterpillar, *I. quadrinotata.*

Microbials (fungal suspension- Entomopathogenic fungi viz., *Fusarium oxysporum, F. monaliformae* and *Aspergillus niger*) and four biopesticides (*Beauvaria bassiana*, *Bacillus thuringensis*, Neem based gronim, crude extract of *Cleistanthus collinis* and combination of crude extract of *C. collinis* + cow urine + vermiwash) were applied against the *I. quadrinotata.* Combination of *C. collinus* + cow urine + vermiwash (67.29%) followed by combination of Neem + cow urine + vermiwash (55.50%) was found most effective against bark eating caterpillar *I. quadrinotata.*

Solvent extract of *C. collinus* in petroleum ether (57.01%) was found most effective against *I. quadrinotata.* Application of Fungal suspension of *Fusarium moniliformae* $1.5x10^{-6}$ (60.73%) was also found to be most effective against *I. quadrinotata*.

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

Objectives:

1. To undertake periodical survey of teak, sal and bamboo forest areas of Madhya Pradesh, Chhattisgarh and Maharashtra for collection and observation on predator, its habit and habitat.

2. To conduct host-developmental stage specificity tests of predator against larval defoliators.

3. To examine the effect of temperature on development of predator.

4. To screen alternate hosts for rearing of predator throughout the year.

Achievements:

Literature and information was collected from internet an library on biology and rearing technique of the predator *Canthecona furcelata*. Surveyed nurseries and natural forests of Teak at Bhadari, Sakri, Maneri, Kharibabliya, Niwas, Bakori and Phoolsagar. Nursery and plantations of Shisham, Khamer, Anjan at Katra, Moiyanala, Maharajpur, Ramnagar Mandla Forest Division. Bamboo and Sal forest in Ghota, Medha, Saida Mawai Sijhora forest range, Khudarhi, Motinala, Dalko, Sarai, Shapura forest range, Dindori Forest Division and surrounding Teak and Bamboo plantation of TFRI Jabalpur (M.P.). Surveyed natural forest, plantation and nursery of Sal, Teak, Bamboo and Aonla in Chilpi, Kawardha(Chattisgarh) and surveyed teak SPA compartment no. 421 range Rukhar and Dudhiya nursery, social forestry nursery, natural forest teak and bamboo, Mul road Chandrapur, Chamorshi, Ashti, Muktapar, Badsa, Bhandra (Maharashtra) and collected eggs, nymph and adult of *C. furcellata* . Screening of alternate host has been carried out for the mass rearing of predator throughout the year in laboratory at different temperature regime (20±1, 27±1 and 35±1^{0}C) and Humidity 70±5 on *Corcyra cephalonica, Eutectona machaeralis, Hyblea puera, Caveria sericia, Plecoptera reflexa, Cryptisia coclesalis* and *Gallaria menollena*. Compilation of data for submission of project report is under progress.

(ix) "Studies on insect biocontrol agent, *Chrysoperla carnea* and its potentiality as insect predator" .

Objectives:

1. To undertake periodical survey of teak, sal and bamboo forest areas of M.P., C.G and M.H. for collection and observation on predator, its habit and habitat

2. To study the status of predator, its identification and laboratory experiments on life cycle.

3. To screen alternate hosts for rearing of predator throughout the year.

4. To conduct host-developmental stage specificity tests and predation potential of predator.

Achievements:

Surveyed natural forest and nursery of teak and bamboo in Rukhar and Dudhiya, Mul road Chandrapur, (Maharashtra), nursery and plantation of Bamboo , Teak in Dindori and Mandla forest, TFRI nurseries and plantations Jabalpur (M.P.) and Sal forest of Chilpi Karwardha (Chattisgarh). Collected the adult and eggs of predator. Rearing of predator on *Corcyra cephalonica* as alternate host in the laboratory. Laboratory experiment on life cycle of predator was completed and will be replicated in the next season. Predatory potential of *C. carnea* had been recorded on *Corcyra cephalonica*.

(x) Studies on effect of introduction of honey bee on seed production of teak seed orchards.

Objectives:

1. To examine the impact of bee hives in seed production.
2. To examine the yield of honey and bee wax.
3. To assess the improvement in qualitative and quantitative parameters of teak seeds due to honey bee pollination.

Achievements:

After field visits for site selection, two sites; TSO, Ghissi, Behrai and TSO, Nanditola, Dharana, were selected for experimentation on effect of introducing domesticated honey bee, *Apis mellfera* colonies on seed production. For comparing effect of introduction of honey bees on fruiting/ seeding, prior to introduction, 800 nos. of teak trees in TSO Ghissi, Behrai in 5 hec. and 500 trees at TSO Nanditola, Dharana in 2.5 hec., have been marked and numbered. Current year's observation on flowering and fruiting status has been recorded for all such marked trees at both TSOs.

The population of domesticated honey bee, *Apis mellifera* was procured initially from the bee keepers, which was maintained and further multiplied. Further multiplication of the colony in terms of number of boxes and bee population is in progress to facilitate introduction in the selected site for further observations on its effect.

Observations on current status of fruiting and seed quality parameters like flowering status, fruit/seed setting on each marked trees, fruit/seed weight, size, total number of fruit/seed per tree and total weight, were recorded before introducing the colonies to assess the effect of honey bee afterwards. Further work is in progress.

(xi) Studies on the causes of *Gmelina arborea* mortality in plantation of MP, CG and its integrated management.

Objectives:

1. To undertake a systematic survey of *Gmelina arborea* mortality in different regions of MP and CG
2. To identify and evaluate the symptoms of mortality and its causal factors in different regions
3. To develop a sustainable management package for protection of *Gmelina arborea* from disease and insect pest

Achievements:

Disease and insect survey in *Gmelina arborea* plantation was conducted and data recorded on mortality status in MP and CG. On an average only 18.9% trees were recorded healthy with no infection while rest 81.1% trees showed low to heavy infestation (36.8% trees showed low infestation, 29.9% medium and 14.5% showed heavy infestation) at different sites. Two insects, *Tingis beesonii* and *Indarbella quadrinotata* and 4 fungi, *Hendersonula, Hexagonia, Hypoxylon,* and *Torula* were identified associated with mortality of khamer (Figs. 1-4). Two sites, one in Betul, Madhya Pradesh and another in Bilaspur, Chhattishgarh were selected for conducting field experiments for management of *Gmelina* mortality. Experiments

were initiated at Sonaghati, Betul and Sakari, Bilaspur. Fungicide, ridomil (0.2%) and insecticide monocrotophos (0.05%) along with organic matter and vermicompost as mulch were applied in the field experiment in RBD.

(xii) Formulation of biofertilizers consortium and their distribution to forest department.

Objectives:

1. Collection of beneficial forest tree specific soil microbes such as *Rhizobium, Azotobacter,* phosphate solublizing bacteria and *Azospirillum* from Madhya Pradesh.
2. Identification and selection of the strains beneficial for forest tree species by laying nursery experiments.
3. Preparation of host specific culture of the collected microbes.

Achievments: Soil and root samples of *Albizia lebbek, A. procera, Dalbergia sissoo, D. latifolia, Pterocarpus marsupium, Tectona grandis, Terminalia arjuna* and *T. tomentosa* have been collected and rhizobacteria (PSB, *Azotobactor*, *Azospirillium* and *Rhizobium*) have been isolated on specific media. Identified mother culture/starter culture of rhizobacteria have been maintained in laboratory including 3 strains of *Rhizobium* (nursery), 8 strains of PSB (3 from nursery and 5 from natural forest), 13 strains of *Azospirillium* (6 from nursery and 7 from natural forest), and 6 strains of *Azotobactor* (natural forest). Seeds of *Albizia lebbek, Dalbergia sissoo, D. latifolia, Tectona grandis, Terminalia arjuna* and *T. tomentosa* have been collected for nursery experiment.

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

Objectives:

Long Term

- To develop value added products from Kusum fruits for economic development.

Short Term

- Evaluation of *Schleichera oleosa* fruits for their nutritional value.
- To prepare value added products from Kusum fruits.
- To estimate nutritional status and shelf life for value added products.

Progress Report:

Fresh fruits of *Schleichera oleosa* were collected from forest areas. Fruits were processed for pulp and pulp was evaluated for its nutritional value (moisture: 84%, carbohydrate: 4%, crude fibre: 1.03%, protein: 0.7%, ascorbic acid: 0.13%, fat: 3.99% and acid value: 0.05). The preservation protocol for pulp was standardized. Eight value added products (Kusum Vati, Kusum Jam, Kusum Sauce, Kusum Thandai, Kusum Squash, Kusum Sarbat, Kusum Morabba & Kusum Powder) were prepared. Sensory evaluation of prepared value added products was carried out following the 9 – point Hedonic scale (25 people). The overall acceptability on 9 – point Hedonic Scale for Kusum Vati, Kusum Jam, Kusum Sauce, Kusum Thandai, Kusum Squash, Kusum Sarbat, Kusum Morabba & Kusum Churna was found 8.8, 8.4, 8.3, 8.5, 8.0. 8.4,

7.5 and 7.1 respectively. Further study on phytochemical analysis and shelf lives of above mentioned products is under progress.

(Value added products prepared from Kusum fruits)

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

Objectives:

Long Term

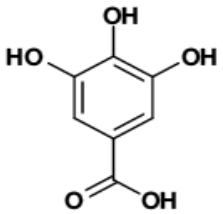
To standardize the processing and storage techniques of Malkangni, Baheda & Baividang fruits/seeds.

Short Term

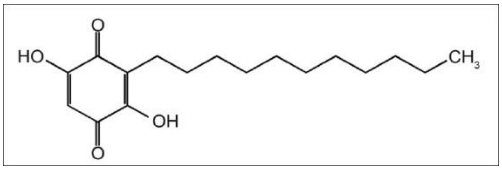
- To evaluate impact of storage on major active ingredients of selected species.
- To standardize the processing techniques of selected species.
- To standardize optimum storage conditions and time for selected species.

Progress Report:

The fruits/ seeds of Malkangni, Baividang & Baheda were collected from the forest areas of Chhindwara district of Madhya Pradesh. The collected fruits/ seeds were dried and processed. Dried seeds of Malkangni (*Celastrus paniculatus*), Baividang (*Embelia tsjeriam – cottam*) and rind of Baheda (*Terminalia belerica*) fruits were stored in different containers (jute, polythene, markin, tin, glass and plastic). Some of the samples of fruits/ seeds were also stored at 4-5^{o}C in refrigerator to examine the effect. Seeds of Malkangni were analyzed for oil percentage by Soxhlet apparatus. Seeds of Baividang and rind of Baheda fruits stored in different containers were evaluated for embelin and gallic acid content respectively using HPTLC technique. In preliminary study, polythene containers at room temperature were found suitable for storing the above said plant materials.



Gallic Acid
3,4,5-TriHydroxyBenzoic Acid



Embelin

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

Objective:

Long Term

- Chemo-profiling of *Solanum* indicum, *Solanum xanthocarpum* and *Uraria picta* from different agro-climatic zones of Madhya Pradesh for their major active ingredients.

Short Term

- Phytochemical analysis of different plant parts using modern analytical tools.
- To find out variation in major active ingredients of targeted species collected from different agro-climatic zones.
- To find out the superior populations/ areas of targeted species in terms of major active ingredients.

Progress Report:

Forest area was surveyed and plant material of *Solanum xanthocarpum* was collected following Random sampling from three places each from eleven (11) agroclimatic regions i.e. Kymore Plateau & Satpura Hills (Jabalpur, Seoni, Katni), Satpura Plateau (Chhindwara & Betul), Chhattisgarh plains (Balaghat), Central Narmada Valley (Narsinghpur, Hoshangabad, Harda), Malawa Plateau (Indore, Dhar, Devas), Northern Hill Zone of Chhattisgarh (Mandla, Dindori, Amarkantak), Grid zone (Gwalior, Shivpuri & Sheopur), Vindhyan Plateau (Sehore, Damoh, Sagar), Nimar Valley (Khandwa, Badwani), Bundelkhand Zone (Datia, Chhatarpur, Tikamgarh) and Jhabua Hills (Jhabua & Alirajpur).

The plant material of *Solanum indicum* were collected following purposive sampling from seven (07) agroclimatic regions i.e. Kymore Plateau & Satpura Hills (Seoni), Satpura Plateau (Chhindwara, Betul), Chhattisgarh plains (Balaghat), Central Narmada Valley (Hoshangabad), Malawa Plateau (Indore), Northern Hill Zone of Chhattisgarh (Amarkantak) and Vindhyan Plateau (Sehore).

The plant material of *Uraria picta* was collected from seven agroclimatic regions following purposive sampling i.e. Satpura Plateau (Chhindwara), Central Narmada Valley (Hoshangabad), Malawa Plateau (Dewas, Mandsaur), Vindhyan Plateau (Sehore), Nimar Valley (Khandwa), Grid Zone (Seopur Kalan) and Jhabua Hills (Alirajpur). The collected plant materials were shade dried and processed.

Quantification of Lupeol in different plant parts of *Uraria picta* and Caffeic acid in different plant parts of *Solanum indicum* and *Solanum xanthocarpum* collected from different agroclimatic

regions was carried out using HPTLC technique. Lupeol content in the roots, stem and leaves of *U. picta* varied from 0.49 – 0.15 %, 0.018 – 0.005% and 0.014 – 0.003% respectively. Data analysis of other two species is going on.

(xvi) Studies on harvesting time of some medicinal plant for their natural antioxidant constituent.

Objectives:

1. Standardization of harvesting time of the selected species with respect to antioxidant activity.
2. Phytochemical analysis of different plant parts.
3. Characterization of the phyto constituent responsible for the antioxidant activity.

Achievements:

Samples of *Asparagus racemosus, Argyreia speciosa and Curculigo orchioides* were collected from Nasik, Buldana and Wardha districts of Maharashtra. The phyto-chemicals viz., phenols, phenolic acids, flavonoids, lupeol and β sitosterol and antioxidant activity as IC_{50} value were evaluated in the collected samples.

The total phenol and flavonoids percentage in *A. speciosa* leaves varied from 0.21 to 3.16% and 0.92 to 2.79%, respectively in the samples collected in July and December. The antioxidant activity in term of IC_{50} varied 2.05 to 2.70 mg/ml.

Total phenols in *A. racemosus* fresh root varied from 0.24 to 0.32%. No flavonoid content was detected in *A. racemosus* root samples. IC_{50} value varied from 30.6 to 68.0 mg/ml.

Phenolic acids i.e. syringic acid, vanilic acid, algenic acid, anthranilic acid, cinnamic acid and coumaric acid and querecetin and β-sitosterol quer were quantified by HPTLC.

Total phenol, flavonoids and antioxidant activity as IC_{50} value varied 0.69 to 3.16% , 0.92 to 2.60% and 40.5 to 57.8 mg/ml, respectively collected in the month of December.

(xvii) Quality standardization of some important medicinal plants of Madhya Pradesh,

Objectives

1.To determine seasonal variation in active ingredients among various agro-climatic regions of the state.
2.To quantify major active ingredients in the selected species with respect to harvesting time and technique.
3.To standardize harvesting and processing technique for obtaining quality produce.

Achievements:

Samples were collected in rainy, summer and winter seasons from agro-climatic zones of Madhya Pradesh. The collected samples were processed for chemical analysis and active components i.e. phenol, flavonoid and antioxidant property were estimated.

Total phenol content in *Ocimum sanctum* samples ranged from 1.56-7.72 % being highest in summer samples of Malwa Plateau. Total flavonoids ranged from 0.87-6.03%, highest in winter sample of Chhattisgarh Plains while antioxidant activity,I C50 value ranged from 0.32-8.86 which was found to be best in the samples collected in rainy season from Bundelkhand zone.

Total phenol content in *Gymnema sylvestre* samples ranged from 0.22-13.19 %, highest quantity was observed in winter sample of Kymore Plateau Satpura Hills agro climatic zone. Total flavonoids ranged from 1.81-8.93%, highest in summer samples of Malwa plateau and antioxidant activity, IC50 value ranged from 0.40-60.8 which was found to be best in the samples of Kymore Plateau and Satpura Hills winter samples.

Total phenol content ranged from 1.09-6.8 % found to be highest in winter sample of *Phyllanthus amarus* collected from Chattisgrah Plains. Total flavonoids ranged from 0.23-7.38% with maximum in winter samples of Jhabua Hills.

Maximum quantity of total phenolic content, flavonoids and IC50value in *Tinospora cordifolia* stems were estimated, highest observed in winter season in samples collected from Chhattisgarh Plain agroclimatic zone, Nimar Plains respectively.

The concentration of ursolic acid and eugenol were estimated in *O.sanctum* samples dried by different methods and found to vary from 0.061-0.104% and 8-11mg/100g respectively.

The concentration of phyllanthin, active ingredient of *P. amarus* was found to vary in different processing methods. The quantity of phyllanthin ranged from 0.457-1.108%.

Estimation of active ingredients in various samples is under progress using HPLC and HPTLC.

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

Objectives:

1. To develop sustainable harvesting practices for *Bauhinia vahlii*.
2. To study influence of harvesting time on regeneration of the species
3. To evaluate influence of harvesting time on quality of leaves.

Achievements:

Experiments were laid out to standardize sustainable harvesting practices of Mahul Patta (*Bauhinia vahlii*). Average % increase of number and size of *Bauhinia vahlii* leaves were observed after 40%,60% and 80% harvesting at Keochi (Marvahi), Sapalwa (Pali) Katghora and Lamni (Bilaspur) experimental sites. The flower and fruiting status were recorded at different sites during April to October to assess the impact of harvesting intensities on *Bauhinia vahlii* climber. Flowering was recorded in matured climbers only. The strength of the leaves was observed in different collection period. The leaf samples collected from different sites in summer season showed more strength (2.47-2.53N) followed by leaf samples collected in spring (2.23-229 N).

(xix) Standardization of non-destructive harvesting practice of *Commiphora wightii* oleo-gum resin.

Objectives:

1- To standardize non-destructive harvesting technique for obtaining oleo gum resin (Guggul).

2- To standardize optimum harvesting age of plant for tapping of Guggul.

3- To find out the influence of harvesting season, age and technique on quantity and quality of Guggul.

4- To assess the influence of storage on quality of Guggul.

Achievements:

Surveyed different regions of Madhya Pradesh for the identification of potential areas to conduct experiments for sustainable harvesting of Guggul. Different girth size (0-10,10-20,20-30,30-40 cm) plants were selected at Piprai,Amba (Murena),Kankura,Barhi,Oosad (Bhind) in Madhya Pradesh. Experiments were laid out in the month of March,2014 in randomized block design to standardize harvesting technique of Guggul at Piprai, Kankura and Barhi. Different methods i.e. cuts of different size (2&4cm), 2mm depth, using Guugle Jawahar blazer with application of gum solution (traditional method) and without gum solution.

(xx) Evaluation of non edible oil seeds for development of surfactants and their utilization in pest management.

Objectives:

1. To prepare surfactants from oil seeds of *Jatropha curcas*, *Pongamia pinnata, Schleiochera oleosa* and *Sapindus mukrossi*.
2. To assess physico-chemical properties of surfactant.
3. To study surfactants for their suitability in pest management.

Achievements:

Seeds of *Pongamia pinnata, Schleiochera oleosa, Jatropha curcas* and *Sapindus mukrossi,* were collected and processed. Seed's biochemicals were isolated and modified into surfactants. The properties of surfactants viz., solubility, surface tension, viscosity, foaming power, alkalinity of modified products and triton –X-100 at different dilutions were assessed.

The phytotoxicity of different surfactant dilutions was assessed on the basis of ocular observation.

Pesticidal activities of formulations of modified products were assessed against insect pest - *Heliothis armigera*, Brinjal shoot sucker –*Leucinodes orbonalis* in field conditions, insects of stored seeds,mosquito larvae, fungicidal activities against wood decaying fungi - *Pycnoporous sanguinius* by soil block method. Bija Sal wood blocks are used for testing. Weedicidal activities were also tested against broad leaf weeds -*Checorium intybus* and *Medicago denticulate*. Potential insecticidal and herbicidal activities were recorded.

(xxi) Evaluation on phyto-polymers as eco-friendly bioadhesives.

Objectives:

1. To isolate and modify natural polymers of *Shorea robusta, Jatropha curcas, Madhuca indica, Mangifera indica, Amorphophallus companulatu*, *Semicarpus anacardium, Momordica dioica* and *Pheonix acularis for* the preparation of adhesives.
2. To assess properties of adhesives.
3. To evaluate the application of adhesives.

Achievements:

Starch and crude protein were isolated from *Shorea robusta, Jatropha curcas, Madhuca indica, Mangifera indica*, *Curcuma angustifolia* and *Amorphophallus companulatus* for the preparation of adhesives. The effect of type and quantity of stabilizer/ filler were assessed. The compatibility of natural polymers with polyvinyl alcohol was also assessed. The properties of adhesives i.e. pH, solid content, water resistance, viscosity and density were assessed. Viscosity, solid content and pH of the adhesives ranged 121-2020 mPas., 75-85% and 10-12, respectively. The mechanical properties-tensile strength and thermal properties of the adhesives were determined. Adhesiveness was assessed on different substrates viz., paper-paper, glass-glass, wood-paper, and wood-wood. The adhesiveness was also compared with synthetic adhesive. The change in viscosity was also assessed.

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

- The plantation was maintained. Data for growth (quarterly) was recorded.
- Soil sample was collected from each plot.
- Used plastic cement bags were utilized as tree guards to protect plants from browsing by the wild animals
- Weeding and gap filling work was completed.
- Quarterly recording and evaluation of growth data was done.
- Observations on eight species (21 months) revealed that *Dalbergia sissoo* had highest survival percent and highest growth rate while lowest survival percent was recorded in *Gmelina arborea*.
- During the year 2014-15 it was observed that the maximum average height was attained by *Dalbergia sissoo* (123 cms) followed *by Dendrocalamus strictus* (106 cms) *and Terminelia arjuna* (68.3 cms) and minimum height was achieved by *Tectona grandis* (29.59 cms).
- Individually *Dalbergia sissoo* exhibited best growth (165 cms ht) this year in treatment No. 138 (spacing 3x3m, pit size 60 x60x60 cms), *Dendrocalamus strictus* (151.88 cms ht) in the treatment No. 108 (5x5m, 60 x60x60 cms)and *Terminelia arjuna* showed the best height (86.75 cms) in the treatment No. 112 (2x2 m, 45x45x45 cms).

3. *Biodiversity Conservation and Ecological Security*

(i) Study on Indigenous knowledge and Documentation of extent of utilization of herbs in folk- medicines prevalent in tribal pockets of Madhya Pradesh

- The study was conducted in districts of Chhatarpur, Panna , Satna , Jabalpur and Seoni to document information from 4-5 localities or clusters and in sampling stage 2) 6—8 villages cluster 2 , the criteria sites being predominance of tribal and non tribal communities in identified, in each locality of sampling

- During the survey Local vaidraj were identified in different clusters in each district as presented in Table -2 . Identified from 5 districts namely Chhattarpur, Panna, Satna, Jabalpur and Seoni from selected pockets and cluster of villages through multistage sampling. 67 vaidraj were identified in the selected districts. Information was recorded as per schedule and Focussed Group discussion .

- Identification of local indigenous community / Village community / tribe : The survey recorded information from tribal communities belonging to Saur , Raj Gond , Gond , Khirwar , and Mawasi .

- Recording of information from vaidraj and local community about use of indigenous flora and plant parts used in herbal medicines, local and scientific name, family : Recorded information on plant parts used as roots, rhizomes , leaves , bark, flowers , fruits , gum , panchang of local flora in forest areas and fringe areas of local community

- Recording of information from vaidraj on cure of different ailments through formulations prepared from plant parts : Recorded Species , local name, Scientific name , formulations prepared , dosage in cure of various ailments are Diabetes as per traditional knowledge in cure of ailments utilizing herbal medicines .

- Recording of information through focused group discussion: This method is being used for collecting information at group level per village. The advantage of group discussions over individual household surveys is that they provoke discussion. However, a disadvantage is that there is social pressure to give socially correct answers, which may not reflect actual opinions and practices.

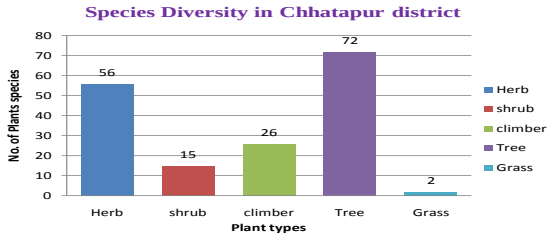
- Recording of information on existing flora : Species overexploited and at verge of extinction being recorded from local community and traditional healers for plant parts used in herbal medicines- name of indigenous flora local and scientific name, formulations prepared , dosage in cure of ailment .

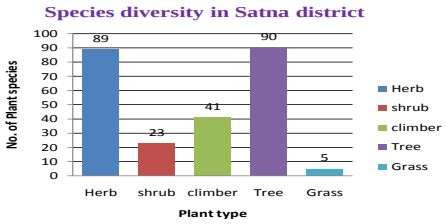
- Recording of information on utilization and collection methods of plants : The information from local community for *utilization* of plants and collection methods of plant parts , and method of collection of local flora.

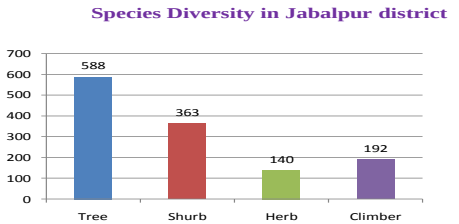
- The plant species over exploited were documented : They are *Amorphophallus sylvaticus* (Bajra kand), *Andrographis echioides* (Kalmegh), *Butea monosperma* (Palas) , *Bacopa monnieri* (Brahmi) , *Beta vulgari* (Chukandar) , *Caesalpinia bonduc* (Gattaran) , *Chlorophytum arundinacaea* (Safed Musli) , *Citrulus colocynthis* (Kahira) , *Costus specious* (Keokand) , *Curcuma amada* (ama haldi) , *Eulophia herbacia* (Bilarikand) , *Hedychium coronarium* (Gulbakawli), *H.spicalum,* *Jasminum grandiflorum* (Van chameli) , *Justica procumbens* (pitpada), *Mimosa pudica* (Lajwani) , *Nardostachy grandifolra* (Jatamansi), *Plumbago zeylanica* (Chitrak) , *Litsea glutinosa* (Maidachal ,bark) , *Parkia biglandulosa* (Shivlingi), seeds of *Psoralea corylifora* (Bavchi) ; *Commiphora mukul,* , *Solanum surattense,* *Tinospora cordifolia* (Giloy) , and *Vitivera zizanoides* (Khus) .

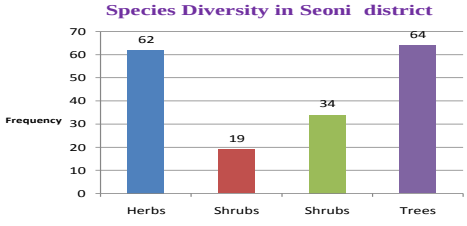
- The plant species at the verge of extinction are documented : They are *Abroma angusta* (Ulat kambal) , *Abelmoschus moschatus,* (Bajrakand) , *Abrus precatorius* (Gunchi) , *Butea parvilora* (Palsh bel) *Curculigo orchoides* (Kali musli) ,*Terminalia arjuna* (Arjun) , Vajradanti , *Dioscorea hispida* (Bechandi) *Curcuma angustifolia* (Tikhur) , *Curculigo orchoides* (Kali musli) , *Mucuna pureins* (Kemach) *Grewia hirsuta* (Gudsakri) ,*Gloria suberba* (Kalihari) , *Terminalia bellarica* (Baheda) and *Terminalia chebula* (Harra)

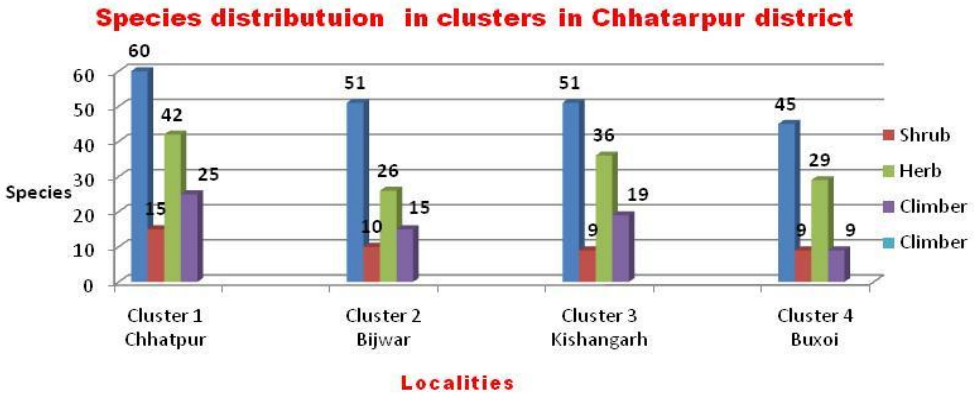
Species diversity in project districts Chhatarpur, Satna , Jabalpur and Seoni

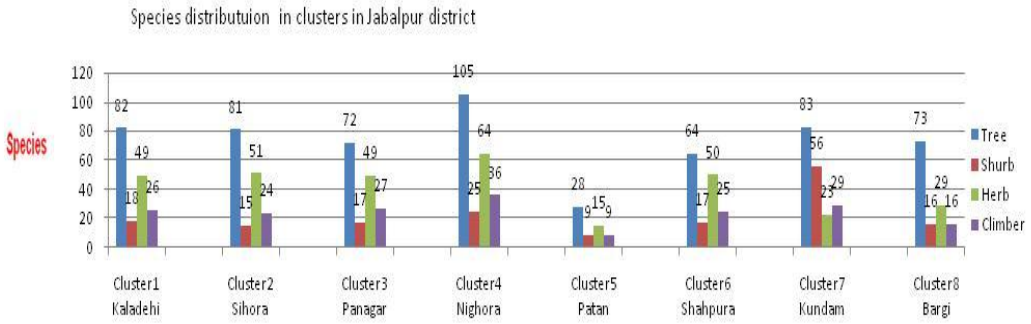


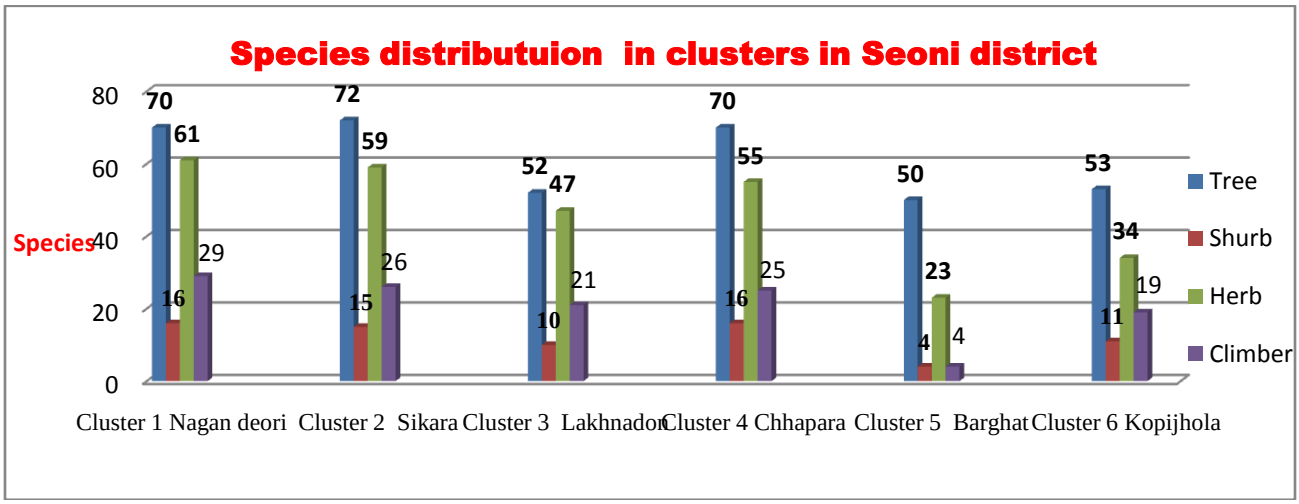


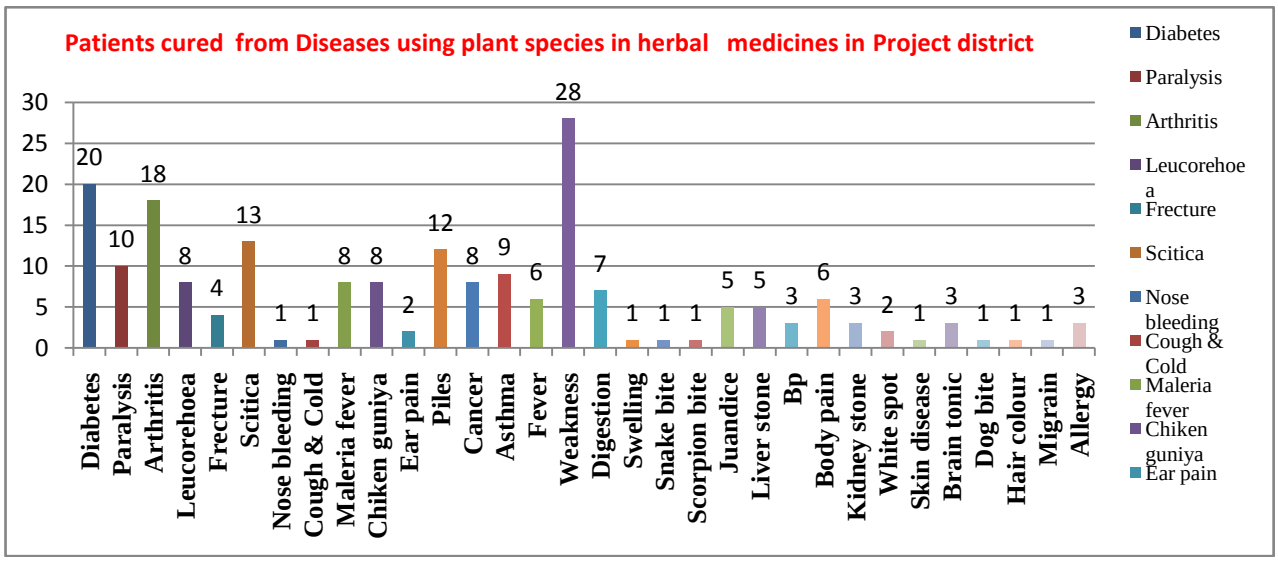







Species distributuion in clusters in Jabalpur district
Species
120
100
80
60
40
20
0
82 49 18 26
81 51 15 24
72 49 17 27
105 64 25 36
28 15 9 9
64 50 17 25
83 56 23 29
73 29 16 16
Tree
Shurb
Herb
Climber
Cluster1 Kaladehi
Cluster2 Sihora
Cluster3 Panagar
Cluster4 Nighora
Cluster5 Patan
Cluster6 Shahpura
Cluster7 Kundam
Cluster8 Bargi


Species distributuion in clusters in Seoni district
Species
80
60
40
20
0
70 61 16 29
72 59 15 26
52 47 10 21
70 55 16 25
50 23 4 4
53 34 11 19
Tree
Shurb
Herb
Climber
Cluster 1 Nagan deori
Cluster 2 Sikara
Cluster 3 Lakhnadon
Cluster 4 Chhapara
Cluster 5 Barghat
Cluster 6 Kopijhola


Patients cured from Diseases using plant species in herbal medicines in Project district
30
25
20
15
10
5
0
Diabetes 20
Paralysis 10
Arthritis 18
Leucorehoea 8
Frecture 4
Scitica 13
Nose bleeding 1
Cough & Cold 1
Maleria fever 8
Chiken guniya 8
Ear pain 2
Piles 12
Cancer 8
Asthma 9
Fever 6
Weakness 28
Digestion 7
Swelling 1
Snake bite 1
Scorpion bite 1
Juandice 5
Liver stone 5
Bp 3
Body pain 6
Kidney stone 3
White spot 2
Skin disease 1
Brain tonic 3
Dog bite 1
Hair colour 1
Migrain 1
Allergy 3
Diabetes
Paralysis
Arthritis
Leucorehoea
Frecture
Scitica
Nose bleeding
Cough & Cold
Maleria fever
Chiken guniya
Ear pain

Field survey in project areas

Field survey

Saur Tribe : Kishangarh ,Chhatarpur

Survey in villlage : Hardua

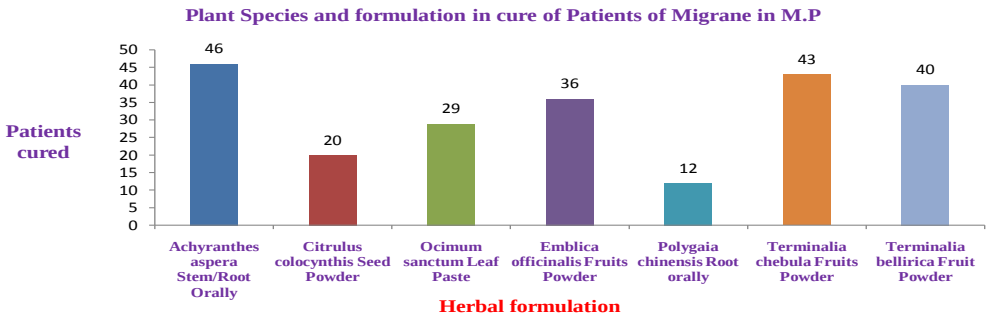
Mawasi Tribe : Majhgaon - Satna

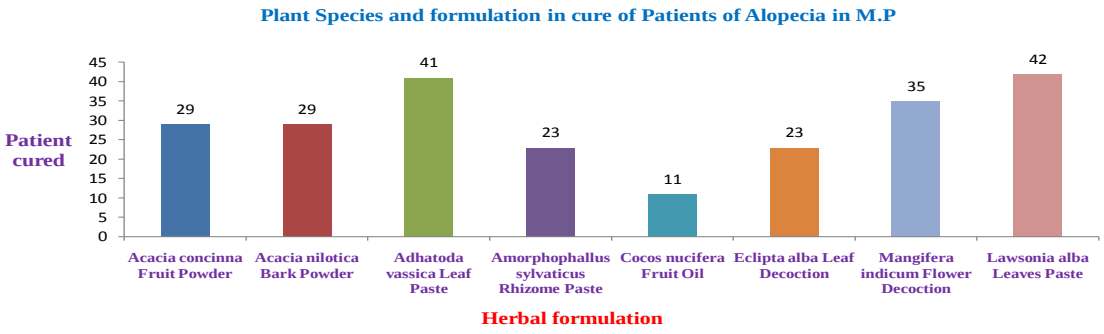
Survey in village kakarhai

Kol tribe : Karma dance

Vaidraj at vanraksha naka Majhgawa

Plants used and patients cured of Migrane in MP.





Medicinal plants diversity in project areas used in herbal medicines

Cissus quadrangularis, Hadjodi

Curcuma angustifolia, Tikhur

Costus speciosus ,Keokand

Curcuma amada

Basella rubra

Boerhavia diffusa ,Purnarnava

Brideia retusa

Butea monosperma

Boerhavia repuens,

Plants parts and formulation used in herbal medicines

BILARIKAND

NANARCHUR

Paras peepal

Kamraj, Laxman kand

BHUI AMLA

Plant herbal formulations recorded in market survey


DIABETES POWDER


VAIDRAJ


ALLERGY


OBESITY


SKIN WHITE SPOT


Bilari kand


COLD & COUGH


ARJUN BARK
HEART AILMENT


Kidney stone

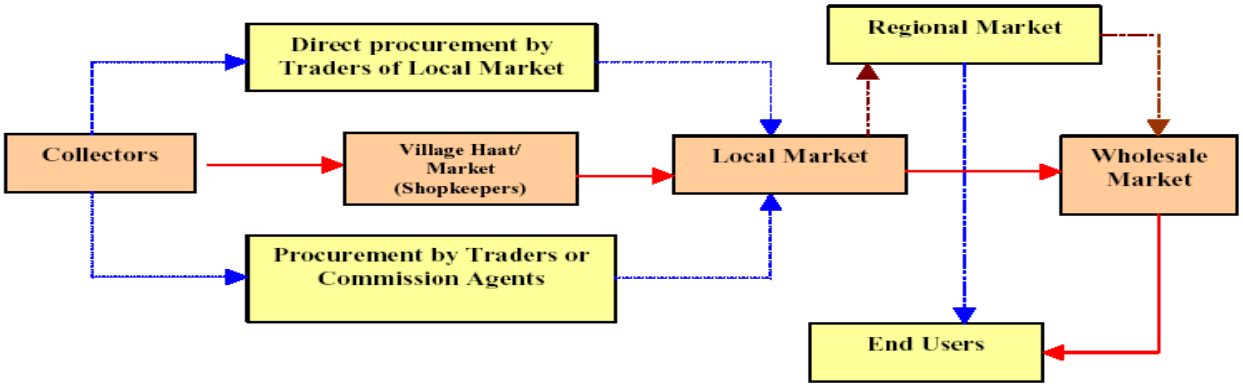

Pitambari oil :
Scitica arthritis


Dysentry : Rasna jadi Reetha


Gulbakawli eye drop : Motiabind

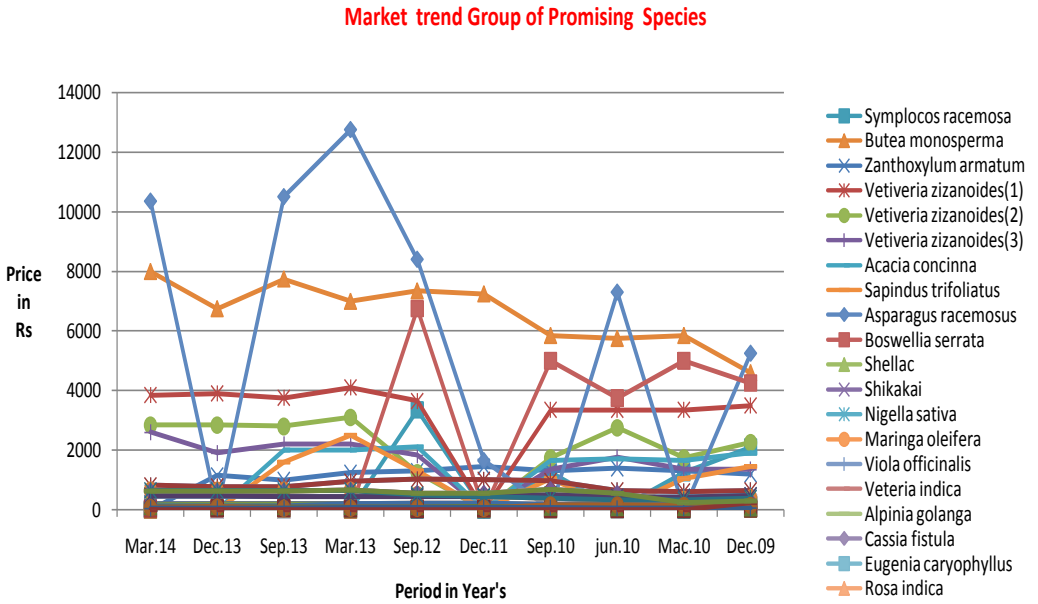

Amla prickles ; Shaktivardhak

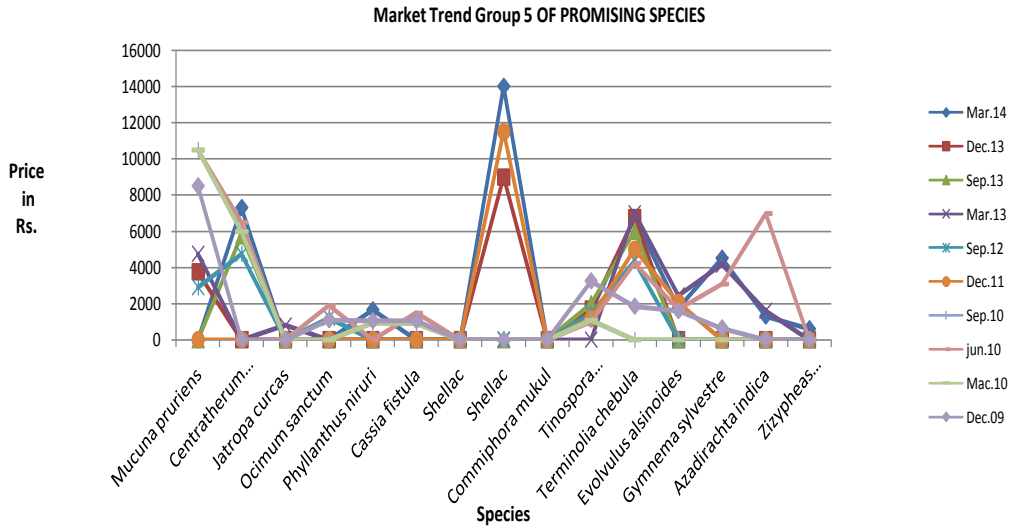

Keokand :Scitica, Arthiritis



Marketing channels in MP

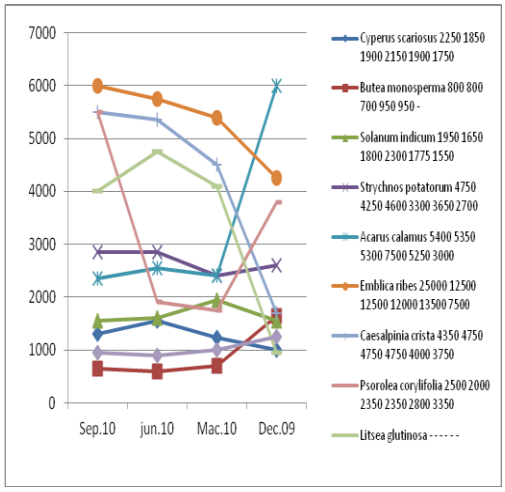
Price fluctuation of medicinal plants recorded during market survey

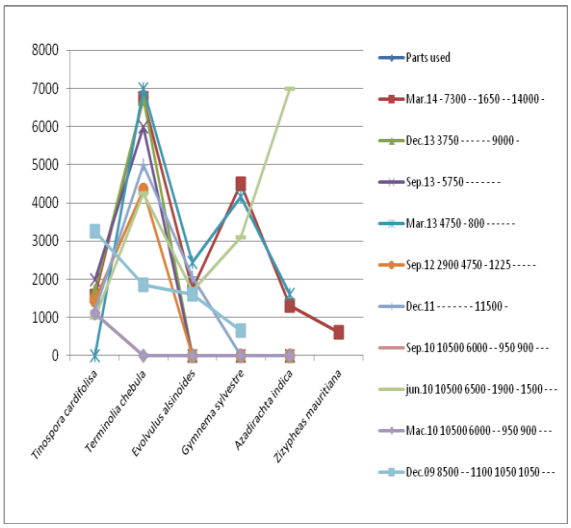


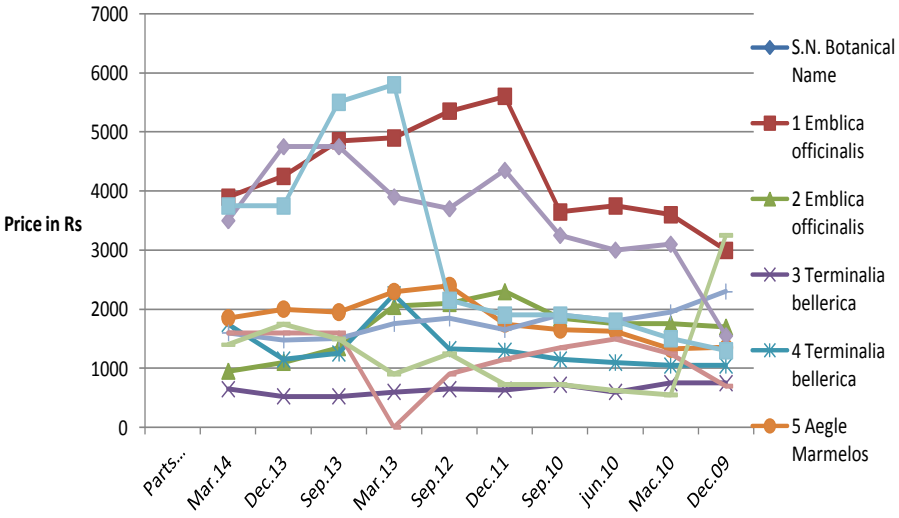


Market Trends Pric e in Rs

Price in Rs







Medicinal Plants _ Over exploted in project areas

Vajradanti Plant & Fruit

Bechandi Plant & Rhizome

Tikhur Plant & Rhizome

Arjun tree bark &Leaves

Arjun flower & Fruit

Gataran

Gataran fruit

(ii) Establishing Arachnarium at TFRI, Jabalpur, M.P."

Arachnarium is a structure where spiders are reared, raised and bred. Since long past study of spiders was restricted only to the taxonomists and hardly attracted the attention of naturalists. To educate people in general, to generate knowledge of subject matter to students and researchers and to include the the importance of beneficial spiders in the working plans of SFDs this demonstrative Arachnarium is proposed. In the present proposal there would be both indoor and outdoor exhibits of live spiders. They would be reared in the laboratory as well as in their natural habitat. To begin with, 50 species of spiders are proposed to be included in the Arachnarium. Some extraordinary spiders, like the fish eating Pisaurids and bird eating giant wood spider would be in prime focus. The museum would be decorated with posters, blowups, information tables of spiders, apart from the preserved specimens from all over India.

The project was initiated during February 2015. The already existing building of TFRI is in the process of renovation. Repairs and electrification of the building is in progress. The surrounding area which was inaccessible with weeds and bushes were cleared making space for outdoor rearing of spiders. Areas were marked to create aquatic habitat for spiders as well as ground dwelling spiders.

Chada Vanogram in the Dindori Forest Range were surveyed and 3 sites were selected for spider collection. Habitats for tarantulas were searched, located and geo-referenced. Spider faunal diversity in and around TFRI estate were recorded.

Arachnarium of TFRI is going to be the 1st of its kind in India and would be completed within 3 years from now. Work on local survey, collection, identification, digital imaging and checklist preparations are well in progress.

(iii) Population dynamics of Threatened medicinal plants species growing in buffer and transition zone of Tadoba National Park Maharashtra

Objectives

- To study regeneration and population dynamics of two vulnerable medicinal plants growing in the region.
- To study the effect of disturbance gradient on distribution and regeneration of two medicinal plants.

Achievements

Survey was conducted in TATR, buffer zone. A total of 714 species were recorded of which 98 species were documented to be used by the traditional healers for preparation of various herbal formulations during the study.

It was found in the survey with the traditional healers, VFC members of the villages in buffer zone of TATR, that *Uraria picta* and *Andrographis paniculata* were once found in abundance in the study area however there is a gradual decline in population of these species.

Density and distribution of the species was determined in the buffer region of the TATR, populations of both the species were identified. Population growth rate and regeneration of *Uraria picta* and *Andrographis paniculata* will be determined.

Survivorship function, survival probabilities, reproductive output, fertility coefficient of the species at different stages, for different populations (4 populations of *Uraria picta* and 7 populations of *Andrographis paniculata*) was determined.

The soil seed bank of the species in each population and seed viability was also determined through lab experiments

Plant community associates of the species, edaphic factors (physicochemical properties), and physical factors like, canopy lifting, PAR, was recorded. Disturbance by anthropogenic factors in the populations was also recorded.

Impact of research

The studies on population dynamics study of endangered species helps in devising effective conservation strategies. Simulation and elasticity analysis for population and projection matrices help us predict the fate of population and thus help in devising effective conservation and management strategies with community participation.

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

Effect of temperature, light, soil type and quality on germination of *Sterculia urens,* and *Boswellia serrata* was evaluated. Best pretreatment for germination of *Sterculia urens* was standardized. Seeds of *Bridelia retusa* were incapable to germinate at any stages of maturation and seeds were found dead before full ripening. Maturation index of seeds of *Sterculia urens,* and *Saraca indica* was determined on the basis of physical parameters and germination and desiccation tolerance test. Storage behaviour of seeds of *Sterculia uren, Boswellia serrata* and *Saraca indica* was evaluated. Seeds of *Sterculia uren,* and *Boswellia serrata* were identified as orthodox category and those of *Saraca indica* was identified as recalcitrant seeds. Seeds of *Boswellia serrata,, Sterculia urens* and *Saraca indica* were stored at different conditions and Stored seeds were sampled at intervals for evaluation of viability.

Fig. 1: Germination of *Boswellia serrata* seeds

Fig 2. Germination of *Sterculia urens* seeds in germinator

Fig. 3.Germination of *Saraca indica* seeds

4. Forest and Climate Change

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

Theme : Climate change and forests

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

In the 1st phase of the project (2010-11 to 2011-12), allometric regression equations for quantification of carbon in *Shorea robusta* trees by non destructive method were developed. Selected sites near Automatic Weather Stations (AWS) and Agro Meteorological Stations (AMS) installed in Kanha, Bandhavgarh and Madhav National Parks of M.P. and collected data on seasonal variation in grass biomass, soil moisture profile, Specific Leaf Area and Leaf Area Index.

In the 2nd phase (2012-13 to 2014-15), laid out 11 quadrats of 0.1 ha size each in Pench, Panna and Satpuda Tiger Reserves of M.P. Regularly collected growth data of the trees found in the selected quadrats and observed seasonal variation in herbaceous and litter biomass and soil moisture profile.

Density and vegetation diversity in the selected quadrats of the tiger reserves was found in the order : Satpuda > Pench > Panna.

Carbon stock per ha was found maximum in the selected quadrats of Pench, followed by Satpuda and Panna, while annual sequestration was found maximum in Satpuda followed by Pench and Panna.

Selected eight sites in west Mandla forest division of M.P. and laid out quadrats, collected data on growth of trees and biophysical parameters. The project is over on 31st March 2015.

Demarcating trees in the quadrats of Pench Tiger Reserve (M.P.)

Laying out 0.1 ha quadrat for vegetation survey in Satpuda Tiger Reserve

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

The research project titled "Carbon sequestration through afforestation at Rourkela Steel Plant (RSP), Odisha" has been conceptualised to quantify carbon stock and annual sequestration in vegetation, litter and soil in more than 40 lakh tree plantations raised by Rourkela Steel Plant in 15000 acres of land and in the nearby natural forest. The objectives of the study are to assess CO_2 released by RSP to the atmosphere through the processes of manufacturing steel and to monitor seasonal, diurnal and locational variation in its concentration. Valuation of plantations for their tangible and intangible benefits will be assessed and outcomes of the project will be disseminated to the stakeholders through training programmes to officers and staff of SAIL.

This is the second year of the project. Sites have been selected and quadrats for trees, shrubs, herbs and litter have been laid out in the plantations and natural forest and biophysical parameters including growth of trees and soil moisture are being studied. As part of the programme, a 10 acre plantation including 11 tree species having higher carbon sequestration potential has been raised at Rourkela Steel Plant, Rourkela with the help of Odisha state forest department.

Vegetation survey of plantations showed that in the quadrats laid out a total of 30 tree species were recorded with maximum number of individuals of *Tectona grandis* (Teak) (284), followed by *Alstonia scholaris* (160) and *Cassia siamea* (105). In the natural forest total 12 tree species with different genus and 11 families were recorded. Shannon Weiner Diversity Index was calculated to be 0.77 and Simpson Index as 0.18. Stem density was found as 38, stand basal area 1.99 $m^2 ha^{-1}$ and stand density 1520.

The soil of Rourkela Steel plant was found to contain 32.19 t Carbon/ha with 1.2 soil density and 0.88% organic carbon.

Tree quadrat laid out at Rourkela Steel Plant, SAIL (Odisha)

10-Acre plantation raised at Rourkela Steel Plant, SAIL (Odisha)

5. *Forest Genetic Resource Management and Tree Improvement*

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

Theme:Forest Genetic Resource Management and Tree Improvement

Up to the last year (2013-14) the first three objectives i.e. development of *in vitro* regeneration system, histological and biochemical investigation at various steps during *in vitro* regeneration and acclimatization and hardening procedure for regenerated plants were completed.

During the review year, genetic fidelity testing of micropropagated plantlets were carried out. Five RAPD (Random amplified polymorphic DNA) and five ISSR (Inter simple sequence repeat markers) were employed to check the genetic fidelity of *Albizia procera* plantlets multiplied in vitro by using nodal explants. Production of monomorphic bands by *in vitro* raised plantlets and mother plant of *A. procera* against RAPD and ISSR markers confirmed the genetic uniformity of micropropagated plantlets

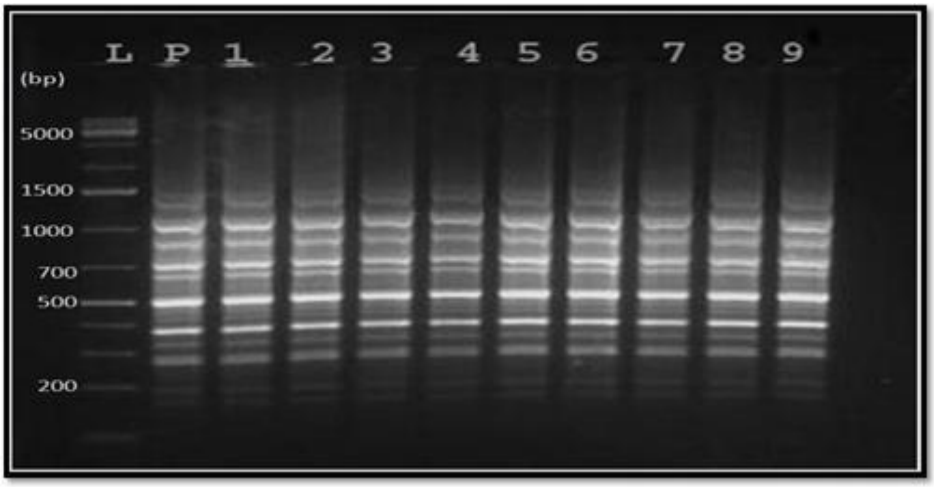


Fig 1. DNA Amplification obtained with primer: RAPD (OPY-10), Lanes L-100 bp plus DNA ladder, P- mother plant, 1–09 in vitro raised plantlets of *A. procera*

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

The highest *in vitro* rooting of 81.67% and maximum number of roots (7) was obtained with GO-MN accession on ½ B5 medium. The hardened plantlets were transferred to the field for trial comprising *in vitro* and seedling raised plants of five genotypes. The samples are to be collected from the trial for estimation of reserpine.

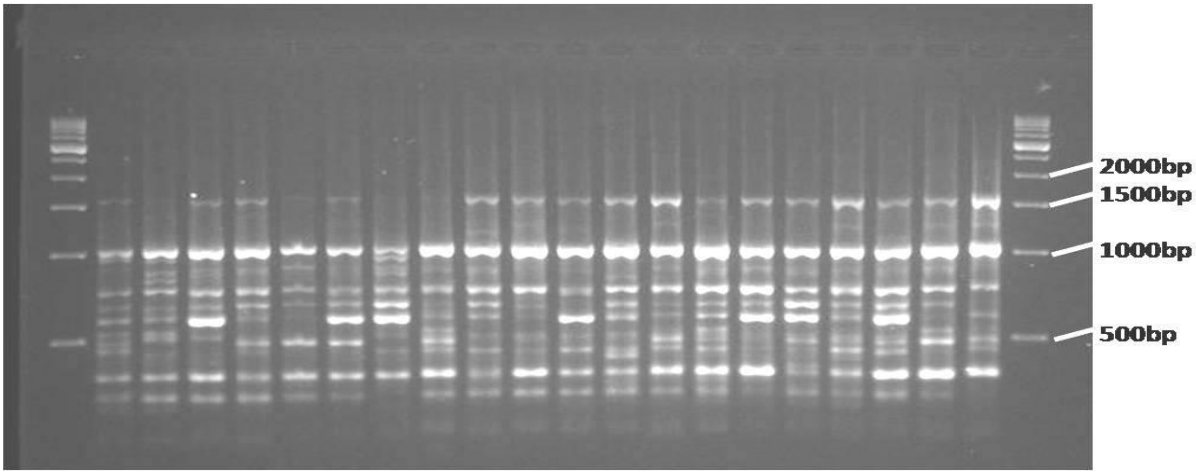
Fig. Field trial of five genotypes of *Rauvolfia serpentina*

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

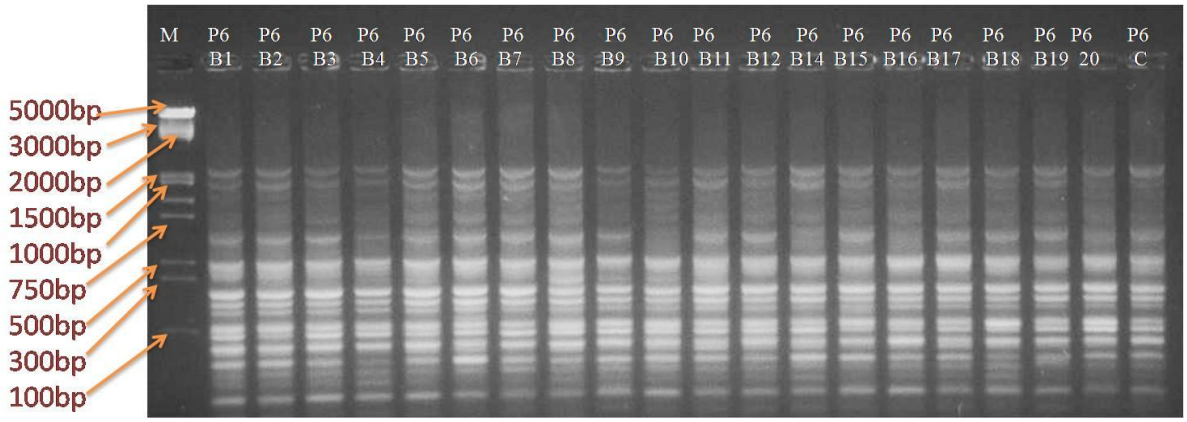
DNA samples from 03 populations of Chhattisgarh were analyzed and recorded high purity index. Genomic DNA was also checked qualitatively on 1% agarose through gel electrophoresis. No contamination of proteins and RNAs was found. Extracted genomic DNA of 12 populations of M.P. and 03 populations of Chhattisgarh were subjected to RAPD and ISSR assay. Results reveal a high diversity index and fragmented population of the species in M.P. and Chhattisgarh. Wood core samples collected from 20 trees of 03 populations of Chhattisgarh viz. Dhamtari, Narayanpur and Sarguja and analysed for fibre length. A considerable variation in fibre length was noted which ranges from minimum 919 µm (Dhamtari) to maximum 1010 µm (Sarguja).

Table: Purity index of DNA and wood fibre length

l. No.	**Populatio n name**	**DNA Purity Index**	**Average length of fibres (in µm)**
1.	Dhamtari	1.6	919
2.	Narayanp ur	1.6	975
3.	Sarguja	1.6	1010



Amplification of genomic DNA of *Boswellia serrata* using ISSR primer UBC-840



Amplification of genomic DNA of *Boswellia serrata* using RAPD primer OPA-01

(iv) Germplasm collection and exsitu conservation of *Pterocarpus marsupium* Roxb

The work of germplasm collection has been completed in nine localities viz, Parvi (20 trees) (range Bhanupratappur), Baisgaon (20 trees) (range Antagarh), Tadoki (20 trees) (range Antagarh), Balod (6 trees) (Durg range), Hati (20 trees) (Dhramjaygarh range, Raigarh), Baraudia (20 trees) (range Bilaspur), Gurda (20 trees) (range Kharsia), Raigarh (six trees) and Raipur (six trees) corresponding to three agroclimatic zones of Chhattisgarh. On the basis of availability 20 trees have been marked in each locality as superior trees based on phenotypic characters. The growth characters of individual trees have been recorded. The GPS data of individual trees have also been recorded.The pods and wood samples were collected from individual trees. The pods were utilized for raising plants. The effect of seed weight and seed size for optimizing germination was standardized. The effect of different seed size on germination was determined in different localities. The seedlings of each germplasm are being maintained in the nursery of the Genetics division. The bark samples were utilized to record dry weight biomass stored in oven at 70. C to record the dry biomass. The seeds collected from above localities were sown and data are being collected and to be analysed. Cotyledon explant responded 83% callus in the medium supplemented 5 µM BA and 2, 4-D. The shoot regenerated

only from the medium supplemented with 1.0, 2.0 and 5.0 µM BA. Nodal segment have been inoculated for *in vitro* propagation. The macropropagation work is in progress employing higher doses of auxin.

Fig: Raising of seedlings of different germplasm

(v) All India Coordinated Programme for genetic improvement of Teak

Sub project (i): Selection of plus trees, raising their progeny trials and establishing germplasm bank

Theme: Tree improvement

Rukhad and Kurai range of Seoni (South) forest division was visited and surveyed. Seven CPTs were marked and data was recorded on them along with 35 comparison trees in the prescribed format. The clonal seed orchared raised in the campus of TFRI was maintained. In Bilaspur division of Chhattisgarh Pali range was visited and surveyed. Five CPTs were marked from Pali beat and 14 CPTs were marked from Chatuva Bhauna beat and data was recorded on them along with 25 and 70 comparison trees, respectively, in the prescribed format.

Fig: Marked Candidate Plus trees in Pali range of Bilaspur Division



(vi) All India Coordinated Programme for genetic improvement of Teak

Sub Project (ii): Development of management practices of Teak Seed Production Areas, Seedling Seed Orchards and Clonal Seed Orchards.

Objectives:

1. To investigate the pattern of seed production in teak SPAs, SSOs and CSOs located in Central India (MP, CG & MS).
2. To develop silvicultural and management practices for increasing seed quantity and quality in SPAs, SSOs and CSOs.
3. To develop certification system for seeds obtained from SPAs, SSOs and CSOs.
4. To study seed physiology for maximum seedling production.
5. To establish new SPA, SSO and CSO from the collected known source and their management.

There are 2 major activities for this Teak AICP Sub-Project II in the 1st year, viz.

1. Collection of information on teak seed sources (SPAs, CSOs & SSOs) and review of existing management practices.

2. Renovation of existing nursery facilities.

- The lists of existing SPAs, CSOs & SSOs have been collected by person from State Forest Departments of MP, CG & MS.
- The above-mentioned reports have been compiled.
- Regarding the 2nd activity about the renovation of existing nursery facilities for teak, the proposal has been designed and submitted.

Nearby to Jabalpur, a healthy SPA has been identified at Kaladehi, Range Bargi, Division Jabalpur, for pursuance of further activities on fertilizer management. The procedure for proposals and necessary permissions are under process.

(vii) All India Coordinated Programme for genetic improvement of Teak

Sub project: (iii) Production of transgenic teak tolerant to defoliating pests

Development of mature teak drupes were collected from different trees and seeds were extracted. An experiment was designed to study the effect of different strengths of MS medium, seed treatment with different concentrations of GA_3 and their interactions on seed germination (%). *In vitro* seed germination in half-MS media, after overnight treatment with 0.2% GA_3 was found to be the most effective. Shoots obtained from the *in vitro* germinated seedlings were multiplied in shoot induction medium and regularly subcultured in fresh medium.

An experiment was designed to induce somatic embryo production from teak seedling explants *viz.*, internode and leaf. The effect of different conc. of IBA & TDZ, and their interaction on callus induction in the teak seedling explants was studied. Though nodular callus was observed in some of the cultures, none of the explants produced somatic embryos. Subculturing of the callus in WPM containing 1µM GA_3+10µM BA+40g/l Sucrose for somatic embryo induction / regeneration, resulted in increase in callus size without somatic embryo formation.

An experiment was conducted to study effect of different concentrations of BA (0, 0.1, 1, 5 and 10 µM) on *in vitro* shoot multiplication. Significant affect of different concentrations of BA was noted. It was observed that the lower doses of BA i.e. 0.1, 1 and 5 µM were more suited for different shoot multiplication parameters, viz., number of shoots, number of nodes , shoot length and number of leaves as compared to control and higher dose of BA. Another two factor experiment was conducted to screen out the nutrient media (MS, WPM, SH, B5 and NN) and cytokinin (BA, kinetin, zeatin, TDZ and adenine sulphate at 0.1 µM concentration) effective for shoot multiplication.

(viii) All India Coordinated Programme for genetic improvement of Teak

Sub-project (iv): Studies on population structure, linkage disequilibrium and marker-trait association mapping of Indian teak.

1. Out of the 15 teak dominated agro-climatic zones identified for collection, material (leaf, wood core and soil) from six zones i.e. Northern Hill Region of Chattisgarh (Mandla), Chattisgarh Plain Balaghat (Balaghat), Kymore Plateau Satpura Hills (Seoni), Satpura Plateau (Betul), Nimar Plains (Khandwa) and Malwa Plateau (Dewas) has been collected

(20 trees/zones) and data on morpho-metric trait (GBH, Plant height & clear bole height) was recorded.

2. Genomic DNA from collected samples (120 trees) was extracted and quantified.
3. Wood fibre slides of all the collected samples were prepared and wood fibre length and breadth (10 fibers / tree) were measured.
4. Genotyping of the collected material is under progress. Two SSR primers were completed.
5. **Base line study:** as initiated by AICP-national Coordinator is under progress to assess the level of linkage disequilibrium using material from NTGB, Chandrapur and efforts are on to complete the baseline study up to June end 2015.

Fig.1 Extraction of wood core sample and marking of tree during field visit

(ix) Collection of germplasm of *Madhuca indica* J. F. Gmel for identification of best sources in Chhattisgarh through phytochemical evaluation.

Field tours were conducted in Sarguja, Kanker, Jagdalpur, Balod and Bilaspur. Mahua trees were selected from five girth classes, viz., 61-90 cm, 91-120 cm, 121-150 cm, 151-180 cm and over 181 cm. Five trees per girth class were selected. GPS location of trees was noted. Height, GBH and crown length of the trees was measured. Around 1-2 kg flowers and fruits per tree were collected. Physical parameters of flowers, fruits and seeds were measured. Fresh weight, dry weight and moisture content (%) of the flowers were recorded. Length and width of 30 flowers per tree in three replications were noted. Girth class had statistically significant effect on the physical parameters. Individual trees also had significant effect. Soluble sugar content (%) of the mahua flowers was estimated (Dubois *et al*., 1951). Phenol content of flowers was also estimated. Fruit length, fruit width and fruit weight, seed length, seed width and seed weight of 30 seeds per tree in three replications were noted. 100 seeds per tree were sown in 4 replications for production of seedlings. Girth class had statistically significant effect on sugar content in flowers of Jagdalpur but Girth class did not have significant effect on sugar content in flowers of Sarguja and Bhanupratapur (Kanker). The interactions between girth class and individual tree had significant effect on sugar content in flowers of Sarguja. Significant effect of Girth class, individual trees and their interactions was noted on phenol concentration (%) in all the three locations of Sarguja, Bhanupratapur and Jagdalpur. Oil content and saponin content in seeds of Balod was estimated. Girth class, individual trees and their interactions had statistically significant effect on oil and saponin content. The maximum oil content (%) was obtained in girth

class 61-90 cm. Mininmum amount of saponin was obtained in seeds collected from trees of girth class above 180cm.

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

Variation in size and shape of mahua fruits and seeds from Balod

(x) Sub project 1: Survey and selection of plus trees and establishment of progeny trials of *Dalbergia latifolia* (Under main project "Genetic Improvement of *Dalbergia latifolia* Roxb. through selection and evaluation of germplasm in central India").

Forest surveys were conducted and trees of *Dalbergia latifolia* (Kala shisham) were located. In South Balaghat Forest Division in Lamta Range 12 trees were selected and 10 trees were selected in Balaghat Range. In North Balaghat Forest Division at Lalbarra Range, one tree was located. In West Betul Forest Division, in Mohda Range 21 trees were selected, in Sauligarh Range 7 trees and in Chicholi Range 3 trees were selected. In South Chhindwara Forest division, in Silewani Range 20 trees were selected. In West Chhindwara Forest Division, in Tamia Range

32 trees were selected. In Satna Forest Division, in Maiher Range 12 trees were selected. In Rewa Forest division 21 trees were selected in Mohaniya Range. In Sidhi Forest Division, 12 trees were selected. In Chhattisgarh in Jagdalpur Forest division at Dondripal Range 10 trees were selected. In Dhamtri Forest Division in Karegaon Range 4 trees were selected.

The morphological data on total height, clear bole height, GBH, crown diameter, number of primary branches, status of flowering and fruiting was noted. GPS data was also noted down.

Half-sib seeds were collected from the trees. Physical parameters of pods, viz., pod length and number of seeds present were noted in 4 replications. 100 seed weight was noted down. Seedlings were raised and germination data was recorded. Height and collar diameter of seedlings was measured.

***Dalbergia latifolia* trees selected in Chhindwara (Tamia)**

***Dalbergia latifolia* trees selected in Betul (Mohda)**

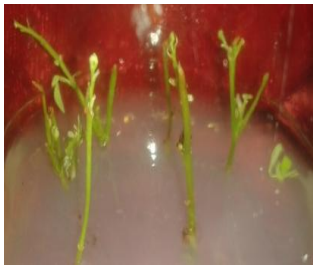
(xi) Sub project 2: To refine existing micro-propagation protocols of *Dalbergia latifolia* for production of improved planting stock (Under main project "Genetic Improvement of *Dalbergia latifolia* Roxb. through selection and evaluation of germplasm in central India").

In vitro cultures were established using nodal segments. Significant effect of MS medium strengths and BA was noted. Maximum number of nodes and shoot length was obtained on Full MS medium with 1µM BA. A two-factorial experiment was conducted to study the effect of different concentrations of BA (Benzyl adenine) (0, 0.5 and 1 µM), different concentrations of 2,4 D (2,4- Dichlorophenoxyacetic acid) (0, 0.5 and 1µM) and their interactions on callus formation (%) from different explants (leaf, internode, root and cotyledon) of *D. latifolia*

collected from Udaypur. Shoot formation was achieved on roots and internodes. Only callus was obtained on cotyledons and leaves. The effect of different doses of BA (0.1, 0.5, 1 and 2 µM) and 2,4-D (0.1, 0.5, 1 and 2 µM) were tested for shoot initiation from roots of *D.latifolia* collected from TFRI campus. Shoot formation was obtained on medium supplemented with 0.5 µM BA and 2 µM 2, 4-D.

A two-factor experiment was conducted to study the effect of different concentrations of GA_3, different culture media (MS, B5, WPM, SH and NN) and their interactions on shoot multiplication through nodal segments. Uniform dose of 0.5 µM BA was added to the medium. Significant effect of culture media and the interactions between culture media and GA_3 was observed on number of shoots. For number of nodes per shoot the effect of culture media, GA_3 doses and their interactions was found to be significant after 15 days of inoculation. GA_3 had significant effect on shoot length after 30 days of inoculation and increased the length of shoots on all the three doses.

Another experiment was conducted with an objective of shoot organogenesis/ somatic embryogenesis through immature cotyledons of *Dalbergia latifolia* collected 30,60,90, and 120 days after flowering. MS medium supplemented with kinetin (0, 0.1 and 1 mg l^{-1}) and 2,4-D (0, 0.5, 2 and 5 mg l^{-1}) was used. The effect of the two plant growth regulators used was not significant for callus obtained from 30 days old immature cotyledons. But, the effect of 2,4-D was found to be significant for callus obtained from 60 and 90 days old immature cotyledons. Somatic embryos were obtained on callus of 90 days old cotyledons.



B_5 Medium with 0.5 µM^{-1} BA & 8.67 µM^{-1} GA_3

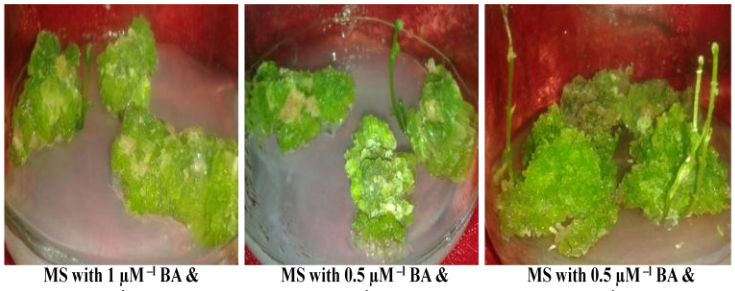
MS Medium with 0.5 µM^{-1} BA & 5.78 µM^{-1} GA_3

Shoot multiplication in *Dalbergia latifolia* after 15 days of inoculation

B_5 Medium with 0.5 µM^{-1} BA & 2.89 µM^{-1} GA_3

NN Medium with 0.5 µM^{-1} BA & 2.89 µM^{-1} GA_3

Shoot multiplication in *Dalbergia latifolia* after 30 days of inoculation



MS with 1 µM^{-1} BA & 1 µM^{-1} 2,4-D | MS with 0.5 µM^{-1} BA & 2 µM^{-1} 2,4-D | MS with 0.5 µM^{-1} BA & 2 µM^{-1} 2,4-D

Shoot initiation from the root callus of *Dalbergia latifolia* after 90 days of inoculation.

(xii) Collection and morpho-molecular characterization of critically endangered *Litsea glutinosa* germplasm from Madhya Pradesh and Chhattisgarh

Dhamtari, Kondagaon, Seoni (South), Bhanupratapur, Jabalpur, Jagdalpur, Rewa, Marwahi, Satna and Anuppur forest divisions were visited and planting material of critically endangered *litsea glutinosa* were collected. Detailed morphometric data (total plant height, clear bole height, girth at breast height, crown radius, crown diameter, crown height, number of primary branches, bark weight per unit area, leaf area, leaf weight and specific leaf area) was recorded on the located trees.

Nursery was raised from the collected planting material. Seeds collected during the last season will be raised in coming April-May, 2015. Recorded data is under process of analysis.

Fig. 1 Marking and recording of data of *Litsea glutinosa* tree in Amarkantak Forest Division

Fig. 3 Fruits of *Litsea glutinosa* tree collected during field visit.

(xii) Bamboo genetic evaluation, improvement and propagation

The bamboo bearing areas of the four species viz, *Bambusa tulda*, *Bambusa vulgaris*, *Dendrocalamus strictus* and *Bambusa bambos* have been visited in three states and selected four numbers of rhizomeson the basis of selection of superior clupms. Besides, the passport data have been recorded for four promising clumps of each species as per the format. Survey was conducted at the Indira Gandhi Krishi Vishvadilaya (IGKV), Raipur and Dondrepal, Jagdalpur (Chhattisgarh) and four number of rhizomes have been collected from these areas. Survey and selection of promising clumps in M.P (Mandla, Chhindwara, Seoni (Fig 2), Odisha (Anugul, Bhubaneshwar) and Chhattisgarh (Bilaspur, Raipur, Raigarh, Kharsia) was done. The clonal trial comprising many species of bamboo was raised by IGKV Raipur but now only two species viz, *Dendrocalamus strictus* and *Bambusa bambos*, are existing. A total of 169 rhizomes have been collected so far. Germplasm bank established in the Silviculture nursery of the institute. Propagation of bamboo species is in progress.

Fig: Collection of diverse germplasm and their propagation

(xiv) Commercial Production of Quality Planting Material of Bamboo Species

The cultures of four assigned species viz, *Bambusa nutans, Bambusa tulda, B. vulgaris* var. Green, and *Dendrocalamus asper* have been initiated.

Fig: Initiation and establishment of shoot cultures of bamboo species

(xv) Comparative field performance of seedling and clonal planting stock of *Buchanania lanzan* Spreng

Half sib progenies (fruits) of *Buchanania lanzan* were collected from thirteen selected plus trees. Before sowing, the seeds were soaked in cold water for 24 hours. 200 seeds of each family (plus tree) were sown in the polybags (size 10x8cm) filled with soil, sand and farm yard manure (FYM) in 1:1:2 ratio. Germination started after ninth day and completed in 21 days. Number of germinates were recorded everyday during the germination period. Maximum 75% germination was recorded for clone number 12 (Delakhari). Mechanical seed coat breaking pretreatment was also given to break the dormancy of one month old seeds. It was observed that maximum 80% and minimum 50% germination were recorded. Seeds of *B. lanzan* were kept in different environment condition i.e. poly house under shade, shade house and open condition. Germination started in seventh day and completed in twenty days in poly house under shade. Oil percentage in CPT no. 8 (56.2%) and CPT no. 5 (55.75%) were found to contain maximum oil content among all the thirteen CPTs analyzed.

6. Forestry Education and Policy Research to Meet Emerging Challenges

6.1. Improving Formal Forestry Education-

6.1.1 FRI University (Applicable to FRI University only)

6.2 Accreditation of Universities: (Applicable to FRI University only)

6.3 Networking Forestry Education with Research and Extension

6.3.1 Participation in Seminar/Symposia/Workshop/Trainings/Meetings/Key Lecture delivered etc.

National Seminar On Women Empowerment , June 24th - 25th, 2014 organised by Bastar Vishwavidyalaya, Jagdalpur and in Association of Indian Universities, New Delhi 1) Role of Women in Agriculture , Forestry and Allied Industry by Dr Rajiv Rai (2) Women Empowerment, its barriers and need to overcome for Gender equality by Dr Rajiv Rai

National Seminar as Invited Speaker On National Seminar Sustainable livelihoods development through Non Timber Forest Products-Issues Challenges and Way Forward 26-27 sep 2014 submission of Papers and presentation (1) Collection and Harvesting of Prominent NTFPs in Central India by Dr Rajiv Rai (2) Market Infrastructure and Price Structure of NTFP's in Madhya Pradesh by Dr Rajiv Rai

National seminar on Urbanization and its Impacts on Environment" on 6th-7th December 2014 organized by Dept. of Botany Govt. Girl's College, Satna (MP). as Key note speaker and resource person 1) Key Note Speaker Impact of urbanization on Environment, Threat and Strategies by Dr Rajiv Rai. submission of Papers (2) Impact of Urbanisation on Biodiversity of plants yielding Dyes and their utilization from Vindhya Forest Eco system as a source of livelihood by Dr Rajiv Rai. (3) Conservation of biodiversity by ethnic communities in Sacred groves their distribution and threats due to rapid Urbanisation in Satpura region in Madhya Pradesh By Dr Rajiv Rai .

National Seminar Contribution of life science in socio economic development of mankind on 24 Dec 2014 Govt College at Narsinghpur submission of Papers submission of Papers and presentation o n " Uses and Measures to Popularize Traditional Tribal Medicinal with Knowledge special reference to Tribes of Madhya Pradesh and Chhattisgarh by Dr Rajiv Rai .

National Workshop cum seminar March 9-11, 2015 at Indira Gandhi National Tribal University Amarkantak MP submission of Papers and presentation on " Uses and Measures to Popularize Traditional Tribal Medicinal with Knowledge special reference to Tribes of Madhya Pradesh and Chhattisgarh " by Dr Rajiv Rai .

National Seminar on ENVIRONMENTAL CONSERVATION CHALLENGES AND REMEDIES 19-20 March 2015 Ogranised by Autonomous science college, Jabalpur

submission of Papers and presentation on " Assessment of Floristic Diversity, Status, Utilization and Strategies in Conservation of Medicinal Plants in Seoni district, Madhya Pradesh" by Dr Rajiv Rai .

Dr. Nanita Berry, Scientist 'D' participated in the International Conference on " Sustainable NTFPs Resource Management and Market Development' and presented a paper titled **"NTFP resource management & market development**", during "International Herbal Fair" held from 20th December to 22nd December, 2014 at Bhopal (M.P.).

Dr. Nanita Berry, Scientist 'D' participated as coordinator in the National workshop on " **Quality planting material for agroforestry and any plantations**" held from 17th-18th January, 2015 at Rajmata Vijayraje Sindhiya Agricultural University, Gwalior (M.P.).

Dr. Nanita Berry, Scientist 'D' participated and deleivered lecture on Agroforestry and its models for various sites in the Van Vigyan training programme on 27th May, 2014 at VVK Raipur (Chhattisgarh) and on 28th May, 2014 at VVK, Bilaspur and on "ICFRE technologies" at VVK centre of Bilaspur (Chhattisgarh) to the forest officials and progressive farmers of Chhattisgarh state.

Dr. Nanita Berry, Scientist 'D' participated and deleivered lecture on Agroforestry and its models for various sites in the Van Vigyan training programme on 18th September,2014 at VVK Jabalpur (M.P.) VVK, Jabalpur (M.P.) to the forest officials and progressive farmers of Mahakoshal region of M.P.

Dr. Nanita Berry, Scientist 'D' participated and delivered lecture on Agroforestry and its models for various sites in the Van Vigyan training programme on 7th December, 2014 at VVK centre of Jalna, Maharashtra to the forest officials and farmers of various forest circle of Maharashtra state.

Dr. S. Chakrabarti, Scientist F attended training on "Role of Scientists in Environment & Natural Resources Management" held at IIFM, Bhopal on 16 – 20 February, 2015.

Dr. S. Chakrabarti, Scientist F attended two workshops on "Sal borer mortality" held on 16 & 23 March, 2015 held at TFRI, Jabalpur.

Dr. Avinash Jain, Scientist F attended workshop on "Effect of forests on water resource management in the catchment area of west Mandla forest division" during 21 August 2014 at Working Plan Office Jabalpur (M.P.).

Dr. Avinash Jain, Scientist F attended workshop cum training programme on "Strengthening of network for outreach of research findings" during 17 & 30 October 2014 at Van Vigyan Kendra, SFRI Campus, Jabalpur.

Dr. S. Chakrabarti, Head; Avinash Jain, Scientist F, Dr. A.K. Bhowmik, Scientist D; Shri M. Rajkumar, Scientist B; Shri R.B. Manjhi, Res. Officer; Smt. Chandralekha Taksande, Res.

Officer attended workshop on "Biodiversity Act 2002, India" during 19-20 March 2015 at TFRI Jabalpur.

Shri. M. Rajkumar, Scientist B attended one meeting (May 29-June 3 2014) of Task Force constituted by the Forest Department, Govt. of Madhya Pradesh, for assessing environmental impacts of Diamond Mine Project, Majhgawan, Panna.

Avinash Jain, A.K. Bhowmik, R.B. Manjhi, C. Lepande, Shivkumar Kourav and M. Rajkumar. Carbon sequestration assessment and annual sequestration by non-destructive method in plantations raised at NTPC Dadri. Paper published in Souvenir of National Workshop on carbon sequestration in forest and non-forest ecosystem held at JNKVV Jabalpur during 16-17 February 2015.

Dr. N. Kulkarni, Scientist-G participated and presented the invited research paper entitled "IPM in Forest Insect Pests – Retrospect and Prospects" in National Symposium on Entomology as a Science and IPM as a Technology – The way forward, organized by Entomology Society of India, IARI, New at College of Agriculture and Horticulture (Central Agricultural University), Pasighat (Arunachal Pradesh), India.

Dr.P.B.Meshram, Scientist-F, participated and presented the research paper entitled" Biological control of insect pests of some important medicinal plants - *Abelmoschus moschatus, Gloriosuperba, Withania somnifera* and *Emblica officinalis* in 13th Silviculture Conference at Forest Research Institute, Dehradun on 24-28 November, 2014.

Dr. N. Kulkarni, Scientist-G participated and presented invited research paper entitled "Honey Bee as Pollinators: Prospects in Forestry" in National Seminar on Recent Trends in thurst area of Life Sciences" at Department of Bioscience, Guru Tegh Bahadur Khalsa College, Jabalpur on 10th-111th January 2015. Abstract Pp.27-28.

Dr. N. Roychoudhury, Scientist-G participated 13th Silviculture Conference and presented research paper, entitled "Toxicity of bio- and chemical pesticides against beetles of sal heartwood borer, *Hoplocerambyx spinicornis* Newman and their efficacy in tree traps and los in timber depot" authored by N. Roychoudhury, N. Kulkarni, S. Chandra, R.B. Singh and A.K. Das held during 24th -28th November 2014 at Forest Research Institute, Dehradun.

Kulkarni, N., Paunikar, S. and Mishra, V.K. (2014). Entomopathogenic nematodes from forest floors of Madhya Pradesh and their use against forest insect pests (Abstract). Interface on Management of Economically Important Insects in India, JNKVV, Jabalpur pp 50-51.

Chandra, S., Yadav, S. and Kulkarni, N. (2014). Predator potential of *Canthecona furcellata* Wolff. on teak skeletonizer (*Eutectona machaeralis* Walker). Paper in Interface on Econimically Important Insects in India, 16th August, 2014, College of Agriculture, JNKVV, Jabalpur (MP), India (Abstract on no.55).

Ahmad, M., Kulkarni, N. and Paunikar, S. (2915). White grubs: the major pests of seedlings in forest nurseries in cental India. Paper presented in National Seminar on Recent Trends in Thrust

Areas of Life Sciences, Jan., 10-11, 2015, Department of Bioscience, Sri Guru Tegh Bhadur Khalsa College, Jabalpur (MP), India (Abstract no.0-13, p.no. 23)

Kulkarni, N., Chandra, S., Arse, S., Ahmad, M., Kori, B. and Paunikar, S. (2015). Honey bees as pollinators: prospects in forestry. Paper presented in National Seminar on Recent Trends in Thrust Areas of Life Sciences, Jan., 10-11, 2015, Department of Bioscience, Sri Guru Tegh Bhadur Khalsa College, Jabalpur (MP), India (Abstract no.0-17, p.no. 27)

Chandra, S., Kori, B., Kushwaha, D. and Kulkarni, N. (2015). Propsects of *Canthecona furcellata* and *Chrysopela carnea* as biological control agents forest insect pests. Paper presented in National Seminar on Recent Trends in Thrust Areas of Life Sciences, Jan., 10-11, 2015, Department of Bioscience, Sri Guru Tegh Bhadur Khalsa College, Jabalpur (MP), India (Abstract no.0-23, p.no. 31).

Paunikar, S., Kulkarni, N., Bhandari, R. and Ahmad, M. (2015). Susceptibility of white grub, *Holotrichia rustica* (Coleoptera : Scarabaeidae) to entomopathogenic nematode, *Steinernema carpocapsae*. Paper presented in National Seminar on Recent Trends in Thrust Areas of Life Sciences, Jan., 10-11, 2015, Department of Bioscience, Sri Guru Tegh Bhadur Khalsa College, Jabalpur (MP), India (Abstract no.0-26, p.no. 33)

Shri Hari Om Saxena participated in International Conference on "**Harnessing the sub-Himalayan Plant Diversity for Human Welfare"** held on 11 -13th March, 2015 at Dibrugarh University, Dibrugarh (Assam) and presented a paper on "**HPTLC analysis of Lupeol in roots of *Uraria picta* Desv.: A Dashmool species for identification of superior germplasm and conservation".**

Smt. Neelu Singh, Scientist-E & Head NWFP Division attended two days workshop on "Strengthening Network for Outreach of research Findings" on 12-13 March, 2014 at Angul (Orissa).

Smt. Neelu Singh, Scientist-E & Head NWFP Division participated in ICFRE Extension workshop at Bilaspur (CG) from 28-29 May, 2014.

Smt. Neelu Singh, Scientist-E attended a workshop on "Sustainable Livelihoods Development through Non Timber Forest Products: Issues, Challenges and Way Forward" and presented paper entitled "Influence of collection and value addition practices of Non Timber Forest products on their quality" held on 26th-27th Sept., 2014.

Smt. Neelu Singh, Scientist-E attended and delivered lectures on "1. Processing of Bael, 2. Drum Drought Dryer, 3. Preparation of re-cycled paper and 4. Cultivation techniques of medicinal plants- Kalmegh, Satawar, Ashwagandha" in ICFRE Extension Workshop programme in Van Vigyan Kendra, Jalna (MS) on 08-12-2014.

Smt. Neelu Singh, Scientist-E attended a training program/workshop entitled "भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद् द्वारा विकसित अनुसंधान निष्कर्षों के विस्तार हेतु नेटवर्क का सशक्तिकरण पर प्रशिक्षण" from 28th-29th May, 2014 at Bilaspur (C.G.).

Dr. M. Kundu participated in 13th Silviculture Conference to be held in 24st -28nd November 2014 at Forest Research Institute, DehraDun. and presented a poster on 'Ecophysiology of seed germination of a tropical forest tree *Sterculia urens'*

Dr. M. Kundu and Mr. N. P. S. Nain participated in teaching programme on Compulsory Basic Forestry Course for Ph. D students of FRI University

6.3.2 Visits Abroad: NIL

6.4 Capacity Buildings Scientific and Management Cadre (Trainings organized)

- Organized 5 day training programme on "Familarising with Biodiversity-Systematics of Plant and insects" from 3rd-7th November 2014.
- Training for capacity building of stake holders and Bamboo Artisans Date of training: 09 -13th June, 2014 Venue: Ecodevelopment Center- Banjari (Van NiriksharanKutiBanjariDhuma Uttar Seoni (Sa.) Vanmandal)
- Training for capacity building of stake holders and Bamboo Artisans Date of training: Date of training: 09 -12th July, 2014, Venue: CFC- Garra, Balaghat
- Training for capacity building of stake holders and Bamboo Artisans Date of training: 07 -11th August, 2014, Venue: FRH, Kalpi, Mandla
- Training for capacity building of stake holders and Bamboo Artisans Date of training: 14-25July, 2014 Venue: TFRI Jabalpur
- Training for capacity building of stake holders and Bamboo Artisans Date of training: 05 -09th January, 2014 Venue: Eco-development Center, Narsinghpur Range Office
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 05-09th January, 2015, Venue: Eco-development Center, Rahatgaon
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 02-06th February, 2015, Venue: Eco-development Center, Panna
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 02-06th February, 2015, Venue: Hama Depot, Kanpur Road Chhattarpur
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 24-28th February, 2015, Venue: Jaisingh Nagar, Shadol
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 24-28th February, 2015, Venue: Sonaura, Kanpur Road Satna
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 23-27th March, 2015, Venue: Range office, Guna
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 24-28th March, 2015, Venue: Chitrangi, Singrauli.
- Training for capacity building of stake holders and Bamboo Artisans, Date of training: 24-28th March, 2015, Venue: Gandhi gram, Sidhi
- Two trainings entitled **"Training on Analytical Instruments"** and **"Training on Instrumentation"** were organized on 30/06/2014 to 04/07/2014 and 23/02/2015 – 27/02/2015 respectively for enhancing the skills and abilities of participants on various advanced and sophisticated instruments used for carrying out quality research.

7. Forestry Extension for Taking Research to People

7.1 Collection Compilation and Publication of Forestry Reports/Journals

7.1.1 Research Publications (Book, Book Chapters, National journals, International journals, Abstracts, Proceedings, Reports etc.)

Herbal home made remedies in cure of Diabetes in Folk claims in Central India by Dr Rajiv Rai for publication in book Drugs from plants in book edited by Dr P C TRIVEDI .

Ethno Medicinal Uses Of Herbal Plants In Snake Bite Ethno medicinal plants by Dr Rajiv Rai in book edited by Dr P C TRIVEDI .

Cultivation practices of Geranium species Pelargonium graveolens Rai in book edited by Dr P C TRIVEDI.

Sacred groves in tribal pockets of MP and plants in conservation of biodiversity by Dr Rajiv Rai in book edited by Mrs Nandita Krishna.

Wild forestry species prevalent in food among primitive tribes in MP by Dr Rajiv Rai in edited by Mrs Nandita Krishna.

Manpower Potential , Employment status and forest based livelihood opportunities among tribal communities of Jharkhand, India.[International Journal]

Exploration of variables predicting livelihood assets status of tribal communities subs ting in forest in Jharkhand by Dr Rajiv Rai et.al. in J. Human Ecology 47(3) : 241-249.[Internatinal Journal]

Dr. Nanita Berry prepared and submitted "Project completion report of " Evaluation of *Madhuca indica* based silvi-agri system in arid and semi-arid zone of India".

Dr. Nanita Berry prepared and submitted " Report on "Achievements of Agroforestry " since last 25 years.

An abstract of research paper titled ‘ Evaluation of medicinal plant based silvi- medicinal system in Jabalpur district of Madhya Pradesh" was published by Dr. Nanita Berry in the Souvenir of National conference on “ New frontiers in Medicinal Plant Research (NCMP-2015) " held from 26-27 February,2015 at Osmania University and College of Women, Koti, Hyderabad , co-sponsored Institute of Forest Biodiversity, Dullapally, Hyderabad (Telangana).

An abstract of research paper titled ‘Conservation of medicinal plant through silvi- medicinal system : a sustainable approach" was published by Dr. Nanita Berry in the Souvenir of National

Seminar on " Environmental Conservation: Challenges and Remedies " held from 19 - 20 March,2015 at Govt. Model Science College , Jabalpur (M.P.).

Berry ,Nanita (2015). Mahua: adiwasi ki ajiwika ek mahatwpurna sadhan. Van sangyan-March,2015,a TFRI publication.

Dr. Sanjay Singh, as Co-PI prepared the PCR of ICFRE funded project **"**Monitoring the impact of climate variables on plant diversity in Bhimashankar permanent preservation plot of Sub tropical hill forest of Maharashtra."

Dr. Sanjay Singh, as Co-PI prepared the PCR of Chhattisgarh state Forest Department Funded Project "Investigation on floristic diversity in teak plantation of various age groups in Barnawapara Project Division, Raipur, Chhattisgarh"

Roychoudhury, N., Chandra, S. and Deepa, M. (2013). *Dirades* theclata Guenee (Lepidoptera : Epiplemidae) : A major defoliator of *Haldinia* cordifolia (Roxb.) in Madhya Pradesh, *Journal of Tropical Forestry*, **29** (iv) : 63-67.

Meshram, P.B. and Soni, K.K.(2014).Insect pests and diseases of *Buchnania lanzan* and their management in central India. *Indian Journal of Tropical Biodiversity*, 22(1):28-38.

Meshram, P.B. (2014). औषधीय पौधों पर लगने वाले कीट एवं उनका जैविक नियंत्रण. *Van* Sangyan, May 2014:7-15.

Roychoudhury, N., Kulkarni, N. and Das, A.K. (2013). Sal heartwood borer and its natural enemies. *Vaniki Sandesh* **4** (3) : 1-7.

Saxena, H.O., Soni, A., Mohammad, N. and Choubey, S.K. (2014). Phytochemical screening and elemental analysis in different plant parts of *Uraria picta* Desv.: A Dashmul species. *Journal of Chemical and Pharmaceutical Research*, 6(5):756-760.

Singh, Neelu, Kori, D.C. and Choudhary, K.C. (2015). Biological Diversity: Seeds of medicinal plants *Van* Sangyan, March 2015:35-39.

Saxena, H.O., Soni, A., Mohammad, N., Kakkar, A. and Singh, N. (2014). HPLC analysis of rhoifolin in different plant parts of *Uraria picta*: a dashmool species. *Indian J Trop Biodiv*, 22(2): 199-201.

Saxena, H.O., Deshmukh, A., Ganesh, Kakkar, A., Singh, N. (2014). Phytochemical screening and assessment of secondary metabolites in different plant parts of *Solanum xanthocarpum*: a dashmool species. *Indian J Trop Biodiv*, 22(2): 164-169.

Mall, A., Saxena, H.O., Agrawal, N. and Sarkar, N. (2014). Development of various shades on cotton fabrics using natural dyes from leaves of *Butea monosperma* for application on handloom and crafts products. *Indian J Trop Biodiv*, 22(2): 210 – 213.

Mall, A., Saxena, H.O., Agrawal, N., Sarkar, N. and Sharma, B. (2015). Natural dyes from leaves of *Butea monosperma* to enhance livelihood opportunities for craftswomen through applications on handloom products. In: *Women in the 21st Centuary: Working towards Empowerments: Proceedings of conference* (ed. Dominic D.S.), 2015 Feb 13 – 14, Goa College of Home Science, pp. 237 – 239.

Saxena, **H**.O., Tripathi,Y.C., Pawar, Ganesh, Kakkar, A. and Mohammad, N. (2015). Botanicals As Biopesticides: Active Chemical Constituents And Biocidal Action. In: *Familiarizing with Biodiversity- Notes on systemic of Plants and Insects* (eds. S. Singh, P.K. Khatri, P.B. Meshram, P. Subramanyam and U. Prakasham), pp. 196 – 211, TFRI Publication, Jabalpur, India.

Kundu, M.,Chaturbedi, N. (2014). The role of fruit coat in germination of *Pterocarpus marsupium* seeds. International J. current research (6): 7935-937.

Girish Chandra, N P S Nain, U Prakasham, P K Khatri and Kandhi Singh. On Seed Collection Levels in Various Types of *Shorea Robusta* Forest in Hill and Plain Agro-climatic Zones of Central India. International Journal of Statistics and Analysis. ISSN 2248-9959 Volume 5, Number 1 (2015), pp. 1-13

Abstract of the paper entitled 'Storage response of seeds of *Aquilaria agallocha* Roxb. on their viability' was published in the Proceeding of National Seminar on 'Recent advances on agarwood research' to be held in 10-11 March, 2015 at Rain Research Institute, Jorhat

Contributed in book chapters in Advances in forest seed science & technology; ICFRE state of knowledge series-1. Eds: Manisha Thapliyal. Greenfields Publishers, DehraDun.

Kundu, M. (2014). Identification of the best seed collection time with respect to seed maturation stage. In: Seed technology and seed pathology, eds: Archana Sharma, O.P.Choubey, Ram Prakash. Pointer Publishers Jaipur, Rajasthan.

7.1.2 National Forest Library and Information Centre (NFLIC) (Applicable for FRI, Dehradun only)

7.1.3 Environmental Information System (ENVIS) (Applicable for FRI, Dehradun only)

7.2 Dissemination of developed technologies

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

To disseminate information about various technologies developed, institute provide regular funds to organize training programmes by them and also provide literature published in Hindi, English and regional language. Four VVKs one each in the state of Madhya Pradesh,

Chhattisgarh, Maharshtra and Odisha and one Demo village at Moiya Nala, in Bijadandi West Mandla Forest division is working under the institute.

In all 11 training programmes including 3 Workshop cum training programme under One time special grant (OTSG) were organized by TFRI, Jabalpur as per details given herein below in Van Vigyan Kendra of Chhattisgarh, Madhya Pradesh and Maharashtra. These training programmes were organized by TFRI for the frontline staff of state forest department, Vandoots, NGOs, SHGs and farmers.

- One day training programme organized by Forest Extension Division in Van Vigyan Kendra Chhattisgarh on the topic " वन रोपणियों तथा वृक्षारोपणों के कीटों तथा रोगो का समन्वित प्रबंधन" at Raipur on 26/5/2014
- One day Training programme organized by Forest Extension Division in Van Vigyan Kendra Chhattisgarh on the topic " उन्नत नर्सरी तकनिक एवं कृषि वानिकी पर प्रशिक्षण " at Raipur on 27/5/2014.
- A two day workshop-cum-training programme was organized by TFRI, during 28-29 May 2014 at Bilaspur (CG) for Strengthening Network for Outreach of research Findings of ICFRE and its institute under OTSG to ICFRE. For this workshop cum training programme 20 technologies developed by TFRI and other ICFRE institutes, which are suitable for Chhattisgarh were presented and extended to the participants for extension in Chhattisgarh state.
- One day Training programme on "वन रोपणियों तथा वृक्षरोपणों मे कीटो तथा रोगों का समन्वित प्रबन्धन" was organized by Forest Extension Division in VVK Madhya Pradesh, Jabalpur on 27/8/2014. Training programme was attended by 83 Vandoot, Farmers and frontline staff from state forest department.
- One day training programme was organized on 18/9/2014 on "मध्य क्षेत्र हेतु उपयुक्त कृषि वानिकी पद्धतियाँ एवं उनका प्रबंधन".
- One day training programme was organized on 29/9/2014 on "उच्च गुणवत्ता के पौध उत्पादन हेतु उन्नत नर्सरी तकनीकी एवं बीजों का चयन तथा भंडारण".
- **Two,** one day workshop-cum-training programme were organized by TFRI, on 17th and 30th Oct., 2014 at Van Vigyan Kendra, Office of the Conservator of Forest, Research and Extension, Jabalpur on Strengthening Network for Outreach of research Findings of ICFRE and its institute under OTSG, ICFRE. For this workshop cum training programme 20 technologies developed by TFRI and other ICFRE institutes, suitable for Madhya Pradesh were presented and extended to the participants for extension in Madhya Pradesh state.
- In all, 125 and 150 participants attended workshop-cum-training respectively on 17th and 30th Oct., 2014 (SHG, VSS member, Forest guards, Farmers, NGO, and other officials from Madhya Pradesh state Forest department had attended the workshop).
- वन विज्ञान केन्द्र महाराष्ट्र। जालना में दिनाँक 07/12/2014 को **उन्नत नर्सरी, बीज प्रौद्योगिकी, वृक्ष सुधार तकनिक एवं कृषि वानिकी** विषय पर एक दिवसीय प्रशिक्षण कार्यक्रम किसानों, वन विभाग के कर्मचारियों तथा हेतु आयोजित किया गया।
- वन विज्ञान केन्द्र महाराष्ट्र, जालना में दिनाँक 08/12/2014 को **वन रोपणियों तथा वृक्षारोपणों के कीटों तथा रोगो का समन्वित प्रबंधन** विषय पर एक दिवसीय प्रशिक्षण कार्यक्रम किसानों, वन विभाग के

कर्मचारियों तथा हेतु आयोजित किया गया।

- वन विज्ञान केन्द्र महाराष्ट्र, जालना में **दिनाँक 09-10 दिसंबर 2014 को भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद द्वारा विकसित अनुसंधान निष्कर्षों के विस्तार हेतु नेटवर्क का सशक्तिकरण पर *दो दिवसीय* कार्यशाला एवं प्रशिक्षण कार्यक्रम** आयोजित किया गया।

In the Demo village at Moyia Nala, at present plantations of following two technologies are being maintained by Forest Entomology and Forest Pathology division respectively.

a. Relative resistance in some teak clones against defoliator and skeletionizer.
b. Use of biofertilizer (VAM and Azospirillium) in forestry tree species.

Regular watch and ward as well as maintenance activities are being undertaken.

Dr. Nanita Berry, Scientist 'D' participated as a invited speaker and delivered lecture during five days training workshop on "Lac cultivation" to the participants of various districts of Madhya Pradesh and demonstrated at the farmer's field of Sohad village during the programme held on 27 / 11/2014 at TFRI, Jabalpur (M.P.)

Dr. Nanita Berry, Scientist 'D' participated as a resource person and delivered lecture during three days training workshop on "Cultivation of medicinal plants" under MoEF sponsored training programme, New Delhi, organized by TFRI, Jabalpur held from 8/07/2014 to 10/07/2014 .

7.2.2 Direct to consumer Scheme:– Nil

7.2.3 Technologies transferred:-

A seminar cum workshop programme had been organized by the institute for "Outreach of Research Findings". This programme was organized to disseminate research findings of the identified technologies suitable for the state of Madhya Pradesh. Similar such programme has also been under consideration for the state of Chhattisgarh, Orissa and Maharshtra. Following technologies were identified during these programs.

Dr. Nanita Berry participated by presenting the developed technologies on Teak-turmeric silvi-medicinal system, Bamboo based silvi-agri system and Bach-paddy agri-medicinal system in the two days workshop on "Transfer of ICFRE-TFRI Technologies" held from 28th - 29th of May, 2014 at Bilaspur (Chhattisgarh) to the progressive farmer and forest officials of Chhattisgarh state.

Dr. Nanita Berry participated by presenting the developed technologies on Teak-turmeric silvi-medicinal system, Bamboo based silvi-agri system and Bach-paddy agri-medicinal system in the two days workshop on "Transfer of ICFRE-TFRI Technologies" held on 17th October,2014 and 30th October, 2014 at Jabalpur (M.P.) to the progressive farmer and forest officials of Madhya Pradesh state.

Dr. Nanita Berry participated by presenting the developed technologies on Teak-turmeric silvi-medicinal system, Bamboo based silvi-agri system and Bach-paddy agri-medicinal system in the

two days workshop on "Transfer of ICFRE-TFRI Technologies" held from 9th - 10th of December, 2014 at Jalna (Maharashtra) to the progressive farmer and forest officials of Maharashtra state.

Demonstration of agroforestry models:

Demonstrated field of developed technology on various agroforestry system such as Silvi-medicinal system, Bamboo based silvi-agri system and horti-silvi-agri system to the number of groups of Forest guard/ Farmers/ Scientist/ Students of various organization at TFRI demonstration field during the period.

1. A Group of forest officials of Balaghat.
2. A Group of forest guards of Lakhnadon, Seoni
3. A Group of Forest guards of Pachmarhi on 30/12/14.

Transferred technologies developed in Forest Ecology & Rehabilitation Division to farmers and forest officials through workshop-cum-training programme on "Strengthening the network for outreach of research findings developed by ICFRE" conducted during 17 & 30 October 2014 at Van Vigyan Kendra, Jabalpur.

Two days training programme on "Ecofriendly management of bark eating caterpillar on aonla" was organized at CFRHRD,Chhindwara on 09-10th February, 2015. Thirteen SFD officials (Dy Range Officers, Foresters & Forest Guards) and 25 Farmers were participated in training programme. Lectures were delivered and study materials circulated to the trainees. Field visit was conducted in aonla plantation in the campus of CFRHRD, Chhindwara.

7.3 Evolving and coordinating comprehensive extension strategies in forestry research

7.3.1 SLEM

Land degradation is a major concern for India with the country's National Action Plan to Combat Desertification (UNCCS-NAP), 2001 identifying 6 major causes for the issue that include unsustainable water management, poor agricultural practices, human and livestock pressure on land, deforestation, climate change and industrialization. These concerns would multiply many folds if these were juxtaposed with the fact that 72% of India's population is rural ad depend mainly on land and water resources and that at present 80% of all Indian farmers are under the poverty line. In this background Sustainable Land and Ecosystem Management (SLEM) Approach was evolved. SLEM is a joint initiative under the Country Partnership Project (CPP) of Government of India (GOI) and Global Environmental Facility (GEF). The goal of SLEM-CPP is to apply multi-sectoral approach to land management related to Biodiversity Conservation and Climate Change issues in several Indian states through a multi-stakeholders project to support adaptation and Implementation of sustainable land management.

7.3.2. Seminar/Symposia/Workshops/Training Organized

TFRI, Jabalpur organized the following workshop/training programs during the year:-

- Orgnaised a workshop on " National Biological Diversity Act, 2002: constraints and oppurtunities for scientific community, under the auspices of NBA, India. On 19-20 March 2015
- Dr. Avinash Jain, Scientist F organized workshop on "Carbon sequestration through afforestation" at Rourkela Steel Plant (Odisha) on 24 June 2014.

- A workshop on " Carbon sequestration through afforestation" at Rourkela steel plant (Odisha) has been organized by Forest Ecology and Rehabilitation Division on 26/06/2014

Trainings

Total 18 training programme excluding trainings organized in VVKs were organized by TFRI for Bamboo artisans and craftsmen, Research fallows and others as per details given herein below.

- Two training programmes had been organized by TFRI under MP State Bamboo Mission consultancy at Dhooma District Seoni during 9-13 June 2014 and 16-20 June 2014 at Balaghat for Skill upgradation of Bamboo artisans.
- Two training programmes had been organized by TFRI under MP State Bamboo Mission consultancy at Dhooma District Seoni during 9-13 June 2014 and 16-20 June 2014 at Balaghat for Skill upgradation of Bamboo artisans.
- A training programme entitled " Training on Analytical Instrument (30/06/2014 to 04/07/2014)" organized by Non Wood Forest Product Division
- Organized a Short Term Training programme "Familiarizing with Biodiversity: Systematics of Plants and Insects" during 03-07 th November 2014.
- Two training programmes had been organized by TFRI under MP State Bamboo Mission consultancy, in Common Facility Centre under MP State Bamboo Mission at Harda (MP) and Narsinghpur (MP) during 5-9 January 2015 for Skill upgradation of Bamboo artisans.
- Three training programmes, 5-9 January 2015, 12-16 January and 27-30 January 2015 were organized by TFRI for B.Sc. final year students from Govt. Science College, Jabalpur
- Two training programme were organized by institute for B.Sc. students of Government Science Collage, Jabalpur during 02.02.2015-06.02.2015 and 09.02.2015- 13.02.2015
- One week training programme on "Training on Instrumentation" organized at TFRI, Jabalpur during 23-27 Feb., 2015.
- Four training programmes had been organized by TFRI under MP State Bamboo Mission consultancy, in Common Facility Centre under MP State Bamboo Mission at Panna and , Chattarpur during 02-06 February, 2015 and Satna and Shahadol During 24-28 February 2015 for Skill upgradation of Bamboo artisans.

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

During 2014-15 TFRI and CFRHRD celebrated/organized following day/week/pakhwara. Various cultural and competitive activities were organized in this period to create awareness about the events among children, employees and general public.

(i) Dr. N. Roychoudhury, Scientist-G attended as a member of first meeting of Scientific Advisory Committee of BTSSO, Basic Tasar Silkworm Seed Organisation, Central Silk Board (Ministry of Textiles, Govt. of India) at Bilaspur on 19th November, 2014.

(ii) Dr. N. Kulkarni, Scientist-G attended and delivered a special lecture on "रोपण क्षेत्रों व प्राकृतिक वनों के कीट व उनका प्रबंधन" एवम् "वन रोपणियों में लगने वाले नाशिकीटों का प्रबंधन" in training programme in Van Vigyan Kendra, Jalna (MS) on 08-12-2014.

(iii) Dr. P.B. Meshram, Scientist-F attended and delivered a special lectures on "औषधीय पौधों पर लगने वाले कीट एवं उनका नियंत्रण " in training programme in Van Vigyan Kendra, Jalna (MS) on 08-12-2014.

(iv) Dr. N. Kulkarni, Scientist-G attended and delivered two Lecture on "सफेद इल्लियों (White grub) का एकीकृत कीटनाशि प्रबंधन " एवम् "सागौन के कीटों का जैविक नियंत्रण" in training programme in Van Vigyan Kendra, Jalna (MS) on 09-12-2014.

(v) Dr. P.B. Meshram, Scientist-F attended and delivered a special lectures on "सागौन के बीजोत्पादन को प्रभावित करने वाले कीटों व फफूंदों का प्रबंधन" in training programme in Van Vigyan Kendra, Jalna (MS) on 09-12-2014.

(vi) Dr. N. Roychoudhury, Scientist-G attended as RCC member in 56th Research Coordination Committee Meeting at Central Silk Board (Ministry of Textile), Bangalore on 12-02-2015.Dr. N. Roychoudhury, Scientist-G, and Dr. P.B. Meshram, Scientist-F attended 5th Kamta Prasad Sagreiya Memorial Lecture at State Forest Research Institue, Jabalpur on 18-02-2015.

(vii) Dr. N. Roychoudhury, Scientist-G and Dr. N. Kulkarni, Scientist-G attended Second Meeting of *Chintan Shivir* for North & Central Zone, at Indian Institute of Forest Management, Bhopal from 20-2-2015 to 21-2-2015.

(viii) Dr. N. Roychoudhury, Scientist-G attended a workshop on "Biological diversity Act 2002, India: Constrains and Opportunities for Scientist" as a Chairman of the Session-4 : International transit of biological material at TFRI, Jabalpur from 19-3-2015 to 20-3-2015.

(ix) Smt. Neelu Singh, Scientist-E and Shri Hari Om Saxena, Scientist-C attended 5th Kamta Prasad Sagreiya Memorial Lecture at State Forest Research Institue, Jabalpur on 18-02-2015.

(x) World Environment Day was celebrated on 5/6/2014 in the institute. Dr. Avinash Jain, Scientist E and Head, Forest Ecology & Rehabilitation Division of the Institute delivered a lecture on **"Climate Change – Natural or Anthropogenic reasons?"**

(xi) International Day for Biological Diversity celebrated on 22/5/2014 in the institute. Lectures, Painting and Essay competitions were organized to generate awareness about conservation of Biodiversity

7.4 Consultancies Services

- As team leader providing consultancy to MPSBM for - Evaluation of present status of CFC, Need analyses and capacity building of stakeholders
- As team leader providing consultancy to IITDM for – Plantation and greening of IITDM campus in sync with ecology of the site
- As team member providing consultancy to SAIL India for - Carbon sequestration through afforestation at Rourkela Steel Plant
- As team member preparing the Wild life Conservation Plan for Mahan-II, SECL Bhat Gaon area
- As team member preparing the Wild life Conservation Plan for Ketki SECL Bhisrampur area
- As team member preparing the Wild life Conservation Plan for Amagaon SECL Bhisrampur area
- Assessment of green cover and its tangible and intangible benefits and tree cover management plan for STPP-Korba Project', funded by NTPC Korba.
- Preparation of conservation plan and comprehensive study of the impact on the wildlife for Rajgamar underground project, SECL Korba (C.G.).
- Preparation of conservation plan for endangered species in and around Saraipali open cast project, SECL Korba (C.G.).
- Shri Hari Om Saxena, Scientist-C of NWFP Division and Dr. Sanjay Singh, Scientist-C of Biodiversity & Sustainable Management Division were awarded consultancy of Rs. 15 lakhs by IIITDM, Dumna Road, Jabalpur for beatification of the campus in sync with local biodiversity.

7.5 Activities of Rajbhasa

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

हिन्दी पखवाड़े का आयोजन : राजभाषा विभाग, भारत सरकार द्वारा जारी दिशा निर्देशों की अनुपालन में उष्णकटिबंधीय वन अनुसंधान संस्थान, जबलपुर में दिनांक 01 सितम्बर 2014 से 15 सितम्बर 2014 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 का समापन दिनांक 15 सितम्बर 2014 को संस्थान के निदेशक डॉ यू0 प्रकाशम की अध्यक्षता में काव्य पाठ प्रतियोगिता एवं पुरस्कार वितरण का आयोजन किया गया

जिसमें संस्थान के अधिकारियों, कर्मचारियों एवं अनुसंधान अध्येयताओं ने बढ़ चढ़ कर भाग लिया।

All official correspondence is being dealt in hindi as far as possible. All computers in the centre have been provided with hindi font. All seals and name plates are in bilingual as the Govt. of India's direction.

7.6 Awards and Honours:

Awarded 1st prize to Dr. N. Roychoudhury, Scientist-G for the poster entitled "Toxicity of bio- and chemical pesticides against beetles of sal heartwood borer, *Hoplocerambyx spinicornis* Newman and their efficacy in tree traps and los in timber depot" presented at 13th Silviculture Conference, held during 24th -28th November 2014 at Forest Research Institute, Dehradun.

8 *ADMINISTRATION AND INFORMATION TECHNOLOGY*

8.1 Information Technology

The institute has successfully switch over the 100 MBPS NKN link provided under the National Knowledge Network (NKN) scheme of NIC project from the earlier 2MBPS leased line of BSNL. The NKN comprises of an ultra-high speed CORE (multiples of 10 Gbps), complimented with a distribution layer at appropriate speeds. The network is designed to support Overlay Networks, Dedicated Networks, and Virtual Networks. The institute has the 100 MBPS fast Ethernet fiber optic backbone LAN functional and is working smoothly.

The 100 MBPS NKN link is used for Internet access and other online activity. Video Conferencing facility also been used throughout the year. Under IFRIS project various modules including Personal Information Management System (PIMS), Research Information System (RIMS), Payroll Management System (PMS), and Financial Accounting System (FAS) have been successfully operational. The web site of the institute Institutes and it's satellite centre CFRHRD, Chhindwara is frequently updated to extend various activities of the institute. The institute procured 10 online UPS (1kva) for providing backup to the network switches installed at different locations of the institute. The web portal has been generated for the institute's online open access e-magazine ***'Van Sangyan'*** (ISSN 2395 - 468X) and linked with institute's web site. The pages have been updated on regular basis and issues have been uploaded on monthly basis over it for ease of access to the users. Six new laptops have been procured under one time special grant (OTSG) and installed at different locations. Procurement of a high speed scanner under OTSG is also in the process. The reports have been generated for all the activities held at the institutes like conferences/seminars/workshops/trainings/visits of dignitaries/visits etc. through the material received from the concerned organizers and uploaded over institute's web site and also sent to the headquarter for uploading over ICFRE web site. The pages earlier generated for Achanakmar-Amarkantak Biosphere Reserve and institute's bi-annual journal 'Indian Journal of Tropical Biodiversity (IJTB)" has been updated with latest information on regular basis. The contents of the IJTB along with abstracts have been uploaded over web site for access to the users. A link has also provided for the lectures delivered by the speakers during weekly seminar for the users locally. From there they can access the lecture at any time within the institute.

8.2 Sevottam

Activities related to the Citizens/Clients Charter are mentioned as under-

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

Citizen's Charter is being drafted by the Institute. Provision for Annual Review of the Charter after approval is as:

- 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.

8.2.2 Action taken to implement the Charter

Action will be taken for implementing the Charter.

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

These programs will be organized after approval of the citizen charter.

8.2.4 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.

8.2.5 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.

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

9. Balance Sheet

To be prepared at ICFRE level

10. 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	Shri Rajaram Singh, Under Secretary, TFRI, Jabalpur	As per provision and guidlines provided under RTI Act, 2005.
Centre for Forestry Research & Human Resource Development, Chhindwara	Director, CFRHRD, Chhindwara	Dr. P. Subramanyam, IFS, Director, CFRHRD, Chhindwara	As per provision and guidlines provided under RTI Act, 2005

2. Email and Postal addresses

a. TROPICAL FOREST RESEARCH INSTITUTE
(*Indian Council of Forestry Research & Education*)
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

b. Centre for Forestry Research & Human Resource Development, (*Indian Council of Forestry Research & Education*)
Poama, P.O. Kundalikala, Parasia Road, CHHINDWARA - 480 001 (M.P)
Phones: 07162 – 254473(O)
FAX : 07162 – 254463
e-mail **–** head_cfrhrd@icfre.org

3. Intellectual Property

3.1 Patents Granted – Nil

3.2 Others-Nil

List of Abbreviations

AICP- All India Co-ordinated Project
AMS- Agro Meteorological Stations
AWS- Automatic Weather Stations
BA- Benzyl adenine
BSNL – Bharat Sanchar Nigam Limited
CFRHRD-Centre for forestry Research & Human Resource Development
CG-Chattisgarh
CPP- Country Partnership Project
CPTs- Candidate Plus Trees
DST- Department of Science and Technology
DNA- Deoxyribonucleic acid
FRI- Forest Research Institute
FSI- Forest Survey of India
GBH- Girth at breast height
GEF- Global Environmental Facility
GOI- Government of India
GPS- Global Positioning System
HPLC- High-Performance Liquid Chromotography
HPLTC- High-Performance Liquid Thin Chromotography
IARI- Indian Agricultural Research Institute
ICFRE- Indian Council of Forestry Research & Education
IGKV- Indira Gandhi Krishi Vishwavidyalaya
ISSR- Inter Simple Sequence Repeat
ISRO- Indian Space Research Organisation
IFRIS- Indian Forestry Research Information System
JNKVV – Jawaharlal Nehru Krishi Vishwavidyalaya
MS- Maharashtra
MP- Madhya Pradesh
MPCST- Madhya Pradesh Council of Science and Technology
MPSFD- Madhya Pradesh State Forest Department
MPSBB – Madhya Pradesh State Biodiversity Board
NIC – National Informatics Centre
NTFP- Non-Timber Forest Product
NTPC- National Thermal Power Corporation
NGOs – Non Governmental organization
NWFP –Non-Wood Forest Produce
OR- Odisha
OSR- On Station research
OFR- On Farm Research
OTSG- One Time Special Grant
PAR- Photosynthetically Active Radiation
PSB- Phosphate Solubilizing Bacteria
RAPD- Random Amplification of Polymorphic DNA
RAG – Research Advisory Group
RNA- Ribonucleic Acid
RSP- Rourkela Steel Plant

SHGs - Self Help groups
SAIL-Steel Authority of India Limited
SLA- Surface Leaf Area
SFD- State Forest Department
SFM- Sustainable Forest Management
SLEM- Sustainable Landuse Ecosystem Management
TSO- Teak Seed Orchard
TATR- Tadoba Andhari Tiger Reserve
TFRI- Tropical Forest Research Institute
VVK- Van Vigyan Kendra
VAM- Vesicular Arbuscular Mycorrhiza
VFC- Village Forest Committee