Annual Report 2018-19

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

Overview

- Insect specimens of 27 species belonging to the family Tettigonidae representing different habitats viz. grasslands, agriculture land, forests and plantations in 09 agro climatic zones of Madhya Pradesh, Chhattisgarh and Maharashtra were collected and identified by consulting relevant information sources and literature.
- Twenty one insect spp. were documented from mangrove forest of Odisha comprising 8 new records viz. a butterfly, *Jamides celeno,*; a moth, *Lacera alope*; a grasshopper, *Catantops dominans*; a stick insect, *Eremoplana microptera* and 4 dragonflies, *Acisoma panorpoides, Brachythemis contaminate, Camacicinia gigartean* and *Neurothemis fulvia*.
- After analysing different pesticides, foliar spray of Trizophos 0.06% was found to be most effective against seed borer *Bruchus bilineatopygus* in *Albizia lebbeck* plantations.
- Thirty forest fungi were identified from out of 59 samples collected from Maharashtra and Odisha. Sixteen documents of fungi were prepared from Institute's campus and identified. Five new records of fungi were identified from central India (*Amanita constricta, Amanita pantherina, Amanita velosa, Cortinarius iodes* and *Pisolithus arhizus*). Four new host records of fungi namely: *Bremia lactucae* on *Euphorbia heterophylla, Erysiphe alphitoides* (*Pseudoidium* state), on *Acacia mangium, Laetiporus sulphureus* on *Bambusa bulgaris* var. yellow, *Polyporus grammocephalus* on *Ziziphus jujuba,* and *Lenzites acuta* on *Gardenia latifolia* were also identified.
- जबलपुर स्थित बरगी क्षेत्र के ग्रमो का आर्थिक सर्वेक्षण कार्य किया गया तथा यहॉ के ग्रामीणों/आदिवासियो से मशरूम उत्पादन बाबत् चर्चा की गई। कुल 46 ग्रामवासियों प्रशिक्षित किया गया। संस्थान में उत्पादित मशरुम की लागत एवं लाभ की आर्थिक गणना की गयी,, एक कि.ग्रा. के बैग पर औसतया रु0 26.25 लागत आती हैं तथा इससे उत्पादित मशरूम से रु0 94.95 का लाभ प्राप्त होता है।
- Plants of *Bambusa nutans*, *Bambusa tulda*, *Bambusa vulgaris*, *Dendrocalamus strictus* and *Bambusa bambos* are being multiplied and GPM supplied to different end users.
- Flowering and fruiting status of Seed production areas (SPA), Clonal seed orchards (CSO) and Seedling seed orchards (SSO) located in Madhya Pradesh, Maharashtra and Chhattisgarh were recorded. Silvicultural operations were carried out to increase the seed production.
- Promising trees of *Buchanania cochinchinensis* were selected from various locations of Madhya Pradesh.
- Candidate Plus trees of *Gmelina arborea* were selected from plantations at different locations of Madhya Pradesh.
- Tree cover management plan and harvesting guidelines of tree species planted at Rourkela Steel Plant were prepared. CDM guidelines and its applicability for the plantations to avail CDM benefits were also prepared.

- The effect of light, temperature and soil types and depth on germination of *Ougeinia oojeinensis, Lannea coromandelica, Adina cordifolia* and *Mitragyna parviflora* has been standardized.
- Performance of *Gmelina arborea (*Khamer / Gamhar) based agroforestry system in Madhya Pradesh with *Asparagus racemosus, Curcuma longa* and *Zingiber officinale* as intercrops was analysed alongwith *Piper betle* (*Betel vine)* and *P. betle* performed better as a sole crop than as intercrop.
- Fruits of *Acacia concinna*, S.*laurifolius, T. bellirica*, *A.auriculiformis* and leaves of *Z. mauritiana* were collected. Samples were estimated for saponin content which varied from 7.98 to 11.36 %. Formulations were prepared with saponin isolates of *S.laurifolius* and *T.bellirica.*
- For controlling insect pests of paddy in "Rice-Sisham Agroforestry System" social spiders were put into experimentations. It was found that "Parabolic Arch" type bamboo-trap was the best model for establishment of population in paddy fields.
- TFRI and FRC-SD organized 65 training programmes including five GSDP trainings during 2018-19, wherein training had been provided to 2047 persons including unemployed youth, students, teachers, farmers, frontline staff of forest departments and other stakeholders.
- TFRI and FRC-SD is regularly organizing,demonstration and environmental awareness programmes like biological diversity day, environment day etc., implementing 'PRAKRITI' programmefor generating awareness among school students and participating in Kisan melas and trade fairs organized by different organization.

Summary of projects

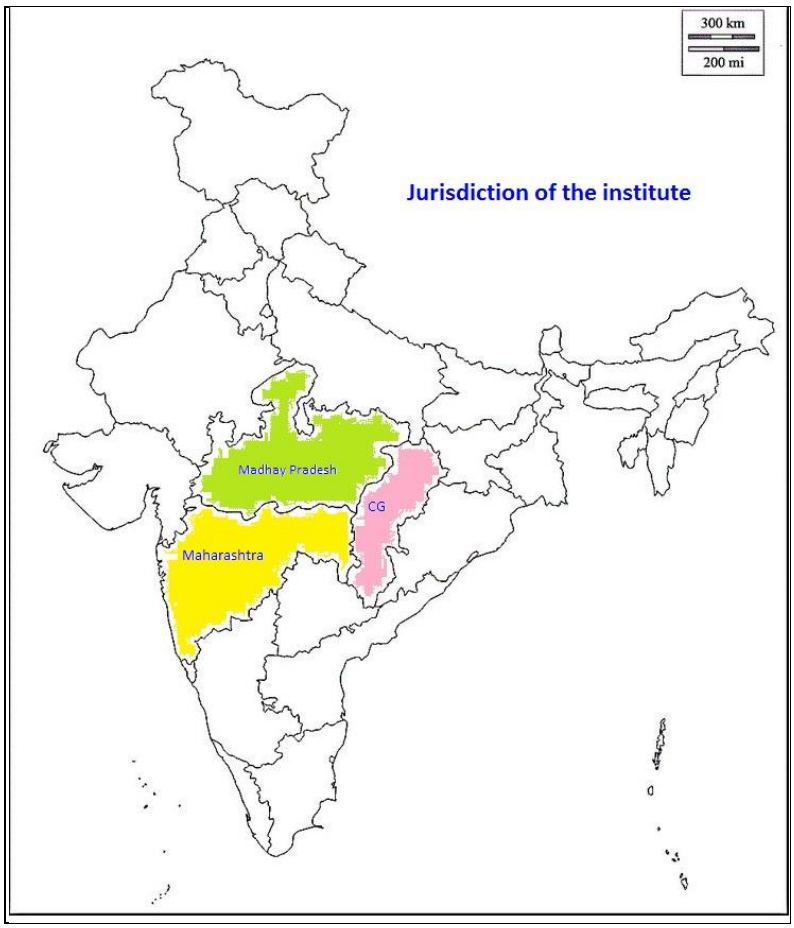
Projects	Completed projects	Ongoing projects	New projects initiated during the year
Plan	04	16	04
Externally Aided	03	06	19
Total	**07**	**22**	**23**

C o n t e n t s

1. Introduction

Tropical Forest Research Institute (TFRI), Jabalpur (M.P.) provides research support to State Forest Departments and other stakeholders in central India covering the states of Madhya Pradesh, Chhattisgarh and Maharashtra. 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, SAU's, funding agencies like NABARD and MPCST.

The institute has a satellite research centre, namely Forest Research Centre for Skill Development at Chhindwara (M.P.) Earlier it was known as Centre for Forestry Research and Human Resource Development (CFRHRD) which came into existence on 30th March 1995. After restructuring of the ICFRE institutes/ Centres vide ICFRE notification dated 16 April 2018, the centre was renamed as Forest Research Centre for Skill Development (FRC-SD), Chhindwara with effect from 01 May 2018.



MoUs signed:

1. MOU was signed between TFRI, Jabalpur and Madhya Pradesh State Bamboo Mission, Bhopal for clonal fidelity test of tissue culture plants of bamboos.

Visit of dignitaries:

- Dr. (Mrs.) Swati Godbole, Mayor, Jabalpur Municipal Corporation on World Environment Day- 2018.

- Shri Chandramauli Shukla, IAS, Commissioner, Jabalpur Municipal Corporation, & CEO, Jabalpur Smart City visited TFRI as Chief Guest of Inaugural function of GSDP Training on Plant Tissue Culture Techniques and its Applications.

- Dr. Anupam Mishra, Director Agricultural Technology, Zonal Project Directorate,ICAR-ATARI visited TFRI as Chief Guest of Valedictory function of GSDP Training on Plant Tissue Culture Techniques and its Applications.

- Dr. Alka Bhargava,IFS, Joint secretary, Ministry of Agriculture, New Delhi visited TFRI during RAG meeting held on 10th October, 2018.

- Sh. N.S. Dungriyal, IFS CCF (Working Plan), Jabalpur visited TFRI during RAG meeting held on 10th October, 2018.

- Dr. S.K. Mandal, IFS, PCCF R/E JFM, Bhopal visited TFRI during RAG meeting held on 10th October, 2018.

- Dr. S. H. Patil, IFS, PCCF (Production and Management), Maharashtra State Forest Department, Nagpur visited TFRI during RAG meeting held on 10th October, 2018.

- Sh. Anil Kumar Sahoo, IFS, APCCF (R / E), Chhattisgarh State Forest Department, Raipur visited TFRI during RAG meeting held on 10th October, 2018.

- Dr. Anil Kumar, Director, CAFRI, Jhansi visited TFRI during RAG meeting held on 10th October, 2018.

- Dr. S.S. Rao, Dean, College of Agriculture, IGKV, Raipur visited TFRI during RAG meeting held on 10th October, 2018.

- Shri Deepak Khare, General Manager, Orient Paper mill, Amlai (MP.), visited as Chief Guest of Valedictory function of GSDP Training on Propogation and Management of Bamboo.' On 18th March, 2019.

- Dr.P.K.Shukla, IFS, Director, Regional Centre of Forest Certification, Jabalpur (M.P.) as Chief Guest of Valedictory function of GSDP training on 'Value addition and marketing.

- Dr. Om Gupta, Dean, JNKVV, Jabalpur (M.P.) as Chief Guest of Valedictory function of GSDP training on 'Insect Pest Management.

- Dr.P.K.Singh, Director, Directorate of Weed Research, Jabalpur (M.P.) as Chief Guest of Inaugural function of GSDP training programme on 'Management of small Botanical Garden'.

- Shri.Mudrika Singh, IFS, Chief Conservator of Forest, Research and Extension Wing, Seoni Circle visited the centre on 26.09.2018.

- Dr. R.V. Kumar, Principal Scientist & Head of Division, ICAR Indian Grassland and Fodder Research Institute**,** Jhansi, (U.P.), visited the centre on 19.02.19 during training programme ‘‘Agroforestry & its Management’’ from 19th -21st February 2019, conducted at FRC-SD, Chhindwara. Acted as a resource person and delivered lecture on “Round the year fodder production from tree based system”.

- Dr. R. P. Dwivedi, Principal Scientist (Ag. Extension) ICAR-Central Agroforestry Research Institute, Jhansi visited the centre and delivered lecture on “Extension Perspectives for Agroforestry development and management “during the training programme on “Agroforestry & its Management’’ 19.2.2019.

- Dr R.S.Yadav, Regional Director, ICAR-Indian Institute of Soil and Water Conservation Research Centre, Datia (MP), visited the centre and delivered lecture on "Role of watershed for Agroforestry system''during the one day training programme on "Agroforestry & its Management'' on 19.02.2019.

- Shri Salil Zakorkar, DDM, NABARD, Chhindwara district visited the centre on 19.02.2019 during the "Agroforestry & its Management'' training programme and delivered lecture on "Role of NABARD in funding Agroforestry projects. Also briefed all the participants about the various bank schemes for the welfare of farmers from 19th - 21st February 2019, conducted at FRC-SD, Chhindwara.

- Dr R.K. Jhade, Scientist (Horticulture), Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Vigyan Kendra, Chhindwara visited the centre and delivered lecture on "Sustainable Agri-Horti-Forestry and IFS Model" during the one day training programme on 19.02.2019.

- Shri Akshat Nagar, Senior Manager, Raw Material Orient Paper Mills, Amlai,Shahdol, visited the centre on 20.02.19 and delivered lecture on टिम्बर आधारित उदयोगो की कृषि वानिकी में संभावना '' during one day training programme on "Agroforestry & its Management.'' from 19th -21st February 2019, conducted at FRC-SD, Chhindwara.

- Dr.Vijay M. Ilokar , Senior Research Scientist & Project Head, Agroforestry, PDKV, College of Agriculture Nagpur visited the centre on 20.02.19 and delivered lecture on "कृषि वानिकी नीति 2014 एंव इसका क्रियान्वयन" during one day training programme on "Agroforestry & its Management" from 19th -21st February 2019, conducted at FRC-SD, Chhindwara.

- Shri Sunil Joshi,Chairman, Bamboo Society of India, Maharashtra Chapter, Nagpur visited the centre on 20.02.19 and delivered lecture on 'बॉस आधारित उदयोगो का महत्व एंव आय संवर्धन during one day training programme on "Agroforestry & its Management'' from 19th -21st February 2019, conducted at FRC-SD, Chhindwara.

- Dr. Surendra Pannase, Principal Scientist KVK, Chhindwara (M.P.) visited the centre on 21.02.19 and delivered lecture on कृषि वानिकी के प्रचार प्रसार में कृषि विज्ञान केंन्द्र की भूमिका'' during one day training programme on "Agroforestry & its Management'' from 19th -21st February 2019, conducted at FRC-SD, Chhindwara.

- Dr. S.L. Swamy , Professor, Indira Gandhi Krishi Vishwavidyalaya **(**IGKVV**),** Raipur**,** Chhattisgarh**,** visited the centre on 21.02.19 and delivered lecture on "बॉस आधारित खेती द्वारा कृषक की उन्नत आजीविका "during one day training programme on

"Agroforestry & its Management'' from 19th -21st February 2019, conducted at FRC-SD, Chhindwara.

- Dr. R. K. Prajapati. Professor, Indira Gandhi Krishi Vishwavidyalaya **(**IGKVV**),** Raipur**,** Chhattisgarh visited the centre on 21.02.19 and delivered lecture on developed सतावर और अश्वगंधा की खेती द्वारा प्रसंस्करण एंव मूल्य संवर्धन आजीविका ''during one day training programme on "Agroforestry & its Management'' from 19th -21st February 2019, conducted at FRC-SD, Chhindwara.

New initiatives:

Following AICRPs were approved during RPC meeting held at ICFRE, Dehradun in February 2019 -

(a) Development of package of practices on *Gmelina arborea* (Khamer or Gamhar) in the selected regions of India
(b) Conservation and standardization of seed technology of wild fruits
(c) Genetic Improvement and value addition of *Madhuca longifolia*

1. Recruitment and promotions during the year:

Recruitment made during 2018-19	-	Process for recruitment of 15 staff (LDC, MTS and Forest Guards) Initiated, exam conducted, screening done & result announced.

- Dr. Vishakha Kumbhare FRC-SD, Chhindwara was granted *in situ* promotion in the grade of Scientist-E.

- Dr. Neelesh Yadav , TFRI was promoted to Scientist –E.

All India Coordinated Research Projects

1. **Taxonomic study of Tettigoniidae (Orthoptera) of India (Under All India Co-ordinated project on Taxonomy) (AICOPTAX)**

Surveyed and selected collection sites in 09 agro-climatic zones of M.P., C.G. and M.S. for collection of Tettigonid insects. 423 insect specimens of family Tettigoniidae from more than 198 sites in different habitats (agriculture land, barren land, grasslands, natural forest and plantations) were collected by manual collection/ light trap-unit. Process of identification and taxonomic characterization is in progress.

Fig 1:- Tettigoniid in grass land at Niwas, Mandla, M.P.

2. Improvement of Teak for Higher Productivity in Central/Peninsular India: A Multi-institutional All India Coordinated Project

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

Different forest areas of M.P., Chhattisgarh, Odisha and Maharashtra were surveyed for selection of plus trees of *Tectona grandis* (Teak) and collection of seeds from selected trees. A total of 91 CPTs have been selected from these four states: M.P.—35; Chhattisgarh---30; Odisha---11; Maharashtra--- 15. Growth data of selected plus trees and comparison trees along with their GPS location was recorded. Seeds were also collected from some of the plus trees marked in M.P., Chhattisgarh, Odisha and Maharashtra. Collected seeds were subjected to alternate drying and soaking treatment and seedlings raised. Raised seedlings (progenies) are being maintained in the nursery and data on height and collar diameter of seedlings was recorded. Rooted plants raised through cuttings of 6 clones of CSO, Ghasipur (Bilaspur) are being maintained. Cuttings collected from 10 clones of CSO, TFRI and planted after treatment for rooting. Progeny trials established at Katni (M.P.) and Chandrapur (MS) surveyed for growth performance.

Fig 2:- Plus trees of Teak selected in Aheri Allapalli, Harisal and Jimalgatta Maharashtra

Sub Project II : Development of Management Practices of Teak Seed Production Areas, Seedling Seed orchards and Clonal Seed Orchards

Survey of 16 Seed Production Areas (SPA), 23 Clonal Seed Orchards (CSO) and 5 Seedling Seed Orchards (SSO) located in M.P., Chhattisgarh and Maharashtra was carried out. Data on height, GBH, crown diameter, spacing, flowering, fruiting, fertilizer application and existing management practices was recorded. Some of the SPAs are having low seed productivity due to their age and closed canopy. However, some of the SPAs are producing good quantity of seeds. Low to moderate seed production was noticed in most of the CSOs and SSOs. Some of the clones are not producing seeds that may be due to the asynchrony in flowering among clones. Poor pollination may be another reason for low seed production. Treatment of urea @ 100kg/ha + SSP @ 20 kg/ha increases flowering and fruiting in selected clones. Seedlings were raised from seeds of various clones. Growth parameters like height and collar diameter were recorded. Analysis of soil samples of surveyed fields' reveals low level of Nitrogen, Phosphorus and Potash in 70%, 25% and 54% samples respectively. Cultural management practices like pruning and trench digging were also adopted to increase the seed production.

Fig 3: Clonal seed orchard of *Tectona grandis* at Ghasipur (CG)

Fig 4: Seed Production Area of *Tectona grandis* at Khondhra (CG)

Studies on population structure, linkage disequilibrium and marker-trait association mapping of Indian teak.

Under this project, total 260 trees from 13 teak dominating agroclimatic zones across the four states have been sampled for the study. Work on phenotyping and genotyping has been completed. Scoring of amplified profiles using microsatellites markers is underway. Successful completion of project will provide the information about the genetic diversity and population structure of teak in central India which is one of the recognized centre of diversity for teak. We are also going to estimate the level of disequilibrium and association mapping in teak which has not been reported earlier.

2. Research Highlights

2.1 Ecosystem Conservation and Management

2.1.1 Overview

2.1.1.1Projects under the Theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	02	04	-
Externally Aided	-	04	-

2.1.2 Climate Change

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

Intangible benefits of plantations raised at RSP were quantified by Contingent Valuation Method for pollution control, soil conservation & remediation and improvement in underground water table and average WTP was calculated to be Rs. 840.70. Maximum WTP was observed in the participants of 41-50 years age group and minimum in > 80 years age group. WTP also increased with increase in education and annual income. As far as livelihood of the dependent population is concerned, maximum WTP was contributed by government servants (Rs. 1251.85), followed by business persons (Rs. 969.18), farmers (Rs. 868.19) and labours (798.68). Among the selected benefits, maximum weightage was given to soil conservation and remediation (409.40), followed by improvement in underground water table (225.46) and pollution control (205.85) by the participants. Tree cover management plan and harvesting guidelines of tree species planted at RSP were prepared. CDM guidelines and its applicability for the plantations to avail CDM benefits were also prepared.

Impact of forest covers change on regulating stream flows of the Narmada River Basin using Macro scale Hydrological Model.

Forest change dynamics of Narmada basin reveals that this basin has 36077.3, 35201.8 and 34905.4 km^2 in the years 1985, 1995, and 2005 respectively. The forest was Deciduous Broadleaf, Mixed, and Deciduous Needle leaf. During 1985–1995, it lost 2.43% (875.58 sq. km of gross forest loss, i.e., sum of all forest area lost) of the forest area that existed in 1985 (36077.3 sq. km), and the rate decreased to 0.84% during 1995–2005 (296.36 sq. km gross loss of 35201.8 sq. km forest in 1995). These statistics does not include plantation and scrub areas. River flow discharge shows an overall increase during the decade 1991-2000 compared to that of 1981-90 and 2001-10.

Table 1 Decadal forest cover change in Narmada basin (Area in Sq.km)

Forest Class	**Year 1985**	**Year 1995**	**Year 2005**	**Loss (1985 to 1995)**	**Loss (1995 to 2005)**
Deciduous Broadleaf	32466.25	30998.74	28083.87	1467.51	2914.87
Mixed Forests	2956.2	3050.04	3215.47	-93.84	-165.43
Deciduous Needle leaf	654.89	1152.98	3606.06	-498.09	-2453.08
Total forest cover	**36077.34**	**35201.76**	**34905.4**	**875.58**	**296.36**
Decadal % change				**2.42**	**0.84**
Shrubland	2466.44	2513.22	2059	-46.78	454.22
Plantations	33.12	37.12	11.63	-4	25.49
Total Tree cover	**38576.9**	**37752.1**	**36976.03**	**824.8**	**776.07**

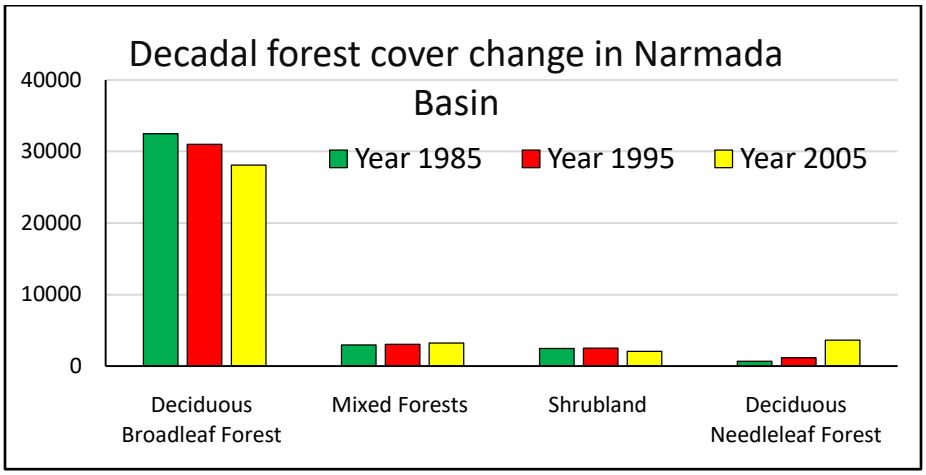


Fig 5:- Decadal forest cover in Narmada river basin (years 1985-1995-2005)

Understanding plant –water relations to annual weather fluctuations in important deciduous tree species

The effect of climate change on forests is one of the emerging concerns across the world. Studies show that central Indian forests are facing a serious but gradual threat due to increased heat. Trees in these forests grow for centuries, but sharp weather fluctuations (water-limited or water-abundant) which last for relatively shorter period may change the forest structure and dynamics. In such seasonal environments where annual water availability and scarcity fluctuate sharply, trees may exhibit unique adaptations and growth pattern. Hence, it is imperative to understand the complex plant-water relationship and the mechanisms that control responses to environmental perturbations. Therefore, here, we try to understand plant-water use in deciduous tree species – *Tectona grandis* (Teak) using Sap flow sensors and also examine the effects of annual weather fluctuations on tree physiology. We are using Sap flow meter for recording sap flux. Preliminary observations from mid-April to December 2018 show a meagre value of 0.537 kg hr-1 average sap flow. While average temperature for these months were recorded as 31.7°C with 81.6 mm average rainfall of which three months were of no rainfall. There was sap flow recorded even during months of no rainfall and leaflessness.

2.1.3 Ecology & Environment:

2.1.4 Biodiversity

Documentation of biodiversity of forest fungi of Central India

Forest fungi were collected from Maharashtra and Odisha and 30 fungal species were identified from out 59 collected samples. Besides these 44 samples of fungi were also collected locally from Institute campus and identified. 5 new records (*Amanita constricta, Amanita pantherina, Amanita velosa, Cortinarius iodes* and *Pisolithus arhizus*) of fungi collected from central India and 4 new host records, *Bremia lactucae* on *Euphorbia heterophylla*, *Erysiphe alphitoides* (*Pseudoidium* state) on *Acacia mangium*, *Laetiporus sulphureus* on *Bambusa vulgaris* var. yellow, *Polyporus grammocephalus* on *Ziziphus jujuba*, and *Lenzites acuta* on *Gardenia latifolia* were also identified. 16 documents of fungi were prepared.

Documentation of insect fauna and flora of mangrove ecosystems in Odisha

Surveyed 05 localities - Bhitarkanika National Park, Rajnagar Forest Division; Hawakhana, Kujang Range, Rajnagar, Mangrove (WL) Division, Mohanpura and Kantipur, Basudevpur Range, Bhadrak Mangrove (WL) Division and Bichitrapur Jaleshwer Range, Balasore Mangrove (WL) Division Odisha.

Surveyed and documented insect fauna which comprised 13 butterflies, 04 species of Moth, 01 species of Beetle, 02 species of Wasp and 01 Species of Bug from five Mangrove rich locations viz. Bhitarkanika National Park, Hawakhana (Kujang Range), Rajnagar (Mangrove WL Division, Mohanpura), Kantipur (Bhadrak Mangrove (WL) Division), and Bichitrapur (Balasore Mangrove WL Division) in the state of Odisha .

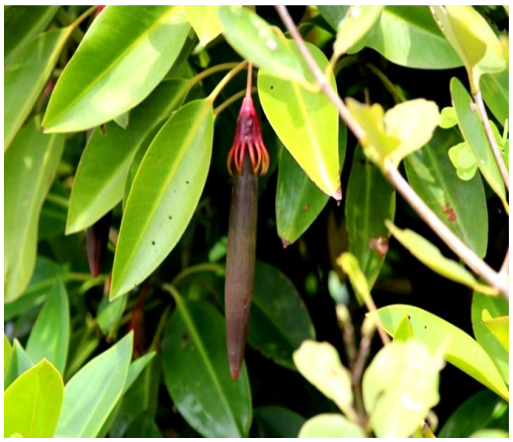


Fig 6:– Mangrove plant, *Bruguiera cylindrica*

Study of sal regeneration status in borer affected areas

Selected unprotected areas in two forest divisions, Mandla and Dindori for laying out experiments on effect of insect borer on Sal regeneration. Quadrates were laid out in Sal forest areas during 3 seasons (winter, summer and rainy). Sal seedlings were tagged to check their survival. Regeneration was recorded into three categories i.e. (a) Saplings (established regeneration), plants below 22 cm girth at breast height with a height of 2 m and above (b) Seedlings (un-established regeneration) plants below 2 m of height excluding the recruits. (c) Recruits - plants having two leaves stage. Recorded data for calculation of density, diversity for Sal regeneration status in 07 & 08 different localities.

Fig 7: - Regeneration of Sal in borer affected area (Comp. 1218 (A) /Pakhwar, Forest Division Mandla)

Studies on the diversity of some beneficial insects in forest ecosystem in Madhya Pradesh.

Survey was conducted in 09 agro-climatic zones in moist, semi-moist and dry forest areas of M. P. Insects were collected by using sweep net, search method, handpicking and by light trap from 22 different locations (Sagar, Damoh, Hoshangabad, Balaghat, Seoni, Umaria, Narsinghpur, Pachmarhi, Khandwa, Indore, Dewas. Chhatarpur, Panna, Anuppur, Chhindwara, Sidhi, Satna, Gwalior, Ujjain, Ratlam, Jhabua and Bhind). Density and diversity of insect were studied. Seven beneficial insects were recorded, photographed and studied for documentation.

Fig 8:– Comb of honey bee on *Ficus religiosa*

Biodiversity, Regeneration and life history feedback of forest communities in response to canopy openings under selection cum improvement felling system

In the state of Madhya Pradesh, selection-cum-improvement felling is carried out in different forest types. Selection felling leaves gaps in canopy. These gaps provide opportunity for trees saplings to establish. Regeneration in these gaps is determined by many factors, i.e. canopy architecture, density and distribution of adults in the canopy, soil seed bank, life history and phenology of the species, and tree temperament. Therefore, the purpose of the research is to study the impact of canopy opening on population structure and community composition under selection cum improvement felling system, and to see how it influences floral diversity and regeneration in three different forest types (*Shorea robusta* – Sal; *Tectona grandis* – Teak; Mixed Deciduous). Observations from 895 stems ha-1 in mixed deciduous forest type reveal *Diospyros melanoxylon*stems has the highest tree density (32%), followed by *Tectonagrandis* (27%) of the community. Whereas highest basal cover was recorded for *Tectona grandis* (7.65 sqm ha-1) followed by *Diospyros melanoxylon* (1.43 sqm ha-1) and *Lagerstroemia parviflora* (1.10 sqm ha-1). Seedlings of 41 tree species were found to be regenerating in the under storey of which 20 were represented in the canopy of the forest. *Anogeissus latifolia*, a characteristic deciduous tree was found to regenerate with high success rate.

Fig 9:- Sap Flow Meter

Studies on maturation and viability of seeds of five important tropical species: *Adina cordifolia, Mitragyna parviflora, Lannea coromandelica, Ougeinia oojeinensis* and *Anogeissus acuminata* for effective collection and seed storage

Seeds of *Lannea coromandelica* (Gunja), *Ougeinia oojeinensis* (Tinsa), *Adina cordifolia* (Haldu) and *Mitragyna parviflora* (Mundi) were collected *and* germination studies were conducted. Seeds of *Lannea coromandelica* have physiological dormancy and this can be avoided by premature collection at a particular stage. Seeds of *Anogeissus accuminata* (Phasi) had very low germination (2-5%) and no given treatment was successful to increase the germination.The effect of light, temperature and soil types and depth on germination of *Ougeinia oojeinensis*, *Lannea coromandelica Adina cordifolia* and *Mitragyna parviflora* had been done. Maturation study on *Lannea coromandelica*, and *Ougeinia oojeinensis*, *Adina cordifolia* and *Mitragyna parviflora* was completed and maturation indicator/s was identified. Through desiccation and freezing sensitivity test seeds of all the five species are categorised as orthodox species. Seeds were stored and sampled to assess the viability at different conditions. Maturation indicator/s was identified for better collection, and germination conditions for seeds of a particular species were identified and best storage conditions were determined for maintaining viability for longer period. The study will help in better germination, identification of best collection period and ex-situ conservation of seeds of five species. Seed leaflets were published for better handling of seeds by SFD or other Plantation Companies.

Biodiversity of Satpura Agro-climatic region with special reference to dependencies of Tribals

Survey was conducted seasonally in selected sites of Satpura plateau. Total 92 insect species belonging to 35 families of the three orders Lepidoptera (19), Coleoptera (11) and

Hymenoptera (05) were collected and identified. Number of insects of each species was recorded. The diversity index of species observed in Satpura plateau is being calculated. Ten different species of insects viz. *Polistes carolina* **(**Tataiya), *Trombidium grandissimum* (Bir Bahuti), *Oelophylla smaragdina* **(**Lal chiti), *Apis dorsata* (Madhu makkhi), *Hieroglyphs banian* (Chidda), *Microtermes obesi* (Dimak), *Pachliopta aristolochiae* (common rose), *Bombax mori* (kosa kida), *Sceliphron* spp. (Mud Wasp) are being utilized by traditional vaidraj of tribal pockets of Satpura plateau for the treatment of various diseases and as food by tribal people. These insects were collected, identified and documented. Total 22 fungal species were collected. Out of this, *Termatomyces* sp., *Sparassis crispa, Plurotus sp., Lantinus sp, Agaricus campestris and Volverriella volvacea* were edible. Data has been collected from collector, traders, and retailers for different available NTFP species from Betul and Chhindwara district. It was observed that there is a wide difference among collector, trader and retailer price. The project will help generate data and status report on insect, edible fungi species diversity and NTFPs present in the Satpura plateau which will be helpful in conservation of biological diversity of the area.

Caterpillars of *Pachliopta aristolochiae* | *Mylabris pustulata* | *Trombidium grandissimum*

Fig 10:- Collection of edible fungi /insects by tribal's for preparation of medicine and food

Disseminated research based information by conducting two trainings at Delakhari, Chhindwara under the project during 2018-19 for farmers, SFDs, Herbal healers to create awareness regarding sustainable uses, importance and conservation of edible fungi, insects and NTFPs of the area.

1. Training organised on 28 December 2018 at Delakhari, Chhindwara with following topics (Number of participants 35)

- Importance of insects and their conservation
- Edible mushroom and nutrition
- Nursery techniques and harvesting of important NTFP species

Fig 11:- Training at Delakhari, Chhindwara

2. Training organised on 10 January 2019 at Mahupani, Betul with following topics (Number of participants 35)

- Importance of insects and their conservation
- Edible mushroom and nutrition
- Nursery techniques and harvesting of important NTFP species
- Two trainings were conducted in tribal rich areas of Satpura plateau and brochures were published on the importance of edible fungi /insects /NTFPs and their conservation for creating awareness among the tribal's.

- Four brochures were published

1. Bir Bahuti –Bahuupyogi Kit (Hindi)
2. Mushroom avm poshak tatv (Hindi)
3. Madhmashi –Labhdayak kit (Marathi)
4. Jav urvarak –Kechua Khad (Hindi)

2.1.5 Forest Botany

2.1.6 Tribal's and Traditional Knowledge System

2.2 Forest Productivity

2.2.1 Overview

2.2.1.1Projects under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	-	02	-
Externally Aided	-	01	02

2.2.2 Silviculture

Studies on quality of nursery seedlings and their relation to out planting performance of *Dalbergia latifolia and Pterocarpus marsupium*

Seed beds were prepared. Polythene bags and root trainers were filled with media for planting seeds of *Dalbergia latifolia* (Kala shisham, Indian rosewood) and *Pterocarpus marsupium* (Bija sal). The primary goal of this project is assessment of seedling quality to quantify accurately the levels of morphological attributes of tree seedling that provide potential for vigorous growth and development.

Study on eco-physiology of seed germination and seedling survival for restoration of natural regeneration of two threatened / rare species of Central India

Seeds of *Dalbergia latifolia* and *Litsea glutinosa* (maida chhal) were collected from different trees from Mandla District and Chindwara district respectively. Viability of seeds of *Dalbergia latifolia* and *Litsea glutinosa* varies from 55%-100% and 90-100% respectively. Effect of temperature and light and soil type and depth on germination of seed was assessed. *Dalbergia latifolia* seeds can germinate from 20-35°C. At 15°C the germination speed was slow. Germination of both species was not affected by light, i.e., seeds can germinate in white light, red light, far-red light and dark conditions. Therefore seed germination is not affected by open or dense forest. *Litsea glutinosa* seeds are physiologically dormant. During rain dormancy is naturally broken and 60-90% seeds germinated in field condition. Observation on germination phenology indicates that intermittent rain at suitable temperature resulted germination and subsequent death of seedlings during dry season. Seeds of *Dalbergia latifolia* and *Litsea glutinosa* were adjusted to 3 different moisture contents and stored at 3 different temperatures. Viability of *Litsea glutinosa* was lost if stored with more than 10% seed moisture content at ambient temperature. Seeds of *Dalbergia latifolia* didn't lose viability, if stored with 3-8% moisture content at any temperature after 18 months of storage. The study will give us information about some of the causes of successful establishment of the selected species in a particular ecological condition. The result of the study will be helpful in not only re-establishment of the species in the changing forest communities, but also will promote the recruitment of these tree species for afforestation program in the similar environmental condition.

Integrated approach for development of standard nursery techniques and value added products of some socio-economically important species of Madhya Pradesh

Collection of seeds of selected species viz. *Terminalia chebula* (harra), *Madhuca indica* (mahua), *Terminalia bellirica* (baheda) and *Semecarpus anacardium* (bhilwa) has been carried

out. Morphological observations on fruit/ seeds were recorded on various parameters after collection i.e. Fruit size, Fruit colour and Fruit weight. Experiment on effect of different seed treatments on germination and seedling growth of *T. chebula*. Seeds were given six pre – sowing treatments. It was observed that depulped seeds with 48 hours soaking in water gave maximum germination (59%) followed by depulped seeds with 24 hours soaking in water (51%). Experiment on effect of organic and inorganic fertilizer on growth of *Madhuca indica* and *Terminalia bellirica* and *Terminalia chebula* has been laid out. Data on growth was recorded. Powder has been prepared of one year old seedlings of *Madhuca indica* and *Terminalia bellirica for analysis of N, P, K.* further work is under progress. Soil samples were collected from nursery and forest. Soil texture, bulk density and organic carbon content were analyzed. Periodic survey was carried out in the nursery for diseases of targeted species. Collection/Isolation, Identification and management of Insect pest/micro organism associated with seeds/seedlings was carried out in nursery of FRC-SD, Chhindwara. Periodical survey was conducted in FRC-SD and State Forest Department nursery for incidence of insect attack of the targeted species. It was observed that larvae *Selenaria impereta* defoliating the seedlings of *Terminalia bellirica*. 7% incidence was recorded. Experiments were conducted for formulation of value added product viz. Biscuits by incorporation *Semecarpus anacardium* (Bhilwa) fruit powder. Further work is under progress for testing of physio-chemical properties, antibacterial and antifungal activities of the herbal gel formulated from *S. anacardium* leaves. The project findings will help the SFDs, farmers and other stakeholders in adopting the nursery techniques and value added products developed under the project.

Impact of silvicultural system on the natural forests of Chhattisgarh with special reference to Sal and Bamboo

Project has just been initiated.

Capacity Building on Seed Nursery Technology and Plantation Techniques for Prioritized Species of Chhattisgarh State

Project has just been initiated.

2.2.3 Social Forestry, Agro-forestry/Farm Forestry

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	-	04	-
Externally Aided	-	02	02

Development of *Gmelina* based Agroforestry System in Madhya Pradesh

The aim of this project is to evaluate and standardize *Gmelina arborea* based Agroforestry system by intercropping of medicinal plants *viz. Asparagus racemosus, Curcuma longa* and *Zingiber officinale* and introduced *Piper betle* (Betel vine) first time. Observations on above (growth and yield) and below ground (soil) of these intercrops were recorded and analysed for tree - crop interactions. Soil samples to estimate the nutrient status of land were collected and analysed. Insect-pest attack on the intercrops was recorded. Yield of *P. betle* under intercrop as well as sole crop were recorded. The data revealed that *P.betle* is performed better in sole as compare to intercrop. The leaves of *P.betle* are sold out @ Rs.1 each before maturity while Rs.0.60 after maturity.

Fig 12:- Intercropping of *Piper betle* under *Gmelina* based agroforestry system at TFRI

Fig 13:- Harvesting of *Piper betle* L. under *Gmelina* based agroforestry system

Impact Assessment of Agroforestry systems existing in farmer's fields of Madhya Pradesh

The aim of this project is to assess the impact of agroforestry system in the socio-economic status of farmers as compared to traditional farming. Questionnaire for the collection of data, village profile, socio- economic parameters like land holding , land use pattern, income from present cultivation practice, dependence on forests in terms of tree fodder and fuel wood, effect of climate change on crop production, reason for land diversification were prepared and tested. Study areas on the basis of existing agroforestry systems were identified and selected. Farmers of Shahpura block of Jabalpur district were interviewed and reported that 85 % farmers are engaged in the traditional practice and only 15% have diversified their land in tree farming mainly *Eucalyptus spp., Gmelina arborea, Tectona grandis* and *Bamboo spp.* planted on bund as well as on row.

Data from 04 blocks of Seoni district were collected and recorded and maximum farmers have adopted *Butea monosperma* (Palas) based system followed by *Mangifera indica* (Mango)/ Citrus, *Eucalyptus* based silvi-agri system and *Acacia nilotica* (Babul) system in their fields. Soil samples for the estimation of nutrient status of the land was collected and analysed to prepare soil health card.

Fig 14:- A view of existing agroforestry system adopted by the farmer's of Jabalpur district (M.P.)

Popularization of improved var. of *Leucaena leucocephala* (Lam.) de Wit. based Agroforestry System

The aim of this project is to popularize improved variety of *L. leucocephala* based agroforestry system to increase farmer's income by selling of its pulp wood to the paper industry. Seeds of improved variety such as K636 cv. of *L. leucocephala* (Subabul) from Central Research Institute for Dry Land Agriculture, (CRIDA) Hyderabad (Telangana) were procured. Study was conducted on seed germination and found 88 % germination for raising of nursery to transplant in the field. A meeting with officials of Orient Paper Mill (wood based industry), Amlai (M.P.) and informed about the promotion of *L. leucocephala* (Lam.) based Agroforestry System. The site has been selected for the implementation of the study. Soil samples of the initial stage of land were collected and analysed.

2.2.4 Forest Soils & Land Reclamation: Nil

2.2.5 Watershed Management: Nil

2.3 Genetic Improvement

2.3.1 Overview

2.3.1.1 Projects under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	-	04	-
Externally Aided	01	04	03

2.3.2 Conservation of Forest Genetic Resources

Population dynamics, structure and genetic diversity of *Pterocarpus marsupium* in the tropical forests of Madhya Pradesh

This project is initiated to develop the conservation strategy for vulnerable *Pterocarpus marsupium* (Bija saal) by investigating the genetic diversity, status of natural regeneration and factors affecting regeneration and establishment. Base line data for the distribution of the Bija saal was collected from the working plans of different forest divisions of Madhya Pradesh. Seven representative sites in different forest divisions of Madhya Pradesh were selected for further study. Morphometric data along with leaf samples were collected from each selected sites for assessment of variation and diversity. Successful completion of the project will be helpful in planning and implementation of conservation strategies for *P. marsupium.*

Fig 15:- Recording of regeneration data in field (Site: Jabalpur-Kundum, Sample plot #2)

Fig 16: Recording of regeneration data in field (Site- Lamta Range, Balaghat Forest Division)

Genetic improvement and conservation of Chironji (*Buchnania cochinchinensis* Lour.) in Central and Eastern India

Available population of *Buchnania cochinchinensis* (Chironji) in Madhya Pradesh, Chhattisgarh and Maharashtra were investigated for the diversity and variation for important traits and promising trees were marked. Potential pockets of Chironji in Chhindwara Forest Division were surveyed and 25 Promising trees were marked for further evaluation. Similarly, morphometric data was recorded and phenotypically promising trees were marked in plantation of FRC-FD, Chhindwara for further evaluation. Successful completion of the project will lead to identification of promising genotypes/populations which can be released / mass multiplied for the farmers/stakeholders.

Fig 17:- Tree no. 14 and 21 marked from the Chhindwara Forest Division for further evaluation.

Fig 18: Selected promising trees of Chironji for further assessment from FRC-FD, Chhindwara

Assessment of diversity and natural regeneration status of *Sterculia urens* Roxb. for development of conservation strategy in Madhya Pradesh.

In this recently initiated project, we are attempting to assess the status of *Sterculia* populations in Madhya Pradesh with respect to genetic variation and regeneration. It is also aimed to standardize the package of practices for raising healthy seedlings Information about the distribution of *Sterculia urens* in Madhya Pradesh was collected. Data on morphological traits for 132 trees of *S. Urens* in TFRI campus was recorded. This patch will be monitored for regeneration study.

Conservation of *Stereospermum suaveolens* (Roxb.) DC. – A rare species in Madhya Pradesh

Tours were conducted for survey and identification of *Stereospermum suaveolens*trees in forest areas of Madhya Pradesh and a total of 128 trees were demarcated.. Out of these 128 trees, 35 trees in Chhindwara, 05 in Hoshangabad, 03 in Jabalpur, 08 trees in Kanha National Park (core area), 24 in Kanha National Park (Buffer Zone), 16 in Khandwa, 03 in Khargone, 01 in Dindori, 05 in Mandla, 02 in Damoh and 03 in Seoni forest divisions. GPS readings were recorded for mapping. Morphological characters (height, girth, clear bole height, crown radius, number of primary branches, length and width of pods, number of seeds etc.) of trees were recorded. During survey, pods (fruits) formation was observed in few trees only at Kanha National Park (core area), Kanha National Park (Buffer Zone), Chhindwara, Khandwa, Khargone, Mandla and Seoni forest areas. Seedlings were raised in the nursery. But the germination percentage was found very low. Leaves, stem bark & root bark from all locations were collected for analysis of active chemical ingredient using HPLC/ HPTLC instruments which is under progress. The primary goal of this project is conservation and estimation of active ingredients and conservation of this rare species i.e. *Stereospermum suaveolens*in Madhya Pradesh.

Conservation of RET species of Chhattisgrh – *Plumbago zeylanica* and *Celastrus paniculatus* and production of quality planting material.

Project has just been initiated.

2.3.3 Tree Improvement

Evaluation of progeny trials of *Tectona grandis* and production of improved planting stock tolerant to defoliator and leaf skeletonizer.

Second year observations for leaf flushing was recorded in the progeny trials of *Tectona grandis* (sagoan) established at Moiyanallah, Behrai and Chandrapur. Trees present in the progeny trials were also assessed for damage caused by leaf defoliator and leaf skeletonizer. Laboratory bioassays were conducted. Data of damage caused by leaf defoliator and leaf skeletonizer in the progeny trials was analysed. Analysis indicated that more damage was caused by teak leaf defoliator on MHAL-A1 and C-59 family. MSSR-PT 45 and TNT-No.3 were more susceptible to teak leaf skeletonizer. In the progeny trial at Chandrapur, C.No. 51 (TSO Raipur), C.No. 55 (TSO Raipur), CSC-16 (TSO Baitul) and MHSC-J1 were found to be tolerant to teak leaf defoliator. Similarly, C. No.51 (TSO

Raipur) and CSC-16 (TSO Baitul) were found to be tolerant for teak leaf skeletonizer. Based on the statistical analysis so far, tolerant families have been selected. PT-46 and MHAL-A4 were found to be tolerant to both teak leaf defoliator and leaf skeletonizer. Data was also recorded for variation in fruit length and width of teak fruits collected from different progeny trails of *Tectona grandis*. Cuttings collected from the progeny trials were treated with IBA (800 ppm) and Thiamine HCl (200 ppm) and planted in shade house. Sprouting of shoots was initiated after 20 days of planting.

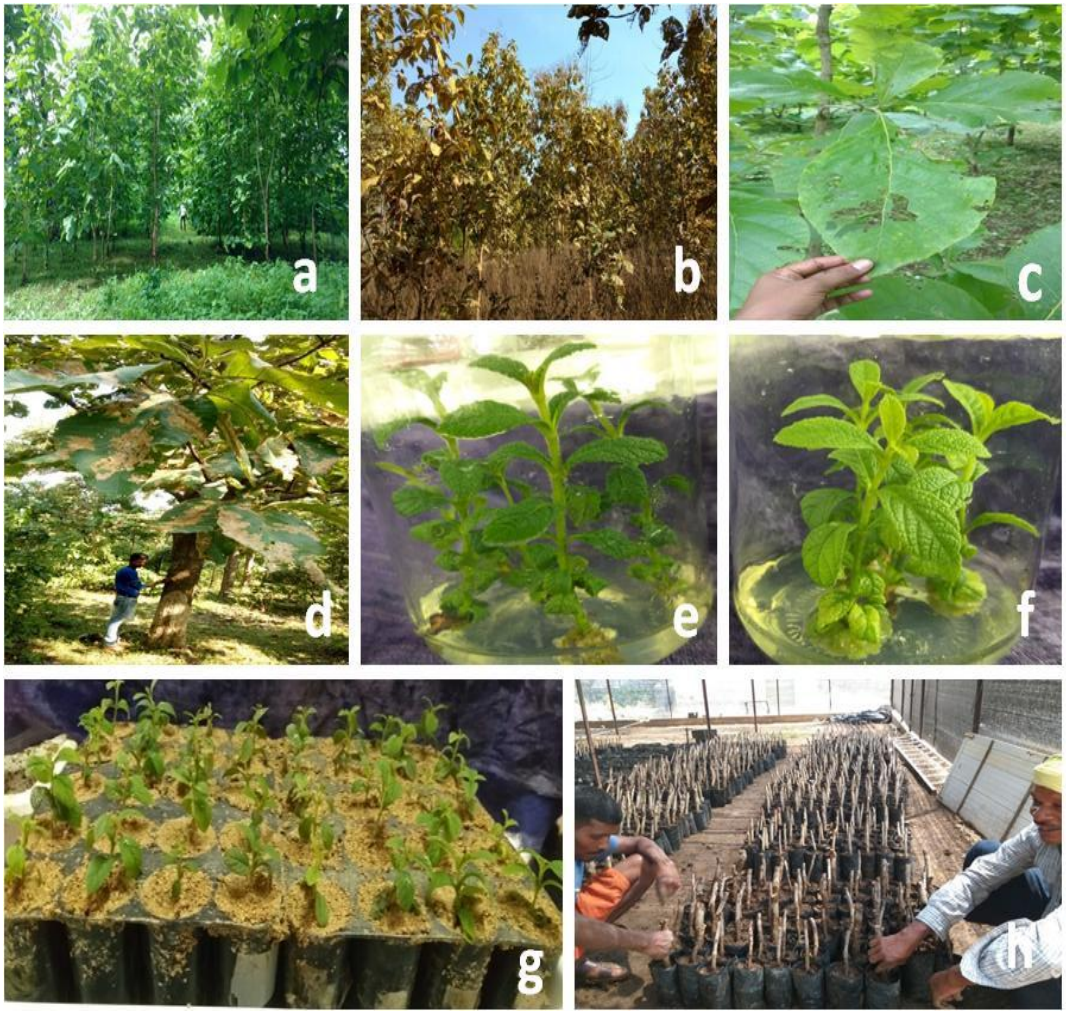


Fig 19:- Progeny trials of *Tectona grandis* at (a) Moiyanala, (b) Chandrapur , (c) Leaf of *Tectona grandis* infected by Defoliator (*H. puera*e), (d) Skeletonizer *E. machaeralis* on teak leaves, (e-g) *In vitro* shoot cultures, *ex vitro* rooting and hardening of teak and (h) cuttings of teak planted in shade house.

Selection of pest and disease free CPTs of *Gmelina arborea* and production of clonal planting material.

Under this MPSFD funded project surveys were conducted for selection of CPTs of *Gmelina arborea* (gambhar, gamari) at different locations in Madhya Pradesh. Surveys were

carried out in Katni (Saraswahi), Damoh (Nohta, Sanga), Jabalpur (Moiyanala, Ranga plantation Bargi, TFRI plantation). The criteria for selection of CPTs were clear bole height, GBH and healthy trees free from pest and diseases. The other quantitative traits measured were total height, crown diameter; crown length, number of primary branches. Straight trees with less taper, bends etc. were selected. Semi hard wood cuttings of the selected CPTs were brought to TFRI for propagation. Cuttings were treated for 12 hours with different treatments (control, 100 ppm, 500 ppm and 1000 ppm IBA) and then planted in nursery. Bark samples were collected for phytochemical analysis of selected trees. Soil samples were also collected from different locations.

Fig 20:- Selected CPT of *Gmelina arborea* and recording of morphometric traits in *Gmelina arborea*

Fig 21:- *Gmelina arborea* population in Devsar, Singrauli Forest Division

Preliminary assessment of Indian Sandalwood population in Chhattisgarh for growth, heartwood, oil and regeneration status.
Project has just been initiated.

Documentation and assessment of the status of permanent preservation plots (PSP), Seedling seed orchard (SSO) and Clonal seed orchard (CSO) in Chhattisgarh.
Project has just been initiated.

2.3.4 Vegetative Propagation

Commercial production of quality planting material of bamboo species

The clumps of four bamboo species assigned in the project viz *Bambusa nutans*, *Bambusa tulda*, *B. vulgaris* var. green, and *Bambusa balcooa* are being maintained as source material for propagule. Plants were produced through micropropagation and macropropagation methods. *In vitro* shoot cultures of all the four bamboo species are being maintained. Culm branch cuttings of *B. tulda* were treated with 200 ppm IBA in three different diameter classes (3-4 cm, 2-3 cm and 1-2cm). In the cuttings of 1-2 cm diameter 63.47 % rooting was obtained, 80.28 % rooting was obtained in the cuttings of 2-3 cm diameter and 52.38% was obtained in the cuttings of 3-4 cm diameter. Around 1200 plants were produced. Culm branch cuttings of *B. vulgaris* var. greenwere treated with 200 ppm IBA in three different diameter classes (3-4 cm, 2-3 cm, 1-2cm) in summer season. Rooting of 85-95% was obtained in the cuttings of 1-2 cm diameter. Around 3000 plants were produced. Culm branch cuttings of *B. nutans* were treated with 200 ppm IBA in three different diameter classes (3-4 cm, 2-3 cm, 1-2cm) in summer season. In the cuttings of 1-2 cm diameter 70-75% rooting was obtained and 2500 plants were produced. *B. balcooa* was propagated through culm treated with 200 ppm IBA and 1000 plants were produced.

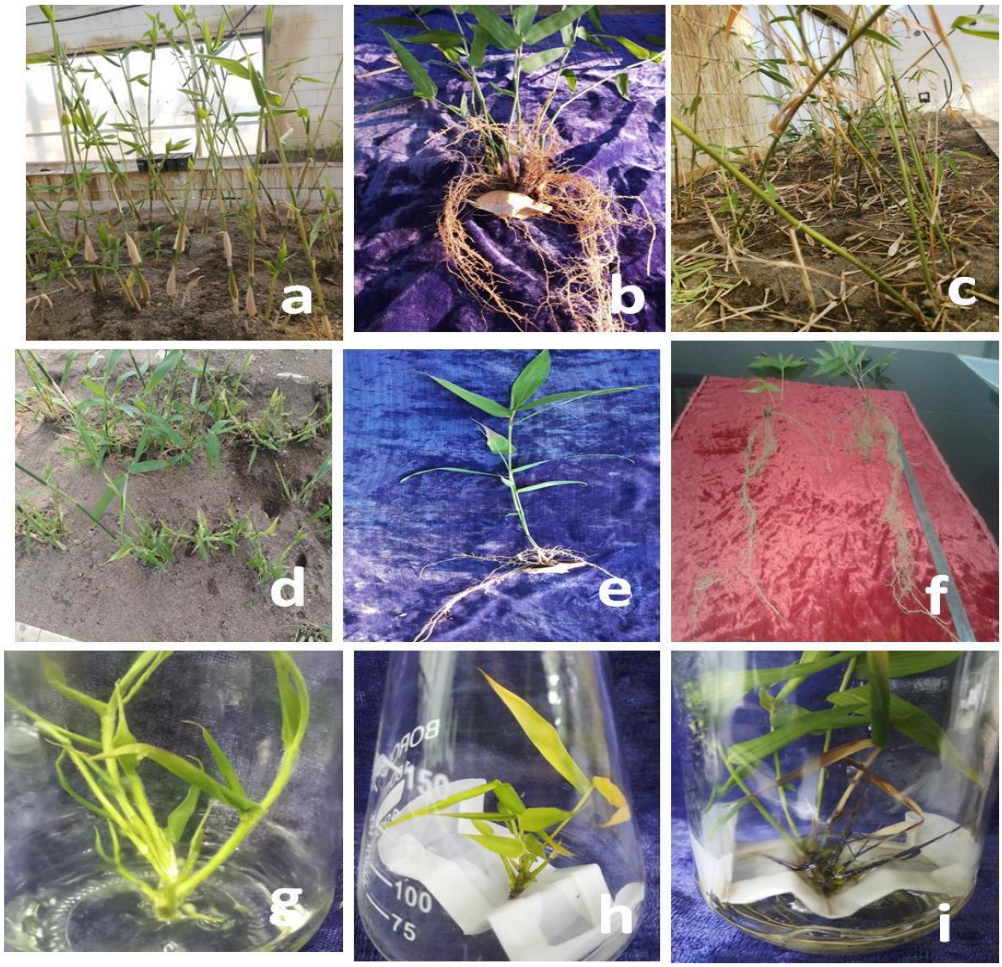


Fig. 22:- Propagation of bamboo - (a-b) *B. nutans*, (c) *B. balcooa,* (d) *B. tulda,* (e-f) *B. tulda,* (g) shoot culture of *B. tulda,* (h-i) Shoot multiplication and rooting in *B. nutans*

Studies on improving adventitious rooting in *Dalbergia latifolia* Roxb. and field performance of its rooted plantlets

Branch cuttings were collected after hedging of the 8 years old progenies of 10 selected trees. Experiments were conducted using cuttings planted in sand beds and polybags after treatment with different auxins viz. IAA, IBA and NAA in combination with Boric Acid and Thiamine HCl. Maximum 26% adventitious rooting was achieved in cuttings planted during the month of April with basal dip treatment of 5mM IAA + 1mM Boric Acid for a period of 20 hrs. Variation in rooting from 15%-26% was recorded in cuttings of different progenies. Rooted plants were kept for acclimatization. Seasonal variation was noted in adventitious rooting. Variation in endogenous IAA and total soluble sugars recorded in progenies during different months. IAA varies from7.02µgg^{-1} fresh weigh to 18.28µg g^{-1} fresh weight during different months. Field planting of seedlings and cutting's raised rooted plants has been done in July 2018. Total 360 plants (90 seedlings and

270 cuttings raised plants) were planted in three replications. Initial data of height and collar diameter was recorded. Survival 100% of plants has been recorded.

Fig. 21:- Field trial of cutting raised plants and seedlings of *Dalbergia latifolia*

1.3.4 Biotechnology

Development of tissue culture protocols for important forestry species, viz., *Buchanania lanzan, Madhuca indica* and *Tamarindus indica*.

Shoot multiplication and rooting experiments were carried out for the three species, viz., *Buchanania lanzan(chironji), Tamarindus indica(imli)* and *Madhuca indica(mahua).* In *Buchanania lanzan* maximum shoot formation was obtained on MS medium supplemented either with adenine sulphate (0.05 µM) or TDZ (0.05 µM) or BA (0.5 µM). Around 1-2 shoots per nodal segments were formed after 30 days of inoculation. Two experiments were conducted for *in vitro* culture establishment of *B. lanzan.* After 20 days of inoculation, maximum number of shoots (2.33- 4.00) were obtained on MS medium supplemented with 0.5µM BA or 0.5µM BA and 0.1µM kinetin. In the second experiment, maximum sprouting was obtained on MS medium supplemented with 3 mgl^{-1}BA and 0.5 mgl^{-1} IAA. Around 3-4 shoots of 2-3 cm shoot length were formed after 20-30 days of inoculation. Shoot cultures of *Tamarindus indica* were maintained on MS medium supplemented with1mg l^{-1} kinetin and rooted plantlets were transferred on ½ strength of MS medium with 20% sucrose for root elongation. Rooted plantlets were hardened in soilrite. *In vitro* shoots of *Madhuca indica* were established through nodal segments on MS medium supplemented with 3mgl^{-1}BA. Maximum sprouting (77.14%) was obtained on buds collected from 1 year old seedlings of *M. indica* as compared to buds collected from seedlings of current year. For *in vitro* rhizogenesis different auxins (IBA, IAA, NAA) and their concentrations (0.5, 1.0 and 2.0 mg/l) were tested and maximum rooting was obtained on IBA treatment. After root initiation, plantlets were transferred to ½ strength of MS liquid medium with 20% sucrose for root

elongation. The project aims to develop tissue culture protocols for the three important NTFP species.

[Abbreviations : MS – Murashige and Skoog, BA – Benzyl adenine, IBA- Indole-3-Butyric acid NAA- Napthalene-1-Acetic Acid, WPM- Woody Plant Medium].

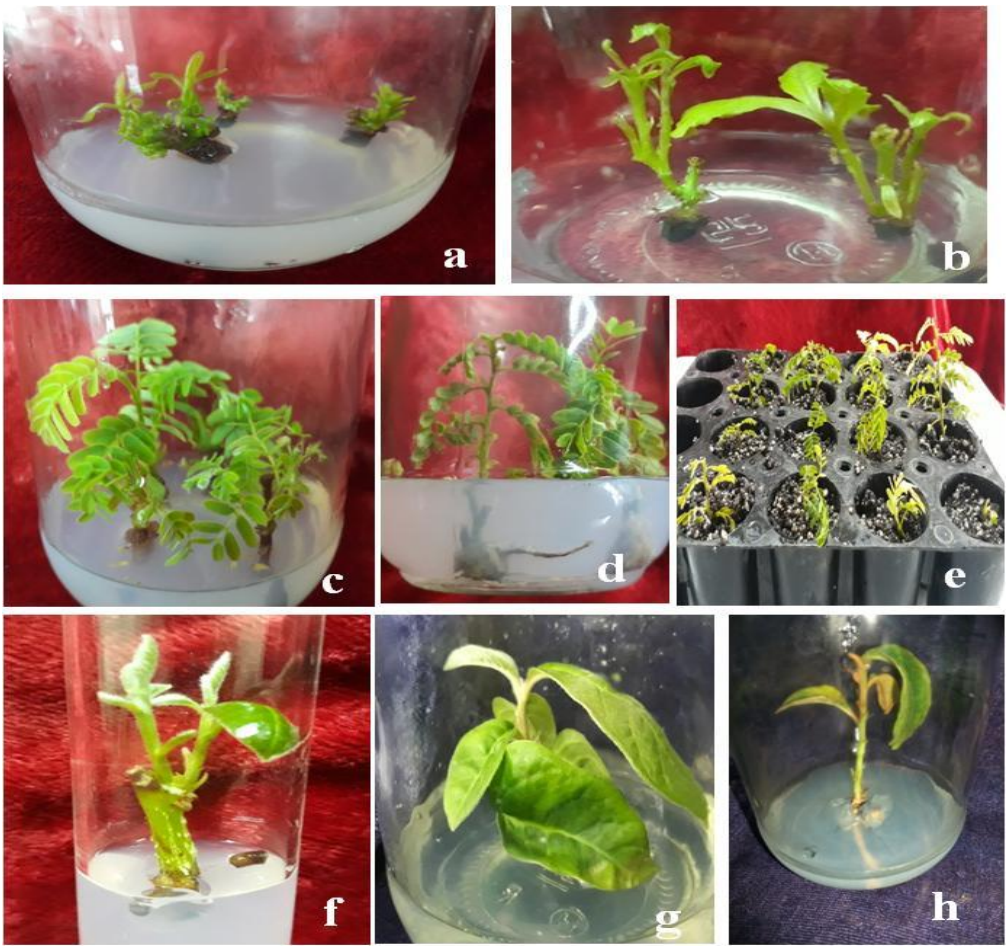


Fig 22:- Cultures of three different species:(a-b) *In vitro* shoot multiplication in *Buchanania lanzan,* (c) *In vitro* shoot multiplication in *Tamarindus indica,* (d) *In vitro* rooting in *T. indica.* (e) Hardening of plantlets of *T. indica,* (f) *In vitro* shoot initiation in *Madhuca indica,* (f) *In vitro* shoot multiplication in *M. indica,* (f) *In vitro* rooting in *M. indica.*

2.4 Forest Management:

2.4.1 Overview

2.4.1.1 Projects under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	-	-	-
Externally Aided	-	01	-

2.4.2 Sustainable Forest Management (SFM)

2.4.3 Forest Economics

2.4.4 Forest Biometrics

2.4.5 Participatory Forest Management

2.4.6 Policy and Legal Issues

Assessing the impact of pruning of *Diospyros melanoxylon* bushes on its yield, quality and natural regeneration of tree species in Maharashtra

Maximum Specific Leaf Area (SLA) was found for healthy leaves, followed by defoliated, diseased and gall infected tendu leaves in State Forest Department (SFD) and Community Forest Rights (CFR) controlled forests in Gondia and Gadchiroli forest divisions of Maharashtra. SLA of second and third harvest in the same season was reported higher as compared to first harvest leaves, which shows that the quality of tendu leaves increased with age. Carbohydrates content was reported maximum in healthy leaves, followed by gall infected and defoliated leaves and minimum in diseased leaves, while ascorbic acid was reported higher in defoliated leaves. Controlled fire experiments produced more number of healthy leaves with higher SLA.

Fig 23:- Collection of tendu leaves for their production, and quality analysis

Fig 24:- Control fire experiment conducted at yield Mehtakheda-2, Maharashtra.

2.4.7 Information and Communication Technology (ICT)

2.5 Wood Products: Nil

2.5.1 Overview

2.5.1.1 Projects under the theme

2.5.2 Wood and other Ligno cellulosic Composites

2.5.3 Wood Processing

2.5.4 Value Addition and Utilization

2.5.5 Wood Chemistry

2.5.6 Pulp and paper

2.6 Non-wood and Forest Products (NWFPs)

2.6.1 Overview

2.6.1.1Projects under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	-	03	-
Externally Aided	-	04	01

2.6.2 Resource Development of NWFPs: Nil

2.6.3 Sustainable Harvesting and Management

Standardization of harvesting time and post harvesting techniques of *Helicteris isora* (Marorphali) and *Mucuna pruriens* (Kaunch)

Project started in November, 2018 only. Fruits of *Mucuna pruriens* were collected from three (03) places belonging to three (03) agroclimatic regions i.e. Hoshangabad (Central Narmada Valley) Mandla and Umaria (Northern Hills Zone of Chhattisgarh) and Jabalpur (Kymore Plateau and Satpura Hills) at monthly intervals. Similarly, the fruits of *Helicteris isora* were collected from Hoshangabad, Umaria and Damoh belonging to Central Narmada Valley, Northern Hills Zone of Chhattisgarh and Vindhyan Plateau agroclimatic regions respectively at monthly intervals. The experiments were laid out to standardize the harvesting time, processing and drying techniques in terms of high active chemical ingredients. The aim of this project is

standardization of harvesting time and post harvesting techniques of *Helicteris isora* (Marorphali) and *Mucuna pruriens* (Kaunch).

2.6.4 Chemistry of NWFPs, Value Addition and Utilization

Evaluation of phytochemicals from forest species-*Terminalia bellirica, Sapindus laurifolius, Acacia concinna, A. auriculiformis,* and *Ziziphus mauritiana* for removal of chemical residues from edible produce.

Fruits of *Acacia concinna,* S.*laurifolius, T. bellirica, A.auriculiformis* and leaves of *Z. Mauritiana* were collected prepared solvent and aqueous extractives. Quantity of saponin glycosides was estimated gravimetrically. Saponin content varied 7.98 to 11.36 % in different samples. Pesticides - Tricel, Profex were applied on Brinjal(*Solanummelongena*) and Okra (*Abelmoschusesculentus*). Pesticidal residues of two marketed formulations (Tricel,Profex) were detected with help of Thin Layer Chromatography and High Pressure Thin Layer Chromatography. Paper chromatography method was standardized for the detection of pesticide and determined with the help of iodine fumigated paper strips and sprayed with silver nitrate solution. Quantity of pesticide residue (Tricel - 20%a.i.chlorpyriphos) was detected with the help of Paper Chromatography. The residues of chlorpyriphos was found below detectable limit in *S. mukrossi* treated with dilutions, 5,10 and 15% for 5 min. Formulations were prepared with saponin isolates of *S.laurifolius* and *T.bellirica.* Physicochemical properties-pH, viscosity, wetting power, solid content and surface tension of formulations were determined.

Assessment of quality of some medicinal plants from different markets of Madhya Pradesh vis-à-vis market value."

Surveyed and collected samples of targeted species Ashwagandha (*Withania somnifera*), Shatavar (*Asparagus racemosus*), Gudmaar (*Gymnema sylvestre*), Baheda (*Terminellia bellirica*) from different markets of Bhopal, Indore, Jhabua, Neemuch and Sheopur of Madhya Pradesh. Physical quality - colour, impurities and size of collected samples of different species were recorded. Moisture % in samples of different species-Ashwagandha, Shatavar ,Gudmaar , and Baheda varied 0.1 to 6.5%. Total phenols, flavonoids,tannins were targeted species. Saponin contents in *A.racemosus* was isolated by solvent extraction method and quantified gravimetrically. saponin content varied 0.04 to 1.32 %. Alkaloid content in *W.somnifera* was quantified by method of Harborne et al. (1973). Quantity of alkaloid content varied 0.44 to 1.56 %. Collection methods of targeted species were recorded. Impurity was observed in Gudmar samples, varied 7.5- 58.8 % due to destructive harvesting. Microbial contamination was observed

in samples of *W.somnifera,A.racemosus,G.sylvester, T.bellirica* in first quarter (July-September). No microbial contamination was observed in *W.somnifera, A.racemosus, G.sylvester.* Bacterial growth was observed in *T.bellirica* samples collected in December. The primary goal of this project is assessment of seedling quality to quantify accurately the levels of morphological attributes of tree seedling that provide potential for vigorous growth and development.

Investigation on variations and domestication of *Curculigo orchioides* Gaertn. (*Kali Musli*) in Madhya Pradesh)

The aim of this project is assessment in variations and domestication of Curculigo orchioides Gaertn. (Kali Musli) in Madhya Pradesh. Working plans of forest department were searched out to check the availability of this species in various forest divisions of Madhya Pradesh. Tours were conducted to Mandla and Damoh forest divisions and rhizomes of *Kali musli* were collected from 06 ranges. Tuber segments containing the apical bud collected from 06 ranges were sowed in nursery beds. Rhizomes were dried in shade and powder was prepared for further estimation of active chemical ingredients using HPLC/ HPTLC instruments.

Identification of prominent locations and best populations of *Terminalia chebula* (Harra) and *Anogeissus latifolia* (Dhawda) in Madhya Pradesh in terms of their active chemical ingredients

The aim of this project is Identification of prominent locations and best populations of Terminalia chebula (Harra) and Anogeissus latifolia (Dhawda) in Madhya Pradesh in terms of their active chemical ingredients. Project started in January, 2019 only. Working plans of Madhya Pradesh forest department were searched out and information is being gathered from forest officials to identify the prominent patches of the selected species in various forest divisions of Madhya Pradesh.

Selection of CPTs, standardization of collection practices and quality evaluation of Gum karaya (*Stercularia urens*) in Chhattisgarh state

The aim of this project is selection and assessment of CPTs, standardization of collection practices and quality evaluation of Gum karaya (Stercularia urens) in Chhattisgarh. Working plans of Chhattisgarh forest department were searched out and information is being gathered from forest officials to identify the prominent patches of *Stercularia urens* in various forest divisions of Chhattisgarh state.

Development of fast food products enriched with *Moringa oleifera* (Drumstick) leaves and skill upgradation training to rural women

Moringa oleifera (drumstick/munga) leaves were collected from available sources, processed and stored for further biochemical analysis and product development work. In continuation to the previous year work, commonly consumed traditional salty food products and vermicelli were prepared by incorporating *M. oleifera* leaves. Six developed food products were analyzed for their sensory and viability studies. Seven workshops cum training programs on "Nutritional benefits of *M. oleifera* leaves and prospects for its value addition" was organized for stakeholders of Chhindwara. Products were also displayed during the 10th Agrovision Exhibition held from 23rd to 26th November 2018 at Nagpur (MS) for exploring market linkages. Three fold brochures in hindi and marathi languages were published for dissemination of research findings. One flex chart was developed for the developed food products for publicity /display purpose during exhibitions, melas, extension activities etc. Further work is under progress as per annual action plan of the project. Technologies developed in project: Biscuits, papads, vermicelli were developed by incorporating *M. oleifera* leaves powder. The research findings of the study will help in improving the nutritional status of tribal /rural women and children by incorporating these developed food products in their day-today diet and thereby overcoming from nutrient deficiencies.

Exploration of adhesive materials for incense sticks from the plant species.

Project just has been initiated.

2.6.5 Biofuels and Bioenergy: Nil

2.7 Forest Protection

2.7.1 Overview

2.7.1.1Projects under the Theme (in table as given at 2.1.1.1)

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	-	06	-
Externally Aided	--	01	03

2.7.2. Insects pests, diseases and control

Field evaluation of biopesticides, Ivermectin and Spinosad against major insect larval defoliators.

Efficacy of biopesticides, Ivermectin and Spinosad 45% SC (CONSERVE) were evaluated through spot spraying against larvae of teak defoliator (*Hyblaea puera*), leaf skeletonizer (*Eutectona machaeralais*), khamer defoliator (*Hapalia aureolalis*) and *Ailanthus* web worm (*Atteva fabriciella*) in plantations. Results revealed 100% larval mortality by 0.03% Ivermectin and 0.003% Spinosad, irrespective of insect pests. The field experiment was continued to assess the impact of selected biopesticides for their effectiveness against insect pests to evolve effective control techniques for future endeavours. The study lead to continuation of toxicity tests of biopesticide, Ivermectin (IVECOP-12) was carried out against larvae of teak defoliator (*Hyblaea puera*) in nursery and 100% larval mortality was obtained by 0.03%. Efficacy of biopesticides, Ivermectin and Spinosad 45% SC (CONSERVE) were evaluated against larvae of teak leaf skeletonizer (*Eutectona machaeralais*), khamer defoliator (*Hapalia aureolalis*) and *Ailanthus* web worm (*Atteva fabriciella*) in plantations. Results revealed 100% larval mortality by 0.03% Ivermectin and 0.003% Spinosad, irrespective of insect pests. The persistent effect of various concentrations of both the pesticides was noticed to determine the toxicity and thereby damage potential. The field experiments exhibit the significant control of insect pests by using suitable concentration of the selected biopesticides. Both the pesticides under trial i.e. Ivermectin and Spinosad has delivered results on the expected lines and will be very useful for recommendation for wider utilization in the effective management of serious insect pests of teak nursery and plantations at early stge.

आय के अतिरिक्त स्त्रोत के रूप में ग्रामवासियों के बीच मशरूम उत्पादन का प्रचार प्रसार।

Objectives:

- आर्थिक सर्वेक्षण के आधार पर आादिवासियों/ ग्रामीणों के समक्ष संस्थान द्वारा मानकित आयस्टर मशरूम उत्पादन के उत्पादन की विधि का प्रचार प्रसार कर उन्हें जागरुक करना।
- आादिवासियों/ ग्रामीणों में उत्पन्न जागरुकता के आधार पर आयस्टर मशरूम उत्पादन की वैज्ञानिक विधि का प्रदर्शन करना एवं इस वैज्ञानिक विधि को अपनाने की लगन एवं लाभ का आकलन करना।

Achievements:

- जबलपुर स्थित बरगी क्षेत्र के ग्रामों खिरवा, दुर्गानगर, पड़रियॉ, मनकेड़ी, हरदुली एवं गागंदा ग्रमो का दौरा कर आदिवासियो/ग्रामीणो से मशरूम उत्पादन बाबत् चर्चा की गई तथा ग्रामीणो में इस कार्य हेतु उत्सुकता रही।

- बरगी क्षेत्र के अंतर्गत ग्राम दुर्गानगर एवं मनकेड़ी ग्रमों के ग्रमवासियों का मशरूम उत्पादन हेतु चयन किया गया।
- ग्रमवासियों के चयन उपरांत उनसे चर्चा करके प्रशिक्षण कार्यक्रम की रूपरेखा तैयार की गई है। चयनित ग्रामवासियों को मशरूम उत्पादन हेतु प्रशिक्षित किया गया।
- मनकेडी तथा दुर्गानगर ग्रामों में आयस्टर मशरूम का गेंहू के भूसे पर उत्पादन विधि पर व्याख्यान एवम् प्रायोगिक विधि का प्रशिक्षण दिया गया। इस कार्यक्रम में 16 एवं 30 कुल 46 ग्रामवासियों ने हिस्सा लिया। मशरूम उत्पादन विधि प्रशिक्षण के बाद ग्रामीणों मे इसे अपनााने की उत्सुक्ता दिखी।
- संस्थान में उत्पादित मशरुम की लागत एवं लाभ की आर्थिक गणना की गयी। मशरूम उत्पादन में एक कि.ग्रा. के बैग पर औसतया रु0 26.25 लागत आती हैं तथा इससे उत्पादित मशरूम से (बाजार भाव 80 रु0/कि.ग्रा. की दर से बेचने पर) रु0 94.95 का लाभ प्राप्त होता है।

Development of delivery system for field application of *Canthecona furecellata* as biological control agent against major insect pests

Survey was conducted in different forest areas to assess the status of predator behaviour on insect pests. Released different stages of *Canthecona furecellata* against the *Hyblaea puera* and *Eutectona machaeralis*, *Plecoptera reflexa* and *Heleothis armigera* for experimental purposes. Observation was taken on the reduction of larvae population and photographs, GPS were taken. Observations were recorded on the reduction of larval population in the Teak, Sissoo plantations and Chick pea crop in the field at Niwas, Mandla, Maharajpur, Gwari-Ghat and Gaur. Based on biology/behaviour of the predator and targeted hosts, the mode/method of field release was standardized through experiments in limited areas.

Fig 25 :- Nymph of *Canthecona furecellata* feeding on larva of *Corcyra cephalonica*

Development of integrated insect pest and disease control system for *Albizia* and *Dalbergia* in plantations of Madhya Pradesh and Maharashtra

Survey was conducted in 16 localities in plantations of Madhya Pradesh and Maharashtra viz - TFRI campus Jabalpur; Borgaon, Forest Division Khandwa; Compt. No. RF-74 / Badbadi

/Kelwara ; Compt.No. RF-79 / Madanpura, Forest Division Katni; RF-1262 / Sonkhawa / Kaparwadi, East Forest Division Chhindwara; Devtola, Dokarbandi, Lalbarra, Nevergaon, Forest Division Balaghat ; Compt.No. P-61/ Kachhwa, Compt.No. P-25 / Gortala, and Compt.No. P-68 / Barhata, Gotegaon, Forest Division Narsinghpur ; compt. No. 832 / Sundardev, Range – Khalwa, Forest Division Khandwa (M.P.) Ramtek, Nagpur Forest Division ; Wardha / adjoining areas, Forest Division Wardha , (M.S.) and observations were recorded on impact of damage caused by insect pests / diseases of *Albizia lebbeck, A. procera* and *Dalbergia* sissoo in plantations. Insect pests - bark eating caterpillar *Indarbela quadrinotata*, termites, *Odontotermes* spp ., defoliator, *Plecoptera reflexa*, semilooper, *Ascotis* spp. and pathogens – *Alternaeria* spp., *Stigmina* spp., *Cladosporium* spp., *Bipolaris spp., Choletotrichum* spp. on *D. sissoo*; *Alternaeria* spp. and *Schizophyllum commune* on *A. lebbeck* and *A. procera* were recorded. Field experiments on integrated pest management (IPM) of insect pests/diseases of *D. sissoo* and *A. lebbeck* were laid out in TFRI campus Jabalpur. Observations were recorded on the per cent defoliation, dying / semi-dying shoots / branches, canker diseases of *D. sissoo, A. lebbeck* and *A. procera*. damaged and healthy seeds of *A. lebbeck.* Treatment chlorpyrifos 0.05% + ridomil 0.2% + mulching + chaubatia paste was found to be most effective against insect pests/diseases in *D. sissoo A. lebbeck* and *A. procera* plantations. Per cent damaged seeds of *A. lebbeck* was less in treatment of trizophos 0.06% and found to be most effective against pod/seed borer *Bruchus bilineatopygus* in *A. lebbeck* plantation.

Fig 26:- Canker disease on *A. lebbeck*

Determining bio-control efficacy of spiders against insect pests of rice agroforestry system

Three varieties of paddy viz., Dantwari (early variety), MTU1010 (mid variety) and Kranti (late variety), 500gms each, were obtained from the seed bank of Jawharlal Neheru Krishi Visva Vidyalaya, (JNKVV), Jabalpur. 36 number of 2x3 meters beds were prepared in 3 cluster where the above three varieties of rice were sown. 3 different types of traps were constructed with bamboo and 18 bamboo-pole-traps, six of each type were mounted in the experimental beds. Mature nests of social spider *Stegodyphus sarasinorum* (Arachnida:Araneae:Eresidae) were fixed on the pole. Pests trapped in the sticky web were collected from inside the nest and were identified as Green leaf hopper (*Nephotettix virescens)*, Gandhi bug (*Leptocoris aacuta)*, Yellow stem borer, (*Scirpophaga incertulas)* Grass hopper (*Hieroglyphus banian)* Hairy caterpillar, (*Psalis pennatula)* and Leaf folder (*Cnapholocrocis medinalis)*. Parabolic arch type trap was the best for establishment of social spider population and hence selected for final experiment to be conducted during 2019-2020.

Fig 27a:-Rice Agroforestry Experimental Site

Fig 27b:- Fixing nest of social spider in the trap-pole

Fig 27c:- Social-Spider-Trap-Pole mounted in the rice field

Production of organic fertilizers/organic pesticides and their application in forest nurseries.

Experiment were laid out in the month of December 2018 at Bamandehi Nursery and Banjara nursery of Seoni Forest Division. Recorded data for effect of Jeevamrut on height and girth of seedlings.

Capacity building of nursery staff on preparation of organic fertilizer and its application.

Project just initiated. Conversation with the stakeholder going on. A letter is being written to CCF, Raipur for arranging the training on capacity building of nursery staff on preparation of organic fertilizers and its application.

Extension of biological control of teak defoliator and skeletonizer through egg parasitoid, *Trichogramma raoi* (TFRI-Trichocards) in plantations.

Project just initiated. Work was carried out mass multiplication of *Trichogramma raoi* in lab condition.

Monitoring and dissemination of knowledge to manage sal heartwood borer, *Hoplocerambyx spinicornis* in Chhattisgarh

Project just initiated. Work was carried out in 02 Ranges – Kawardha and Chilpi, Bhoramdev Abhyaranya. 10 compartments were surveyed for monitoring of sal borer. Minor incidence of sal borer observed only in compt. no. 47 in Kawardha Range.

2.7.3 Mycorrhizae, rhizobia and other useful microbes

2.7.4 Weeds and Invasive species:Nil

2.7.5 Forest Fire and Grazing

Developing a predictive fire model on forests of Maharashtra with relation to various factors and to delineate suitable strategies

Aspect wise incidence of forest fire distribution reveals that South-west surface aspect exhibits highest no. of forest fire (13.7%) followed by North west (12.9%), South (12.9%), West (12.7%), East-south (12.3%), North (12.2%), East (11.6%), and North-East (11.2%). In northern hemisphere, surface with southern aspect gets more radiation. As far as slope is concerned, surface with less than 10° slope exhibited highest count of forest fires (63%). Among the all forest density classes MDF (Moderate dense forest forest) showed highest distribution (41.7%) followed by very dense forest (VDF, 39.6%) and open forest (18.6%). Among all forest types, southern dry mixed deciduous forest showed highest distribution (37.2%) followed by southern

moist mixed deciduous forest (25.4%), very dry teak forest (19.7%), and moist teak forest (14.6 %).

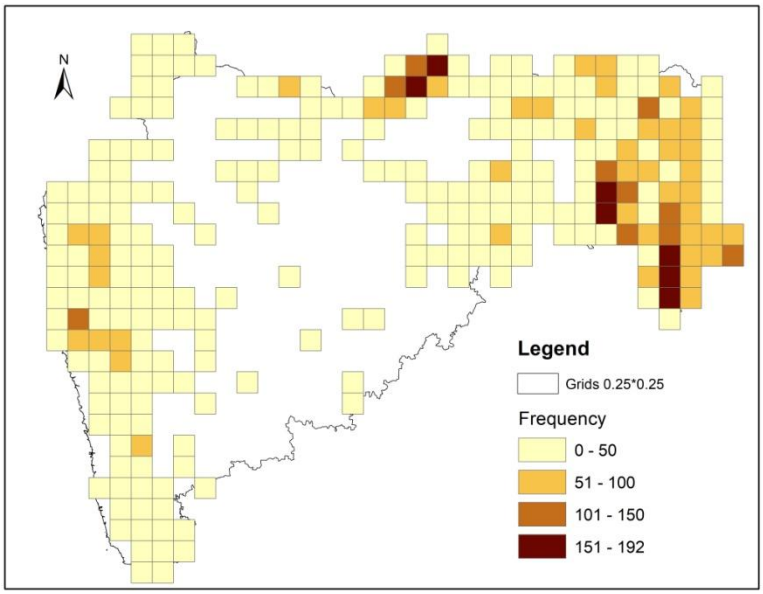


Fig 28:- Fire zoning map (using fire frequency)

3. Education Vistas/Activities

- As a part of education activities, one week dissertation work was conducted by the FRC-SD Total 17 girl students of B.Sc sixth semester (Botany), Rajmata Scindia Govt. Girls College, Chhindwara were enrolled during March 2019. Revenue of Rs. 17,000/- was generated by the centre for ICFRE during the year.

- Group of students from various schools and colleges recurrently visited the TFRI and FRC-SD centre as part of their educational field tour during the year. Students were sensitized about research activities in the institute and awareness was generated regarding environment and biodiversity conservation.

3.1 FRI University (Applicable for FRI, Dehradun only)

3.2 Trainings Organized: Topics must be indicated in text while providing information in the table given below:

Note: Please indicate in numerals i.e. 1, 2, 3…n only. Please do not write one week, six months etc.

Sl. No.	No. of Trainings	Duration (in days)	No. of participants
1.	65	230 days	2047

SNO.	Name of Training Programmes
1	Biological control of insect pests of teak through TFRI-Tricho cards
2	One day training programme was conducted at Anganwadi Kendra, Rural Chhindwara on "Nutritional Potential of *Moringa oleifera* leaves and prospects for its Value addition"
3	One day training programme was conducted at Anganwadi Kendra, Khirsadoh on "Nutritional Potential of *Moringa oleifera* leaves and prospects for its Value addition" underongoung research project ID No. 222/CFRHRD/2016-1(19).
4	One day training programme was conducted at Anganwadi Kendra Umreth on "Nutritional Potential of *Moringa oleifera* leaves and prospects for its Value addition" for on underongoing research project ID No. 222/CFRHRD/2016
5	One day training programme was conducted at Anganwadi Kendra Ridhara on "Nutritional Potential of *Moringa oleifera* leaves and prospects for its Value addition" for on underongoing research project ID No. 222/CFRHRD/2016-1(19).
6	One day training programme was conducted at Anganwadi Kendra Kundalikala on "Nutritional Potential of *Moringa oleifera* leaves and prospects for its Value addition" under on going research project ID No. 222/CFRHRD/2016-1(19).
7	One day training programme on "Environmental Awareness" and "Biodiversity Conservation" was organized by, FRC-SD, Chhindwara
8	One day training programme on "Environment Awareness" and "Biodiversity Conservation" was organized at FRC-SD, Chhindwara.
9	One day training programme on "Insect Pest and "Diseases in Forest Nursery and their Control Measures" was organized at FRC-SD, Chhindwara.
10-16	Capacity building on collection, sustainable harvesting and processing of Harra for NTFP gatherer in M.P. (7 no.)
17- 42	Capacity building on collection, sustainable harvesting and processing of Lac for NTFP gatherer in M.P. (26 no.)
43	Summer course on "**Agroforestry and its Management**" for B.Sc. Forestry students of SHUATS, Allahabad (UP) (1no.)
44 -47	**Agroforestry and its Management**" at FRC & Skill development, Chhindwara for the other stakeholders like farmers, students, students, Professor and NGOs of adjoining 5 villages of Chhindwara. (3 no.)
48	Following Training programme organized in VVK Maharashtra at Jalna: 1. उन्नत नर्सरी तकनिक, वृक्षसुधार, कृषि वानिकी 2. वन रोपणियों / वृक्षारोपणों के कीटों तथा रोगों का समन्वित प्रबंधन
49	Training on Forestry for eco-restoration and low carbon future for officials of Singaji Thermal Power Plant organized at Khandwa
50	One day training programme on "Biodiversity of Sapura plateau with special reference to dependencies oftribals" was conducted at Delakhari, Chhindwara (MP).
51	Plant Tissue Culture Techniques and its Applications under GSDP of MoEF&CC
52	Value addition and marketing of NTFPs (Plant origin):NTFP Products / Medicinal Plants under GSDP of MoEF&CC
53	One day training programme on "Biodiversity of Sapura plateau with special reference to dependencies oftribals" was conducted at Mahupani, Betul (MP)
54	Environmental Awareness and Biodiversity Conservation was organized by FRC-SD

55	One day skill development training programme on Nursery Techniques and Organic Manure preparation was organized by FRC-SD
56	Forest Entomology and Pest Control under GSDP of MoEF&CC
57	Management of Small Botanical garden under GSDP of MoEF&CC
58	Propagation and Management of Bamboo under GSDP of MoEF&CC
59-60	Environmental Awareness and Biodiversity Conservation
61-65	Training on "Plant Biotechnology Techniques" (o5 Nos.)

GSDP Training Programmes at TFRI Jabalpur

Under Green Skill development programme (GSDP) of MoEF&CC,TFRI Jabalpur organized five training programmes on Management of Small Botanical garden, Forest Entomology and Pest Control, Value addition and marketing of NTFPs (Plant origin):NTFP Products / Medicinal Plants, Plant Tissue Culture Techniques and its Applications and Propagation and Management of Bamboo. These training were aimed at skill development of youths and others for self-employment and creation of specialized work force.

Fig 29:- Plant tissue culture techniques and its Applications training under GSDP

Fig 30:- Propagation and Management of Bamboo training under GSDP

Fig 31:- Trainees of Management of Small Botanical garden exposed to raising seedlings in polyhouse

Fig 32:-Trainees of training on Value addition and marketing of NTFPs taken for industrial visit

Fig 33:- Hands-on training during Plant tissue culture techniques and its application training programme

Fig 34:- Hands-on training during Forest entomology and Pest Control training programme

Fig 33:- Training on NTFP under TRIFED

1.3 Visit Abroad: NIL

3.4 Participation in Seminars/Symposia/Workshops/Training

Sl. No.	No. of Trainings	Duration (in days)	No. of participants (Ministerial)
1.	**11 nos.**	**5 days**	**07**

Sl. No.	No of Seminars/Symposia/ Workshops/Trainings	Duration (in days)	No. of participants
1.	**06/--/10/07**	**12/--/18/41**	**06/--/15/09**

SNo.	List of participation in Seminars/ Symposia/ Workshops/ Trainings	Duration (in days)	No. of participants
1	Dr. Pawan Kumar, Scientist-E and Shri A.J.K. Asaiya, Scientist-B attended 06 days training on "Advanced molecular techniques of Pathogenic and Beneficial Microbes" at CCMB, Hyderabad.	06	01
2	Shri A.J.K. Asaiya, Scientist-B attended 05 days training on "Natural Resources and Environmental Management" at IIFM, Bhopal.	05	01
3	Shri Nahar Singh Mawai, Senior Technical Officer, attended 05 days training on "Research Methodology and Statistical tools in forestry" at IFGTB, Coimbatore (T.N.).	05	01
4	Dr. Naseer Mohd., Scientist-D participated in one day Workshop on "State Level Bio-safety Capacity Building Workshop".	01	01
5	Dr. Naseer Mohd., Scientist-D participated in National Workshop on "Recent Advances in Statistical Methods and Applications in Forestry and Environmental Science" at ICFRE.	04	01
6	Dr. Naseer Mohd., Scientist-D participated and poster presentation in 14th National Silviculture Conference held at IWST, Bangaluru on "Forest and Sustainability: Securing a Common Future".	03	01
7	Shri Yogesh Pardhi, Senior Technical Officer attended programme on "Research Methodology and Statistical tools in forestry".	05	01
8	Dr. Hariom Saxena participated in 14th National Silviculture Conference on “Forest and	03	01

	sustainability: Securing a common future at IWST Bangalore.		
9	Dr. G. Rajeshwar Rao participated in National Seminar on "Use of flyash in forestry applications and rejuvenation of waste/degraded lands" at Telangana State Forest Academy, Hyderabad.	01	01
10	Dr. Avinash Jain participated in 14th National Silviculture Conference on "Forest and sustainability: Securing a common future at IWST Bangalore	03	01
11	Dr. Avinash Jain and Sh. M. Rajkumar participated in Training on Valuation of Ecosystem Services; ICFRE, Dehradun.	03	02
12	Dr. Avinash Jain participated in Inception meeting with the officers of Adani Power Maharashtra Limited (APML) on "Establishment of Flyash Park at Tiroda, Gondia (Maharashtra)" .	2	01
13	Dr. Avinash Jain participated in Inception workshop on "Revision of State Action Plan on Climate Change" at EPCO, Bhopal.	2	01
14	Dr. Avinash Jain participated in "Sustainable Development Confluence – 2018" at Bandhavgarh Tiger Reserve organized by Reliance Cementation Pvt. Ltd., Mumbai.	2	01
15	Dr. Avinash Jain and Sh. M. Rajkumar participated in National conference on "Towards resilient ecosystems: The role of Forestry Research"; IFGTB, Coimbatore.	02	02
16	Dr. G. Rajeshwar Rao and Sh.	01	02

	M. Rajkumar participated in One day workshop on "Conservation and restoration of Madan Mahal Hills by Smart City Limited, Jabalpur.		
17	Sh. M. Rajkumar participated in Training on Project formulation-Climate Change Mitigation and Adaptation; BIRD, Lucknow.	05	01
18	Dr. S. Chakrabarti and M. Rajkumar participated in Regional workshop on "The Biodiversity Act-2002"; Dharmashastra National Law University, Jabalpur.	02	02
19	Sh. Dheeraj Gupta participated in Hydrological modelling using QSWAT; NIH Roorkee.	12	01
20	Sh. Dheeraj Gupta participated in Gender mainstreaming for REDD+ implementation and REDD+ MRV; ICFRE, Dehradun.	3	01
21	Shri N.D. Khobragade and Smt Shalini Bhawate attended National Workshop on "Operation and maintenance of Laboratory instrument" at Rajmata Sindhiya Govt. Girls College, Chhindwara. (M.P.).	1	02
22	Dr. Vishakha Kumbhare Shri N.D. Khobragade and Smt Mamta Meshram attended "National Workshop on Intellectual property Rights" organized by Indira Priya Darshini College, Chhindwara sponsored by Madhya Pradesh Council of Science & Technology, Bhopal, (M.P.)	1	03

4.1 Extension Panorama/Activities

- National Forest Library and Information Centre (NFLIC) (Applicable for FRI, Dehradun only)
- Environmental Information system (ENVIS) (Applicable for FRI, Dehradun & IFGTB, Coimbatore only)

4.2 Report on Van Vigyan Kendras (VVKs) and Demo Village (DV)

A two day training programme was organized by the TFRI, Jabalpur in VVK Maharashtra at Jalna during 11-12 Dec. 2018 to disseminate technical knowhow related to research and developments of commercially important tree species to staff of Maharashtra Forest Department as well as farmers, NGOs and general public. More than 150 stakeholders attended the training programme. Regular routine activities were carried out in Demo village at Moiya Nallah.

Fig 36:- VVK Maharshtra training at Jalna

4.3 Technologies transferred : NIL

4.4 Research Publications: Please provide information in the tables given below:

Research articles published by the Institute

Sl. No.	Number of research articles published in scientific journals and books/ proceedings		
	National Journal	Foreign Journal	Chapter in Books / proceedings
1	25	17	20

Research articles presented in seminars/conferences/workshops and abstracts and popular articles published by the Institute

Sl. No	Number of articles presented in seminar/conferences/workshops and abstracts and popular articles published		
	Article presented	Abstract published	Popular articles
	18	28	16

Books and booklets, brochures/pamphlets published by the institute

Sl. No	Number of books and booklet, brochures/pamphlets published	
	Books	Booklets/Brochures/Bulletins/Pamphlets
1.	04	17

Sl. No	List of books and booklet, brochures/pamphlets published	
	Books	Booklets/Brochures/Bulletins/Pamphlets
1	S. Chakrabarti, 2018. Birds of TFRI Campus. (DG, ICFRE, on 12th April, 2018, released a "Pre-Published-Print" of this book.	
2	Berry, Nanita (2018) Agroforestry Systems	**Brochures** Harra, Lakh, Krishivaniki, Gmelina arborea based agroforestry system, Baheda, Babul Paddy, Bach paddy, Agri-lac culture(Revised)
3	Berry, Nanita (2018) Lakh ki Kheti evam uska prabandhan	
4	R.K. Verma, A.J.K. Asaiya and G. Rajeshwar Rao (2019). Records of Indian Fungi, Part-I and II	
5		**<u>Bulletins</u>** 1. User manual of seed and nursery techniques of commercially important trees, Saravanan, S; Kundu,M; Berry,Nanita and G. Rajeshwar Rao.

		2.Virtual herbarium with bi-lingual description of medicinal plants collected from Chhattisgarh, India 3. Technical bulletin titled *Chironji ki nursery avam ropani*.
6		**Pamphlets** 1. शेवगाःप्रकृतिचीएकअमूल्यभेंट 2. मुनगाःप्रकृतिकीएकअनमोलभेंट *3. BirBahuti –Bahuupyogi Kit* in Hindi, *4. Mushroom avm poshktatv* in Hindi *5. Madhmashi –Labhdayak kit* in Marathi 6. *Javurvark –KechuaKhad* in Hindi

4.4 Seminar/Symposia/Workshops Organized 11 Institute level monthly seminar and one workshop was organized

Sl. No	No. of Seminars/Symposia/ Workshops/ meetings organized	No. of days	No. of participants
1.	Bamboos for Better Tomorrow	One day 30/05/2018	50
2.	i. Various techniques learnt during training programme organized by ICFRE ii. Assumption of the analysis of variance, causes for deviation, remedial measures to address the same iii. Hydrological modelling using QSWAT	One day 29/06/2018	55
3.	Prospects of Bamboo cultivation	One day 17/01/2018	49
4.	Environmental and Economical function of Agroforestry	One day 23/07/2018	35
5.	A viewpoint on Tree Improvement in Indian Sandalwood	One day 30/08/2018	45
6.	Glimpses of ecological research done in Tropical Forest Research Institute	One day 24/09/2018	47
7.	Abiotic Stresses on Forests	One day 22/10/2018	40
8.	REDD-plus Mechanism: MRV requirements	One day 30/11/2018	47
9.	Trends in the Development and formulations of Microbial inoculants for preparing biofertilizers	One day 18/01/2019	48
10.	Carbon Flow in Indian Forests – A Review	One day 31/01/2019	40
11.	Bird mediated germination of some difficult seeds of forest trees	One day 15/03/2019	50
12.	Meeting was organized on *"*वन सम्पदा से स्वरोजगार की असीम सम्भावनाये*"* at TFRI, Jabalpur for Jabalpur Chambers of Commerce	One day 26.06.2018	40

4.5 Consultancies

S. No	Title	User agency
1	Monitoring and Evaluation of works performed under CAMPA	CAMPA, CG
2	Ecosystem Services Improvement Programme (ESIP)	World Bank
3	Capacity building of NTFP gatherers on MFP-MSP training programme under TRIFED, New Delhi sponsored funded by MFP federation, Bhopal(M.P.)	MFP federation, Bhopal (M.P.)
4	Monitoring of NTPC Ltd. Accelerated Afforestation Programme of Plantation of 10 Million Trees – In Seven States (M.P. and Maharashtra)	NTPC
5	Implementable forestry research for ash utilization promotion and development of research park at APML, Gondia	Adani Maharashtra Power Ltd
6	Controlling fugitive dust emission through biological reclamation of flyash lagoons in Shri Singaji Thermal Power Project (SSTPP), Khandwa (M.P.)	M.P. Power Generating Co. Ltd.
7	Preparation of Wildlife Conservation plan for Kanchan Open Cast Expansion Project.	SECLJohilla Area (Madhya Pradesh)
8	Preparation of Wildlife Conservation plan for Jhilimili Underground and Coal Mines.	SECL Baikunthpur Area (Chhattisgarh)
9	Preparation of Wildlife Conservation plan Damini Underground and Rajendra Underground Coal mines.	SECL Sohagpur Area (Madhya Pradesh)

4.6 Technical Services

1 Dr. P.B. Meshram, Scientist-G and Dr. R.K. Verma, Scientist-G attended enquiry on die-back in teak trees in Panna Tiger Researve on 19-21 July 2018 and submitted report to the Field Director.

2 Dr. P.B. Meshram, Scientist-G/Head attended an enquiry on mortality/die-back due to viral and insect attack in teak plantation at Cherapodi Range, Kundam Project Division, Jabalpur (M.P.R.V.V.Nigam) on 21.08.2018 and suggested suitable recommendations.

3 Dr. P.B. Meshram, Scientist-G/Head attended enquiry on White Grub in teak nursery Belkund, M.P.R.V.V. Nigam and Sarswahi, R&D circle, Jabalpur on 11.08.2018 and suggested suitable recommendations.

4 Clonal fidelity testing services were provided to CG Forest Department for Eucalyptus and bamboos and earned revenue of approximately 16.00 lakh for institute/council.

5 An MOU has been signed with Madhya Pradesh State Bamboo Mission, Bhopal for DNA fingerprinting and clonal testing of bamboos.

6 Total 2662 soil and forest floor samples received from FSI, Nagpur were analyzed for organic carbon content. Total revenue of Rs. 1,33,100/- were generated for the centre and ICFRE out of the analysis work.

7 Total 1901 soil samples and 761 plant samples received under ESIP project, ICFRE, Dehradun was analyzed for organic carbon and dry weight determination. Rs. 1,32,575/- were generated as revenue for the centre and ICFRE out of the analysis activity.

4.7 Activities of Rajbhasha

उष्णकटिबंधीय वन अनुसंधान संस्थान में, भारत सरकार, गृह मंत्रालय, राजभाषा विभाग की मार्गदर्शी रूपरेखा के अनुसार, 14 सितम्बर, 2018 को **संस्थान के निदेशक, डॉ. जी. राजेश्वर राव, कृ.अ.से. की अध्यक्षता में** हिन्दी दिवस का आयोजन किया गया। इस अवसर पर,निदेशक की उपस्थिति में, संस्थान के प्रशासनिक भवन के प्रांगण में गृह मंत्रालय, राजभाषा विभाग द्वारा जारी **माननीय गृह मंत्री भारत का 'हिन्दी दिवस' पर जारी संदेश का वाचन समारोह आयोजित किया गया**।

गृह मंत्रीजी के संदेश वाचन समारोह में, समस्त वैज्ञानिक, अधिकारी एवं पदाधिकारी साथ-ही-साथ अनुसंधान अध्येयताओं ने उत्साहपूर्वक भाग लिया। वर्ष 2018-19 के दौरान राजभाषा कार्यान्वयन समिति की तिमाही बैठकें प्रत्येक तिमाही में आयोजित की गई एवं बैठक के कार्यवृत्त भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्, (भा.वा.अ.शि.प.) मुख्यालय, देहरादून के समक्ष प्रेषित की गई। संस्थान की राजभाषा हिन्दी के प्रगामी प्रयोग की तिमाही हिन्दी के त्रैमासिक प्रतिवेदन भा.वा.अ.शि.प. एवं राजभाषा विभाग के संबंधित कार्यालयों को प्रेषित की गई।

वर्ष 2018-19 के दौरान, संस्थान के राजभाषा अधिनियम 1963 की धारा 3(3) के तहत जारी किये जाने वाले दस्तावेज संस्थान में पदस्थ हस्ताक्षरकर्ता अधिकारियों ने हिन्दी-अंग्रेजी में एक साथ जारी किया एवं संघ की राजभाषा नीति का इस संस्थान के हित में अनुपालन सुनिश्चित किया।

Hindi Divas was celebrated on 14th September, 2018 under the chairmanship of Dr. G. Rajeshwar Rao, ARS, Director**,** Tropical Forest Research Institute as per the standard guidelines of the Department of Official Language, Ministry of Home Affairs, Government of India. On the occasion, a special get together programme of all the employees of the institute was organized and the message of the Honourable Union Home Minister of India issued by Department of Official Language, Ministry of Home Affairs was read out in front of the administrative building of the Institute in the presence of the Director.

During this celebration, all Scientists, Officers and staff as well as Research scholars participated enthusiastically. During 2018-19 the meeting of the Official Language Implementation Committee (OLIC) was convened in each quarter regularly and the minutes of the same were sent to ICFRE, Headquarters. Quarterly progressive reports in respect of Official Language viz. *Hindi ka tramasik prativedan* were also sent to the ICFRE, Headquarters and other respective offices of the Department of Official Language.

During 2018-19 the documents which comes under section 3(3) of The Official Language Act, 1963 were issued in Hindi as well as in English simultaneously by the concerned signing authorities of the institute and the prescribed target of Hindi correspondence were also achieved to ensure compliance of The Official Language Policy of the Union in the interest of this Institute.

Fig 37 : टी.एफ.आर.आई. में निदेशक की अध्यक्षता में हिन्दी दिवस समारोह का आयोजन।

Fig 38 : निदेशक की अध्यक्षता में राजभाषा कार्यान्वयन समिति की तिमाही बैठक का आयोजन।

4.8 Awards and Honours: NIL

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

TFRI and FRC-SD celebrated/participated in :

- International Biodiversity day (22 May 2018),
- World Environment Day (5 June 2018),
- International Yoga Day (21 June 2018)
- Independence Day (15 August 2018),
- SadbhawnaPakhwara (20 Aug.-5Sept. 2018)
- Parthenium Awareness day, 17 August, 2018
- Hindi Diwas (14 Sept. 2018)
- Vigilance awareness week October 2018
- 10th Agrovision at Nagpur during 23-26 November, 2018,
- Golden Jublee celebration of ISWS at DWR, Jabalpur during 21-24 November, 2018
- Republic Day 26 Jan. 2019)
- International Forestry Day 2019 (19 March, 2019)
- Programmes under "PRAKRITI"
- Monthly Swatcchata Abhiyaan

Fig 39:- Painting competition on the occasion of International Biodiversity day 22 May 2018

Fig 40:- Winners of Painting competition organized during International Biodiversity day 22 May 2018

Fig 41:- Photos related to World Environment Day 5 June 2018 celebration at TFRI

Fig 42:- Van Mahotsav Celebration at TFRI on 6 July 2018

Fig 43:- Independence Day on 15 August 2018

Fig 44:- Parthenium Awareness day, celebrated on 17 August, 2018 at TFRI

Fig 45:- Hindi Diwas 14 Sept. 2018

Fig 46:- **Participation and stall in Golden Jubilee celebration of ISWS at DWR, Jabalpur during 21-24 November, 2018**

Fig 47:- TFRI stall during 10th Agrovision at Nagpur during 23-26 November, 2018

Fig 48:- Republic Day celebration at TFRI on 26 Jan. 2019

Fig 49:- Celebration of International Day of Forests, 2019 at TFRI

Programmes orgainzed under "PRAKRITI"

Fig 50:- A view of KV student's visit at TFRI

Fig 51:- Interactive programme organized under Prakriti at JNV Bargi in the presence of Shri A, Ramachandra, Joint commissionar, NVS, New Delhi

Fig 52:- JNV Bargi students invited to TFRI to have first hand information on forestry research

5. Administration and Information Technology

Introduction

5.1 Information Technology

Introduction

5.1 Information Technology Cell

The institute has 100 MBPS NKN link provided under the National Knowledge Network (NKN) scheme of NIC project. The NKN comprises an ultra-high speed CORE (multiples of 10 Gbps), complimented with a distribution layer at appropriate speeds to support Overlay, Dedicated and Virtual Networks. The institute has a 100 MBPS fast Ethernet fiber optic backbone LAN, which 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) have been in operation successfully. The new web site of

the institute (http://tfri.icfre.org) has been launched with new contents. Web pages have been updated for the institute's online open access e-magazine 'Van Sangyan' (ISSN 2395 - 468X) linked with institute's web site on regular basis and issues have been uploaded on monthly basis over it for easy access to the users. Reports have been generated for all the activities undertaken at the institutes level - conferences/seminars/workshops/trainings/visits of dignitaries/visits etc. are uploaded on institute's web site and also sent to the headquarter for uploading over ICFRE website. A mobile App for the Insects Pests of Tropical Forests, Nurseries and Plantations developed by IT Cell. Another online web application of Insects of Mangrove forest of Odisha has been developed by IT Cell. Contribution to Group-C recruitment process was given by IT Cell in examination and result declaration. Nearly 25 new desktop computers were procured and distributed in the institute. Various networking facilities extended within the institute. All the circulars, notifications, office orders, proceedings of monthly seminars and other documents have been regularly uploaded over the Online Office Records (Order /MoM / Agenda etc.) System for wider circulation.

5.2 Administration: A brief note on general administration activities along with information on the following**:**

5.2.1. Sevottam: Activities relating to the Citizens/Clients Charter as detailed below has to be included in the Annual Report.

5.2.1.1 Action taken to formulate the Charter for the Department and its subordinate formation:

Provision for Annual Review of the Charter after approval is as:

5.2.1.2 Action taken to implement the Charter

Action will be taken for implementing the Charter, after its finalization.

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

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

5.2.1.5 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 will be initiated, after finalization.

5.3 Welfare measures for the SC/ST/Backward/minority communities:

The interest of the above section are being safeguarded and as per the guidelines of Government of India a Liaison Office is in position who monitors the promotion / recruitment as per the roster.

Recruitment made during 2018-19

Examination process for the recruitment of 10 posts of MTS including sanitation attendant and 01 post of Forester has been completed.

Promotion made during 2019-19 under group"C" posts: - NIL

6. Annexures

1. RTI

वर्ष 2018-19 के दौरान टी.एफ.आर.आई., जबलपुर में आरटीआई के 49 मामले अभिप्राप्त हुए थे जिनमें 41 मामलो का अनुबंधित समयावधि के भीतर निपटान किया गया।

In TFRI, Jabalpur, 49 cases with regard to RTI were received during the year 2018-19 and 41 cases were disposed within stipulated time period.

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	Director, TFRI, Jabalpur	Shri Vijay Kamble, Assistant Director (OL)TFRI, Jabalpur	As per provision and guidelines provided under RTI Act, 2005.
Centre for Forestry Research & Human Resource Development, Chhindwara	Head, CFRHRD, Chhindwara	Head, CFRHRD, Chhindwara	As per provision and guidelines provided under RTI Act, 2005

2. Information on vigilance cases - Nil

3. Information on audit objections – Nil

4. Email and Postal addresses

Director
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**

Head,
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 – 292061 (O)
e-mail: head_cfrhrd@icfre.org/dir_cfrhrd@rediffmail.com

5. Intellectual Property

5.1 Patents Granted - NIL

5.2 Others- NIL

List of Abbreviations

ACZ – Agro Climatic Zone
AICRP – All India Coordinated Research Project
AM- Arbuscular Mycorrhiza
APML- Adani Power Maharashtra Limited
ARS – Agriculture Research Services
BA- Benzyl Adenine
CAMPA – Compensatory Afforestation Fund Management and Planning Authority
CCF – Chief Conservator of Forests
CG - Chhattisgarh
CPT- Candidate Plus Tree
CSO - Clonal Seed Orchard
DFO – Divisional Forest Officer
DNA- Deoxyribonucleic acid
EPN- Entomopathogenic Nematode
FRCSD- Forestry Research Centre for Skill Development
FRI- Forest Research Institute
GBH- Girth at Breast Height
GIS- Geographical Information System
GNSS - Global Navigation Satellite System
GPS – Global Positioning System
GSDP – Green Skill Development Programme
HoFF – Head of Forest Force
HPLC - High Performance Liquid Chrometography
HPTLC – High Performance Thin Layer Chrometography
IAA- Indole Acetic Acid
IBA - Indole Butyric Acid
ICAR – Indian Council of Agricultural Research
ICFRE – Indian Council of Forestry Research and Education
IFRIS – Integrated Forest Resource Information System
IFS – Indian Forest Service
IGKVV – Indira Gandhi Krishi Vishwavidyalaya
IPM - Integrated Pest Managment
JNKVV- Jawaharlal Nehru Krishi Vishwavidyalaya
JNV - Jawahar Navodaya Vidyalaya
KVK - Krishi Vigyan Kendra
MDF - Moderate Dense Forest
MP- Madhya Pradesh
MOU – Memorandum of Understanding
MOEF&CC- Ministry of Environment, Forests and Climate Change
MPCA- Medicinal Plant Conservation Area
MPCST – Madhya Pradesh Council of Science and Technology
MPFDC - Madhya Pradesh Forest Development Corporation

MPSFD - Madhya Pradesh Forest Department
MS- Maharashtra
MS- Murshige and Skoog
NAA – Napthyl Acetic Acid
NABARD - National Bank for Agriculture and Rural Development
NGO - Non Government Organisation
NTFP- Non-Timber Forest Produce
NTGB-National Teak Germ Plasm Bank
NTPC – National Thermal Power Corporation
NWFP –Non-Wood Forest Produce
OFR – On Farm Research
PCCF- Principal Chief Conservator of Forests
PMS – Payroll Management system
PSB- Phosphate Solubilizing Bacteria
RFRC - Regional Forest Research Centre
RIMS – Research Information System
RSP - Rourkela Steel Plant
RTI – Right to Information
SAIL – Steel Authority of India Limited
SC - Schedule Caste
SCI – Selection Cum Improvement
SECL – South Eastern Coalfields Limited
SFD – State Forest Department
SLA – Specific Leaf Area
SPA- Seed Production Area
SSO - Seedling Seed Orchard
SSR – Simple Sequence Repeat
ST – Schedule Tribe
TFRI- Tropical Forest Research Institute
TSO - Teak Seed Orchards
UP – Uttar Pradesh
VAM- Vesicular Arbuscular Mycorrhizae
VDF – Very Dense Forest
WPM – Wood Plant Medium