ICFRE

Annual Report
2018 - 2019

Arid Forest Research Institute

Jodhpur, Rajasthan

CONTENTS

Overview

AFRI Institute has executed Plan Projects as well as Externally Funded Projects of different funding agencies of Government of India. During 2018-19 two plan projects and two externally aided have been successfully completed, whereas 14 Plan Projects and 5 externally funded projects have been executed. During this period one new plan project alongwith two exeternally aided projects were initiated. Simultaneously this year recruitment process were also initiated against 7 vacant posts also two MoUs were signed between AFRI and National Medicinal Plant Board (NMPB) and with Jaipur National University (JNU), Jaipur. Project related to Assessment of biological diversity and people interaction on socio economic studies was carried out. It was found that 47% population of the area is involved directly or indirectly in saving the wild life. Besides climate change, reduction in rainfall, use of hybrid seed and infestation by insect pest has influenced change in cropping pattern for livelihood support. Studies were undertaken to identify and enlisting the flora and fauna of Rajbhawans of Rajasthan. During the study it was found 150 plant species exist in Rajbhawan of Jaipur. Among these 60 were trees and shrub species, 12 herb, 7 climber and 1 grass species. As a new initiative, AFRI has undertaken 2 sandal wood plantations in Anand and Rajkot in Gujarat and 1 sandal wood plant at Jaipur in Rajasthan. This sandal wood plantation is a new adventure to introduce sandal wood in the State of Gujarat and Rajasthan. Studies were also undertaken for the evaluation of existing Sandal wood plantations and development of agroforestry trials and capacity building to promote cultivation in Gujarat and Rajasthan. Studies were also carried out on seed germination and nursery technology of *Anogiessus pendula* where the natural seed germination is less then 1%. Similarly, studies were carried out to increase crop yield, soil fertility and gum production in *Acacia Senegal* based traditional agroforestry system in arid regions of Rajasthan. In Rajasthan, saline soil nature and soil nutritions are the limiting factor for raising the plantation an attempt were made to rehabilitate salt affected soil with amendments of biofertilizers. Genetics Division of the Institute is engaged in development of regeneration protocols and for the genetic improvement of the planting stock. In this direction significant results have been obtained towards development of protocol for the kite making bamboo i.e. *Schizostachyum dullooa*, In medicinally important plant Jivanti i.e. *Leptadenia reticulate* superior strains were identified and now process is being standardized for its tissue culture protocol for plant regeneration. In *Azadirachta indica* i.e. Neem which is frost-prone species attempts are underway to introduce frost tolerant gene into the neem. *Tecomella undulata* known as marwar teak is exhibiting three colour flowers. These three distinct marpho types of flower color (yellow, orange and red) are being studied with respect to its timber quality, phenology and molecular diversity level. In *Commiphora weightii* seeds were collected from 647 genotypes from Gujarat so as to established seed production area to get better germ plasm. Clonal trials of Casurina have been initiated and the initial assessment reveal

that clones of inter specific hybrids between *Casurina equisetifolia* and *C. junghuniana* are performing better in all the clonal trials established. In *Ailanthus excelsa* the female plant produces higher biomass therefore screening of DNA Markers were carried out at early stage so as to distinguish male and female plant. Value addition studies of NTFPs were carried out and value added products such pickle and murrabba were prepared from the fruits of *Feronia limonia.* Similarly value addition of *Diospyros melanoxylon* was done with the preparation of squash and jem. Productivity enhancement work of bamboos was taken up and significant results was obtained with the use of AM fungi, PSBs and Azospirillum. Plant growth promoting activity of rhizome was noted in legumes by the development of consortia . Beside above all the scientific activities large number of trainings were organized notably trainings under Green Skill Development Programme of Government of India, One week compulsory training course for IFS Officers. Number of programmes were undertaken under PRAKRITI programme and a total of 2,817 visitors visited AFRI under various programme . All environmental days were celebrated, farmers fairs was organized and radio talks were delivered .

Summary of the projects

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2018-19
Plan	2	14	1
Externally Aided	2	5	2
Total	4	19	3

1. Introduction

1.1 New Initiatives

S.No.	Title of the Project	Principal Investigator	Remark
Theme 1 :Managing Forest and Forest Products for Livelihood Support and Economic Growth			
	NIL		
Theme 2 : Biodiversity Conservation and Ecological Security			
	NIL		
Thrust Area 3 : Forest and Climate Change			
	NIL		
Thrust Area 4 : Forest Genetic Resource management and Tree Improvement			
01.	Cloning and characterization of a salt tolerance conferring gene from *Prosopis juliflora* (Sw.) Dc. – *PjNHX1* (vacuolar Na^{+}/H^{+} antiporter)	Dr. Tarun Kant, Scientist-F	

02.	Identification, collection, characterization and field testing of various seed sources of Indian sandalwood (*Santalum album* L.) for early growth performances in Rajasthan and Gujarat.	Dr. M. Hegde, Scientist-F	

1.2 MoU Signed

1. MoU was signed between National Medicinal Plant Board (NMPB) and AFRI.
2. MoU was signed between Jaipur National University (JNU) and AFRI.
3. MoU was signed between SFD Gujarat & AFRI, Jodhpur for Renewal of VVK .
4. MoU was signed between SFD Rajasthan & AFRI, Jodhpur for Renewal of VVK.

1.3 Vistit of Dignitaries

1. Dr. L. N. Harsh, Ex-Vice Chancellor, Agriculture University Jodhpur.

2. Sh. S. D. Sharma IFS, DDG (Research) ICFRE, Dehradun

3. Sh. G. Viswanatha Reddy IFS, PCCF(TREE) Rajasthan.

1.4 Recruitment and Promotions during the year:

The recruitment process was initiated at AFRI against total of 7 vacancies from 4 posts. These were Lower Division Clerk (2 vacancies – 1 General & 1 SC category), Forester (1 Vaccancy – General category), Forest Guard (2 vacancies – both General category), Multi Tasking Staff (2 vacancies – 1 General & 1 OBC). Online applications were invited through an application portal created by Rajcomp Info Services Ltd, a Government of Rajasthan undertaking. A total of 7192 applications were received during a one month application window. The examinations were conducted offline in two sessions each on 27/01/2019 (LDC and Forester) and 3/2/2019 (Forest Guard and MTS) at different centres in Jodhpur. The question paper carried 100 multiple type questions from Science, Mental ability, General Awareness, Quantitative aptitude and General English as per the post syllabus and standard. The candidates answered by filling up OMR sheets. The OMR sheets were scanned and scored professionally and the merit was prepared. Against each vacancy top 10 candidates were shortlisted. The shortlisted candidates for the post of LDC were called for typing test for 10 minutes at AFRI on 26/3/2019. Candidates with minimum 30 words per minute typing speed for Hindi and 35 words per minutes speed for English were considered eligible. For the posts of Forester and Forest Guard, the shortlisted candidates were called for Physical Standard Test on 27/3/2019. The candidates were subjected to a 25 km walk in 4 hours along with minimum height and chest criteria for eligibility. Both, the Typing Test and the Physical Standard Tests were completed successfully. The recruitment process will be completed after the meeting Departmental Selection Committee and approval by ICFRE Headquarter.

अवधि 01.04.2018 से 31.03.2019 तक

नवनियुक्त/कार्यभार ग्रहण

1. डॉ0 परवीन, वैज्ञानिक–ई ने एफ.आर.आई, देहरादून से स्थानान्तरण पर दिनांक 18.03.2019 (पूवाह्न) को कार्यभार ग्रहण किया।
2. श्री माना राम बालोच, आई.एफ.एस. ने दिनांक 06.12.2018(अपराह्न) को निदेशक के पद पर कार्यभार ग्रहण किया।
3. डॉ0 रश्मि, वैज्ञानिक–ई ने एफ.आर.आई, देहरादून से स्थानान्तरण पर दिनांक 04.09.2018(पूवाह्न) को कार्यभार ग्रहण किया।
4. डॉ0 महेश्वर टी. हेगडे, वैज्ञानिक–ई ने आई.एफ.जी.टी.बी, कोयम्बटूर से स्थानान्तरण पर दिनांक 04.06.2018(पूवाह्न) को कार्यभार ग्रहण किया।

स्थानान्तरण/कार्य–मुक्त/सेवानिवृत्त

1. डॉ0 रंजना आर्या, वैज्ञानिक–जी अधिवर्षिता आयु पर दिनांक 31.01.2019 को सेवा निवृत्त हुई।
2. श्री कमल प्रसाद भंवरे, प्रवर श्रेणी लिपिक अधिवर्षिता आयु पर दिनांक 31.07.2018 को सेवा निवृत्त हुए।
3. श्री जगदीश प्रसाद गहलोत, कार्यालय परिचारक स्वैच्छिक सेवानिवृत्ति पर दिनांक 31.07.2018 को सेवा निवृत्त हुए।
4. श्री ए.के. सिन्हा, वैज्ञानिक–डी का भा.वा.अ.शि.प., देहरादून में स्थानान्तरण होने पर दिनांक 21.05.2018 (अपराह्न) से कार्यमुक्त किया गया।
5. श्री एन. बाला, वैज्ञानिक–एफ का वन अनुसंधान संस्थान, देहरादून में स्थानान्तरण होने पर दिनांक 25.05.2018 (अपराह्न) से कार्यमुक्त किया गया।

पदोन्नति

1. श्रीमती देशा मीणा, वैज्ञानिक–बी को दिनांक 01.01.2019 को वैज्ञानिक–सी पद पर पदोन्नत किया गया।
2. डॉ0 एन. के. बोहरा, वैज्ञानिक–बी को दिनांक 01.01.2019 को वैज्ञानिक–सी पद पर पदोन्नत किया गया।
3. डॉ0 एम. टी. हेगड़े, वैज्ञानिक–ई को दिनांक 01.01.2019 को वैज्ञानिक–एफ पद पर पदोन्नत किया गया।
4. डॉ0 शिवानी भटनागर, वैज्ञानिक–सी को दिनांक 01.01.2019 को वैज्ञानिक–डी पद पर पदोन्नत किया गया।
5. श्री हेमन्त कुमार गागल, अनुभाग अधिकारी दिनांक 21.02.2019(अपराह्न) से अवर सचिव पद पर पदोन्नती पर कार्यभार ग्रहण किया।
6. श्री जितेन्द्र भाटी, अवर श्रेणी लिपिक को दिनांक 12.10.2018 से प्रवर श्रेणी लिपिक पद पर पदोन्नत किया गया।
7. श्री अमीन उल्लाह खान, तकनीकी अधिकारी को माह अक्टूबर, 2018 में तकनीकी सेवा नियम–2013 के अंतर्गत असेस्मेंट प्रमोशन (Assessment Promotion) के अंतर्गत दिनांक 09.03.2016 से वरिष्ठ तकनीकी अधिकारी के पद पर पदोन्नत किया गया।
8. श्री प्रताप राम, वरिष्ठ तकनीकी सहायक को माह मई, 2018 में तकनीकी सेवा नियम–2013 के अंतर्गत असेस्मेंट प्रमोशन (Assessment Promotion) के अंतर्गत दिनांक 15.10.2016 से तकनीकी अधिकारी के पद पर पदोन्नत किया गया।

9. श्री अनिल शर्मा, वरिष्ठ तकनीकी सहायक को माह मई, 2018 में तकनीकी सेवा नियम–2013 के अंतर्गत असेस्मेंट प्रमोशन (Assessment Promotion) के अंतर्गत दिनांक 14.11.2016 से तकनीकी अधिकारी के पद पर पदोन्नत किया गया।
10. श्री लखपत सिंह शेखावत, वरिष्ठ तकनीकी सहायक को माह मई, 2018 में तकनीकी सेवा नियम–2013 के अंतर्गत असेस्मेंट प्रमोशन (Assessment Promotion) के अंतर्गत दिनांक 20.06.2017 से तकनीकी अधिकारी के पद पर पदोन्नत किया गया।
11. श्री राजू राम, अवर श्रेणी लिपिक को दिनांक 03.05.2018 से प्रवर श्रेणी लिपिक पद पर पदोन्नत किया गया।

देहावसान

1. डॉ0 मीता शर्मा, वैज्ञानिक–बी का दिनांक 04.07.2018 को स्वर्गवास हुआ।

1.5 New Infrastructure Developed During the Year:

1. Installation of 200 KW Solar System on the roo top of the office building in order to reduce the electricity expenditure.
2. A 5L Bioreactor was deployed for raising suspension cultures of *Commiphora wightii* (Guggul)

1.6 All India Coordinated Research Projects:

1. Identification, collection, characterization and field testing of various seed sources of Indian sandal wood (*Santalum album* L.) for early growth performances in Rajasthan and Gujarat.

P.I. Dr. M. Hegde, Scientist-F

1. Introduction

Arid Forest Research Institute, Jodhpur (Rajasthan) is one of the nine institutes of the Indian Council of Forestry Research & Education (ICFRE), an autonomous organization of the Ministry of Environment, Forests & Climate Change, Government of India. The goals of the institute are to carry out scientific research in forestry & allied fields to enhance the productivity and vegetative cover, to conserve the biodiversity and to develop the technologies for the stakeholders working in forestry sector in Rajasthan, Gujarat, Dadra & Nagar Havelli and Daman & Diu (Fig. 1). Major emphasis of research at the institute are on soil, water & nutrient management; technologies for afforestation of stress sites; management of plantations; growth and yield modeling; planting stock improvement and biotechnology; bio-fertilizers and bio-pesticides; Agroforestry & extension; phytochemistry & non-timber forest products; integrated pest and disease management; biodiversity and climate change; and forestry education and extension.

Figure 1. Jurisdiction map of AFRI, Jodhpur

2. Research Highlights

2.1 Ecosystem Conservation and Management

2.1.1 Overview

There are two projects under this theme that cover biological diversity assessment and development of management plan for wildlife outside protected areas based on people perception and fields assessment. The second one covers listing of flora and fauna of Raj Bhawan areas of Jaipur and Mount Abu areas of Rajasthan for developing a coffee table book including importance of these species in traditional and ecological terms.

2.1.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2018-19
Plan	-	-	-
Externally Aided		1	1
Total	-	1	1

2.1.2 Climate Change

2.1.3 Ecology and Environment

2.1.4 Biodiversity

Project 1: Assessment of biological diversity and people perception for developmental plan and awareness generation in different community reserve areas in Jodhpur district.

Principal Investigator: Dr. G. Singh, Scientist G

Despite of its situation in arid zone, Jodhpur is bestowed with a variety of flora and fauna exists outside the protected areas. It is because of diversity in habitats developed under varying geomorphic (sand dunes, alluvial areas dotted with isolated hillocks and scattered hill chains), edaphic (red desert, desert, regosols and lithosols type soils) and climatic (annual rainfall of 207 mm in Baap to 424 mm in Bilara tehsil) conditions. Forests, fallow lands, Current fallows and pasturelands constitute 0.31%, 16.1%, 10.6% and 5.4% of the district's geographical area. Human and livestock population are 3.69 million and 3.59 million with density of about 160 person/animals per sq km. Though varied species of wildlife exist in the region, but presence of Chinkara and Blackbuck is associated with religious, cultural, social and historical traditions of the people and the ethics of conservation nurtured by saints, philosophers and religious '*Gurus'*. Regardless of facts wildlife are facing numerous threats in the form of industrialization, urbanization, rising human and livestock population, eco-transformations and encroachments of Oran and gauchars resulting in shrinkage and degradation of their habitat. This advance both negative and positive interactions between wildlife and

humans. To minimize such growing conflicts and conserve and manage wildlife effectively this project was sanctioned to AFRI, Jodhpur with financial outlay of Rs 22.5 lakhs by Jodhpur Forest Department. The objectives of the project were: (i) Assessment of biodiversity in wildlife intensive areas outside protected areas; (ii) Preparation of wildlife conservation plan at village/panchayat/cluster level for areas outside protected areas; (iii) Help department in motivating people and gram panchayat in declaration of these areas as community reserves; (iv) Capacity building for the local community in conservation, protection and improving livelihoods; and (v) Awareness activities for conservation and protection of wildlife.

1. People interaction and socioeconomy

People perception on wildlife protection and conservation outside protected areas were collected though well design questionnaires and interviewing with villagers through focus group discussions. Fifty five villages from 9 tehsils were selected in an inception workshop based totally on high wildlife availability. Villages are 8 from Baap, 7 from Bhopalgarh, 5 each from Bilara, Jodhpur and Lohawat tehsil, 14 from Luni and 3 each from Osian in Jodhpur and Rohat in Pali district. Vegetation and soil properties were also assessed from available land uses viz. agriculture, Agor, gauchar, Oran and forests in these villages. Caste composition of the respondents was 13% SC, 3% ST, 68% OBC and 16% general categories. About 91% respondents are vegetarian in food habit. Nine interactive workshops were organized in different villages and at AFRI, Jodhpur that were attended by 407 villagers, public representatives, wildlife conservation activist, NGO's, academicians and forest staffs.

Most household (HHs) are of low income category and live in Kachha houses particularly ST, who reside mostly in remote areas of distant tehsils like Shergarh, Balesar, Osian, Lohawat and Baap. Housing conditions are much related to socioeconomic conditions and education levels. About 83.1% HHs have electric connection, which is positively correlated ($r=0.396$, $P<0.01$) to Pakka houses. Average literacy rate is 54.4%, in which lowest literacy is in female, but shows an increasing trend of education in younger generation. Agriculture and animal husbandry are dominant occupation involving >90% HHs, whereas average land holding, family size

and domestic animals are 22.8 bigha, 6.4 person and 5.1 animals per HHs. Low rainfall and economy and Kachha houses are correlated to greater number of domestic animals particularly sheep and goat ($r=0.305$, $P<0.05$). There is increasing trend in buffalo population at present. Total income appears low covered by about 25.8% HHs under Rs 1000-10000 per months from different sources. Most people use to harvest rainwater for drinking, but drinking water scarcity still exists in the region particularly during April to July. Though varies with tehsils, average groundwater depletion rate is 7.5 feet per year. Village ponds are mostly utilised by general caste and Tanka by OBC residing in 'Dhani'. Availability of drinking water for 35-86% population is <5 km range, i.e. 0.5 km for most general, <5 km for OBC and ~ 15 km for ST population. Fuelwood, dung cake and crop residue are dominant source energy for cooking foods used by >80% HHs. Average consumptions of dung cake (143.3 kg and 202.4 kg), fuelwood (214.8 kg and 291.0 kg), crop residue (22.1 kg and 29.9 kg), LPG (4.5 kg each season), and kerosene (10.8 lit and 12.4 lit per month) during summer and winter season respectively indicating relatively lower consumption in former than latter season. About 84.3% HHs depends on agriculture land for fuelwoods, but ST population depends mostly on forestland. Dominant fuelwood species are *P. juliflora, P. cineraria, C. decidua, Zizyphus* spp., *C. procera*, *A. indica*, *Vachellia nilotica*, *C. polygonoides* and *L. pyrotechnica* on which 74.8%, 0.7%, 1.3%, 1.2%, 5.3%, 0.1%, 1.8%, 7.9% and 0.2% HHs depend respectively. *P. cineraria*, *Zizyphus* spp., and *V. nilotica* are utilised for fodder by 26.6%, 13.4% and 1.1% HHs, respectively mostly collected from agricultural lands (87.9% HHs). Preferred plant species for wildlife are *C. decidua, D. glaulcum*, *M. emarginta*, *Sa1vadora* spp., *T. unduata* and *Zizyphus* spp. and the grasses *E. compressa*, *C. pennisetifonnis/ciliaris* and *C. jawarncussa*.

Fig. 2. Interactive workshops organised at different locations in Jodhpur districts

2. Biological diversity

About 47.2% population are involved directly or indirectly in saving the wildlife reflecting positive attitude towards wild animals particularly Chinkara and Blackbuck, the population of which (along with other wildlife) vary widely with methods of data recording, i.e., public opinion, waterhole point count and line transect methods. However, there is consensus on significant decrease in wildlife population in last 20 years in the region. However, significant increase in population of Nilgai (Bluebull) and wild pigs has increased (along with Chinkara, blackbuck and rats) human-wildlife conflict because of increased crop raiding. Increased road accidents, poaching and hunting and chasing and killing by feral dogs, temperature, and forests and pastureland degradation, decrease in surface and ground water availability, and expansion of *P. juliflora* invasion in most common lands are increasing threats to wildlife that negatively affects livelihoods and extends conservation problems.

We observed 19 trees, 11 shrubs, 3 under shrubs and two woody climber species belonging to 21 families including a rare species *Ephedra foliata*. *Prosopis cineraria, P. juliflora, C. decidua*, *V. tortilis*, *S. persica* and *S. oleoides* are dominant trees, whereas *Z. nummularia, A. pseudotomentosa*, *C. procera*, *L. pyrotechnica, C. polygonoides* and *G. tenax* are dominant shrubs. *P. cineraria* and *T. undulata* are dominant trees and *Z. nummularia* and *C. procera* are dominant shrubs in agriculture lands. Other land uses are dominated by *C. decidua*, *P. juliflora* and *V. tortilis* as trees and *C. polygonoides*, *Aerva pseudotomentosa* and *L. pyrotechnica* as shrubs. Though *V. tortilis* and *P. juliflora* are contributing to the tree density and basal cover, but their use in plantation and/or invasion is negatively affecting population of *P. cineraria, C. decidua* and *Z. nummularia* and surface vegetation covers. Though vary among land uses, average density and basal area of 68.2 tree ha^{-1} and 1.75 m^2 ha^{-1} for trees and 77.5 shrubs ha^{-1} and 0.27 m^2 ha^{-1} respectively indicating low vegetation cover. Values of species richness, diversity, dominance and evenness at 2.05-4.33, 0.45-1.21, 0.36-0.70 and 0.41-0.87 for tree species and 0.21- 2.79, 0.13-1.05, 0.41-0.66 and 0.00-1.10 for shrubs are also indicative of low floral diversity influenced strongly by climatic and edaphic conditions than land use variations as shown by

positive correlation between annual rainfall and tree species richness, diversity and evenness.

Soils are alkaline in reaction and low in SOC, carbon stock and soil available NH_4-N, NO_3-N and PO_4-P nutrients. Most of these soil variables differ between tehsils and land uses, but spatial effects are stronger than land use. Organic manuring and fertilization has enhanced soil nutrients and carbon stock in agriculture land. However, lowest soil carbon and nutrients and higher bulk density in gauchar and forest lands are indicators of their degradation under combined effects of rainfall, soils, climatic conditions and human activities.

3. People perception and biodiversity conservation

Climate change, reduction in rainfall, hybrid seed for increased farm yields and infestation by insect-pests and wild animals has influenced change in cropping pattern for livelihood support. Former two are being considered most important factors endorsed by >60% villagers. Though availability of sacred groves, pasturelands and other common lands appears to be beneficial in protecting and conserving wildlife outside protected area, but for effective conservation of wildlife and sustenance of this dry land ecosystem >90% villagers consider community reserves as best approach. Attitude of the local community is positive towards Chinkara and Blackbuck, but negative (>80% respondents) towards Nilgai and wild pigs. The increasing human-wildlife conflicts are mainly because of crop damage and in some cases damage to pets for which >90% villages needs compensation. Interestingly, people of some villages do not require compensation mainly from Baap area indicating their tolerance and attachments with the wildlife.

People feels that the impacts of increased temperature, habitat loss, forest and grazing lands degradation and decrease in surface and ground water availability would be medium to very high for survival and population growth of wild life. Wild animals are presently facing various threats of increased road accidents, poaching, hunting and chasing and killings by feral dogs in last 10 years indicated by exponential increase in

injured wildlife. Majority of population would like to protect wild life from both the existing ones and from the predicted threats of climatic adversities. For this various conservation and management mechanisms have been suggested by the villagers that include: wildlife protection and conservation (97% respondents), effective protection from hunting and killing by wild dogs and rescuing of injured animals through community reserve and related developmental activities (>85% population). Suggested activities are enhancing **food, shade** and **water** availability, **establishment of rescue centres**, **regular field visits** by the forest staffs, a **toll free number** for pressing information and successful rescuing and treatments of injured animals and p**lantation** of *P. cineraria*, *Zizyphus* spp., *C. decidua, S. oleoides, S. senegal, L. pyrotechnica, M. emarginata* etc. and reseeding of grasslands.

People of Jodhpur region desire to assist in control of encroachments of community lands, reseeding of grass species and plantation of multipurpose trees and shrubs, construction of rainwater harvesting structures, fencing of developed area, rescuing wild animals and development of rescue center. Level of people's participation includes participation in meeting as a committee member and volunteer member, help to conserve and protect wildlife and actively participating in improving wildlife habitats. Decisions related to developing and implementing management programmes is dominated by collaborative decision and implementation by local community (12.5% respondents) and involvement of communities in decisions and implementation both (27.7%). Hence most of the people are not in favour of accepting the decisions imposed from top or external agencies in implementation of policies/programme in conserving and managing wildlife outside protected areas.

Fig 3. Different species of wild animals outside protected areas in Jodhpur district.

There are four proposals for declaration of 'Community reserve' and some more desire to propose. Different villages has been ranked based on various factors required for effective management of wildlife and could be useful in motivating people further for declaration of community reserve and participate in different programmes for wildlife conservation and management. Conclusively, most public of the region are keen in participating in community-based conservation and management of wildlife and related natural resources, but conservation awareness and education needs to be

streamlined and enhanced further to improve positive attitudes. Plantation of fodder species and grass seeds sowing in pasturelands/rangelands for food and shade, enhancing water availability and erection of boundary walls/ fencing around developed habitats to improve habitat condition, saving wild life from hunting and feral dogs, establishment of wildlife hospital and rescue centres, and providing trainings to the local youths as paraveterinary for taking care at village level are important measures in taking cooperation and people participation in protecting, conserving and managing wildlife in Jodhpur.

Project 2: Study of Flora and Fauna of Raj Bhavans of Rajasthan.

Principal Investigator: Dr. G. Singh, Scientist-G

Rajbhawans of Rajasthan are situated at both Jaipur and Mount Abu. These have lush green lawn with variety of tall trees and flower beds blooming with seasonal flowers and are attractive places in terms of biological diversity. Raj Bhavan of Mt Abu is situated in foothill of Gurushikhar, the highest peak of Mt Abu and supports and wide variety of flora ranging from xeromorphic to subtropical evergreen species. Because of luxurious vegetation many birds and other fauna are also visible. These altogether make these places points of attraction to many visitors. Treasure of nature goes sometimes unnoticed until proper documentation is not done. There is need to document and enlist the flora and fauna of these Raj Bhawans for further records and scientific, social and ecological benefits. Pictorial information of important plants and animal species presented in the form of a coffee table book, it will also benefits to the visitors and guests of Rajbhawan and it can could also be useful for the researcher and academician for extension to other areas. Therefore monitoring biodiversity and related environmental quality in urban areas is an important issue offering possibilities to control and improve urban habitat quality as well as to avoid adverse effects on human health. **The objectives of the project were:** (i) **s**urvey, identification and enlisting of flora and fauna of Raj Bhawan at Jaipur and Mount Abu area of Rajasthan; (ii) preparation of pictorial information of flora and Fauna of both Raj Bhawans; (iii) develop appropriate signages for the important flora and fauna of both Raj Bhawans; and (iv) publish a coffee table book with photographs and illustration of important species available in these areas.

A total number of 150 plant species have been recorded in Rajabhavan of Jaipur in Rajasthan. Among these 60 each of tree and shrub species, 12 herbs, 7 climbers and 1 grass species. Some uncommon species recorded during November-December 2018 are: *Acalypha wilkesiana*, *Plumeria obtusa*, *Dracena hookeriana*, *D. marginata*, *D. reflexa*, *Ixora coccinea*, *Jatropha integerrima*, *Roystonea regia*, *Bridelia micrantha.* The study conducted on biological diversity in Raj Bhavan Areas of Mt Abu in Rajasthan indicates presence of 34 trees, 50 shrubs, 6 climbers and 6 herbaceous species and grasses. Dominant tree species were *Mangifera indica* followed by *Phoenix dactylifera*. The least dominant tree species was *Butea monosperma*, *Citharexylum substratum*, *Crateva religiosa*, *Eriobotrya japonica*, *Juniperus communis*, *Lannea coromandelica*, and *Michelia champaca*. Some endemic species in Rajbhavan area of Mt. Abu Rajasthan were: *Asparagus aethiopicus*, *A. setaeus*, *Holmskioldia sanguine*, *Russelia equisetiformis*, *Solanum seaforthianum* etc

Ixora coccinea

Plumeria pudica

Cestrum diurnam

Hiptage benghalensis

Fig 4. Some plants recorded at Rajbhavan Jaipur (top row) and Mt Abu area (bottom row).

2.1.5 Forest Botany: NIL

2.1.6 Tribals and Traditional Knowledge System: Nil

2.2 Forest Productivity

2.2.1 Overview

Two sandalwood plantations were planted at Anand and Rajkot in Gujarat. One sandalwood plantation was planted at Jaipur in Rajasthan. Various horticultural plants were used as medium to long-term hosts in these field trials. At Rajkot Chana and at Anand Sunhemp were taken as crop in between Sandal Plantation. Initial Data were taken.

Anogeissus pendula Seeds were collected from Kota,Bundi,Sawai Madhopur,Pali,Sirohi,Jaipur. In all, 28 seed lots were collected and were tested for their germination percentage, rate of emergence and germination index . Highest germination of 2.11% percent in seeds collected from Sirohi was recorded after treatment with IBA. In field condition best germination (5.73%) was observed in seed lot collected from Parasram Mahadev with GA_3 treatment while without any treatment best germination (4.49%) was observed in seeds collected from Desuri.

Three field trials of clones of Casuarina were established in Rajkot, Habatpur and Hathab in Gujarat. Among these Rajakot is inland and Habathpur is saline area and Hathab is coastal area. These clonal trials were established with total 30 clones of which thirteen clones belonged to *Casuarina equisetifolia,* twelve clones belonged to *Casuarina junghuhiniana* and five clones belonged to hybrid between these two species released by IFGTB.

2.2.1.2 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year 2018-19
Plan	**1**	**3**	**1**
Externally Aided	**1**	**1**	**-**
Total	**2**	**4**	**1**

2.2.2 Silviculture

Project 1: Studies on Seed Germination and Nursery Technology of *Anogeissus pendula*.

P.I. Dr. N.K.Bohra, Scientist C

Seeds were collected from Kota,Bundi,Sawai Madhopur,Pali,Sirohi,Jaipur etc. In all, 28 seed lots were collected and were tested for their germination percentage, rate of emergence and germination index . Seeds were sown in laboratory conditions as well as in nursery mother bed. Wide variation in seed size and 1000 seed weight was observed. . Large variation in germination parameters among seeds of trees from same locality was also observed. Effects of growth regulators IBA, GA_3, IAA in various concentrations on seed germination was studied. Germination initiated within 6-7 days and completed in 30 days period. All collected seedlots were tested for germination percentage in laboratory as well as in field conditions. In laboratory condition highest germination (10.79%) was recorded in seeds collected from Desuri of Pali district without any treatment with growth enhancers (control).

Highest germination of 2.11% percent in seeds collected from Sirohi was recorded after treatment with IBA. In field condition best germination (5.73%) was observed in seed lot collected from Parasram Mahadev with GA_3 treatment while without any treatment best germination (4.49%) was observed in seeds collected from Desuri.

Effects of sizes of root trainers (150 and 300cc) and poly bags (12x25cm and 15x25cm size) and effects of potting mixture of 1:1:1 and 1:1:2 (Sand: Soil: FYM) on growth of seedlings were studied. In February 2019, 35 seedlots from different agroclimatic zones including Jojaver, Kalighati,Desuri,PAli, Sawai Madhopur ,Koata ,Bundi etc for testing various germination parameters and further nursery work.

Fig 5. *Anogeissus pendula* seed germination in mother bed

Benefits of the research- The *Anogeissus pendula* has very low germination rate and the study will provide information on better areas for seed collections, seed treatment procedures to enhance germination and also provides a holistic nursery protocol for quality seedling production.

Project 2: Evaluation of existing Sandal wood (*Santalum album*) plantations and development of agro forestry trials and capacity building to promote cultivation in Gujarat and Rajasthan.

PI Dr.N.K.Bohra, Scientist-C

Two sandalwood plantations were planted at Anand and Rajkot in Gujarat. One sandalwood plantation was planted at Jaipur in Rajasthan. Various horticultural plants were used as medium to long-term hosts in these field trials. For sandalwood 5x5 meter espacement was followed and for horticultural crop hosts 1 or 2 meter spacing was followed for intermediate and long term hosts During the first year Sunhemp was grown in between Sandal plantation while in Rajkot Channa(Bengal gram) was grown as annual crop. Harvesting of annual agricultural crop was carried out and yield data have been recorded for further analyses.

Fig 6:Sandalwood plantation at Jaipur National University Campus

Fig 7:Sandal plantation at Rajkot.

Fig 8:Sandalwood plantation at Anand Agriculture University campus

Benefits of the research: Providing scientific information on growth of sandalwood under various agroforestry models and suggestion of suitable crops under sandalwood plantations to provide better income to farmers.

2.2.3 Social Forestry, Agro-forestry/ Farm Forestry

3. ***Project:*** **Study on crop yield, soil fertility and gum production in *Acacia senegal* based traditional agroforestry system in arid region of Rajasthan.**

PI: Dr. Bilas Singh, ACTO

Height, diameter at breast height (DBH) and canopy of scattered *Acacia senegal* (kumbhta) tree and Photo Active Radiation (PAR) were recorded in different tree density viz. 10- 20, 20-30 and 30-40 trees/ha at nine sites on farmer's land in Jodhpur and Barmer districts and three sites on farm boundary in Didwana, Nagaur district. Height and Dbh difference were greater in 20-30 trees/ha tree density than other densities. However, Photosynthetic Active Radiation (PAR) did not differ between tree densities. PAR ranged between 240 and 1727 μmol m^{-2}.

Rainfed crops failed due to very low rainfall in the region during 2018-19. Grain yield of Bajra was only recorded at 9 Q/ha at 20-30 trees/ha in irrigated condition at one site. Crop yield reduction was highest near tree trunk than at canopy edge when compared with sole crop. Total biomass of Bajra was recorded as fodder only and that was 0.75 to 2.3 Q/ha at two sites and tree densities of 20-30 trees/ha 30-40 trees/ha in rainfed condition at Shergarh and Jakhada sites. Cost of cultivation of Bajra crop was recorded under irrigated condition and benefit of Bajra based agroforestry systems were Rs. 10,450 at 20-30 tree/ha.

Total nitrogen, available phosphorus and potassium in soil were assessed. However, these parameters did not differ between tree densities. Total soil nitrogen ranged

between 0.056 and 0.086%, available phosphorus (PO_4) ranged between 2.34 and 3.83 mg kg^{-1} and available potassium (K_2O) between 115 and 184 mg kg^{-1} soil.

4.*Project:* Study on the effects of tree on soil fertility and crop production in Rajasthan. Period 2016-19, Funded by Rajasthan Forest Department,

PI: Dr. Bilas Singh, ACTO, EAP

Study of different traditional and improved agroforestry models on farmers fields were conducted in each agro-climatic zone and total 15 districts of Rajasthan covering both Kharif and Rabi seasons. There were 119 tree-crop combinations in the Rajasthan covering 21 dominant crops associated with 22 silviculture and horticulture tree species.

Results reveal that different agroforestry models have different potential depending upon the availability of natural resources, tree management and cultivars of crops. Crop yields reduced significantly ($p<0.05$) in all agroforestry systems. Crop yield reduction was 59.83% (across the crops) at 1 m distance from tree trunk and it was 22.95% at canopy edge as compared to the sole agriculture crops. However, nearly 50% observation showed highest crop yield at canopy edge of *P. cineraria* based system.

Increase in soil organic carbon was greater (across the tree species) by 29.3% at 1 m distance from tree trunk and 22.5%, at canopy edge of tree as compared to sole agriculture crops. Total soil nitrogen, available phosphorus (PO_4) and potassium (K_2O) were also greater, i.e., by 5.62%, 12.88%, 24.52% at 1 m distance from tree trunk and 7.87%, 6.64% and 15.64% at canopy edge of tree, respectively than sole agriculture crops.

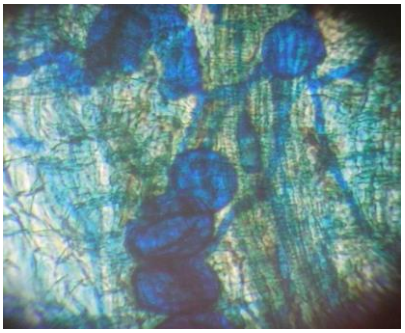
Literatures on agroforestry were collected and their synthesis is in progress.

2.2.4 Forest Soils and Land Reclamation

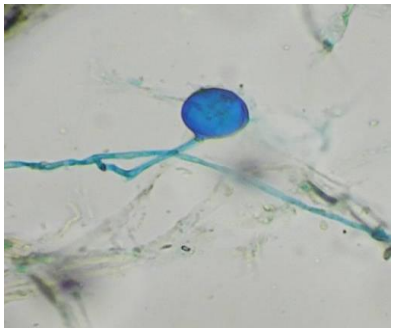
5.Project: Rehabilitation of salt affected soil with amendments of biofertilizer (AM Fungi)

PI: Smt. Bhawana Sharma, Scientist D

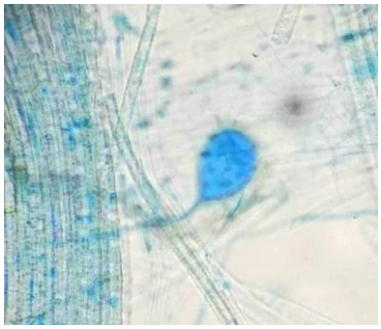
Rhizosphere soils and root samples of *Salvadora persica* (Khara Jal) were collected from different selected sites of seven district of Rajasthan *viz.,* Jodhpur, Bikaner, Jaisalmer, Nagur, Barmer, Jalore and Pali. Four genera of associated VAM species were identified as *Glomus, Acaulospora, Scutellospora* and *Sclerocystis.* Among these four genera *Glomus* was most dominant with four species like *G. aggregatum, G. microaggregatum*, *G. constrictum*, *G. fasciculatum* and *G. mosseae* . Soil physic-chemical (soil moisture, pH, EC, % Organic carbon and phosphorus) analysis work of the collected soil samples were completed. Mass multiplication of inoculums was done and maintained.



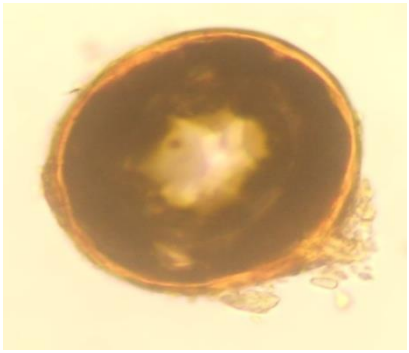
Root of *S. persica* showing globose, subglobose type of vesicles



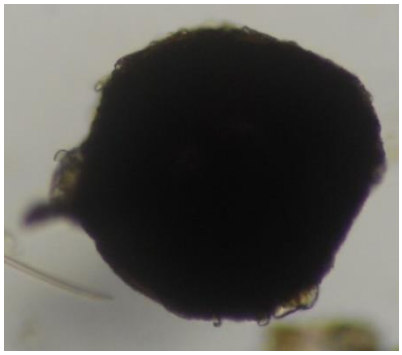
Spore formation in the root of *S. persica*



Root of *S. persica* showing subglobose type of vesicles



Glomus species collected from *S. persica*



Scutellospora species collected from *S. persica*

Mass multiplication of inoculum in pots

Fig 9. Different stages of VAM fungi associated with roots of *Salvadora persica* and its mass multiplication

6.Project: Impact of harvesting on soil nutrients and carbon stock in canal side plantations of Indira Gandhi Nahar Pariyojana (IGNP)

Principal Investigator: Dr. G. Singh, Scientist G

Objective of this project is to study the impact of harvesting on soil nutrients and carbon stock in canal side plantations of IGNP, quantify harvested wood biomass and develop allometric equations based on tree growth parameters and monitor temporal changes in soil parameters brought about by new plantations. Information collected on harvesting schedule from the concerned forest officials. Visit to the IGNP has been made to mark plots, measure tree growth parameters and collect soil samples for analysis. Ten plots have been enumerated comprising four species (*Acacia tortilis*, *Acacia nilotica*, *Eucalyptus camaldulensis* and *Dalbergia sissoo*) and soil samples collected. Five trees have been marked in each plot for recording biomass during harvesting. Harvesting have been done for two plots of *E. camaldulensis* and two plots of *Vachelia tortilis* in 20018-19 as harvesting depends on schedule of harvesting defined by Forest Department and execution by the contactor . Forty two soil samples from 14 plots have been collected and analyzed for pH, EC, SOC. Analysis of soil available NH_4-N, NO_3-N and PO_4-P for the collected samples are in progress.

Fig 10. Growth data recording of *A. tortilis* (left) and soil sampling during harvesting of *A. tortilis* in IGNP area.

2.2.5 Watershed Management: NIL

2.3 Genetic Improvement

2.3.1 Overview

Genetic and Tree Improvement division of AFRI is involved in various diverse activities under the discipline through 6 plan projects and 3 EAPs. Work on propagation, genetic improvement, variability assessment, development of seed production areas and various other aspects on important species relevant to the area are underway. An overview of these is presented below.

Schizostachyum dullooa, commonly known as Dolu bamboo is a thin walled sympodial moderate sized to large tufted bamboo in north east India. This bamboo is used in kite-making in Gujarat due to its long internodes. Gujarat state wants to promote this bamboo for its commercial use. The present project is carried out for development of tissue culture protocol for Dolu bamboo.

Leptadenia reticulata is commonly known as Jivanti/Dodi/Dudi a valuable threatened medicinal plant belongs to family Asclepiadaceae. This plant is known to be medicinally important because of the active constituent 'stigmasterol' which has lactogenic/ galactogenic effect. It has also been mentioned as stimulant, eye tonic, astringent, used in controlling habitual abortion and maintaining pregnancy. This is an important ingredient of Sudarshan churna, chvanprassha and some veterinary drug formulation. Huge demand and multipurpose uses of this plant in pharmaceutical industries has made this plant endangered. This plant propagates naturally through seeds. However, very low seed setting and low germination rate of seeds limits its propagation through seeds. Besides this, increasing demand and overexploitation has also led to wide spread habitat destruction, making at threatened species. Technologies are being developed to mass multiply and conserve it.

Ailanthus excels (Ardu) (Simarubiaceae) is a fodder and timber yielding tree species of arid region. This species is dioecious in nature and female trees have shown better growth performance as compare to male trees. Therefore work on identification of molecular markers is underway that can be useful for separation of plants on the basis of gender at very early stage of nursery.

Azadirachta indica (Neem) tree is of multifaceted importance. It has tremendous economic importance. However it is frost-prone species and experience die-back at seedling stage and of young shoots in mature trees, leading to poor seed set. Research work is underway for developing a genetic transformation protocol for neem using *Agrobacterium*. Once established, the protocol will be used to insert two genes to the neem genome to test their effect on development of cold-tolerance character. The experiments on co-cultivation of neem cultures *Agrobacterium* carrying selectable marker genes have shown positive results so far. Experiments on optimization of transformation events are progressing well.

Reckless over-exploitation for oleo-gum-resin has resulted in enlistment of the Ayurvedic divyaushidhi plant of the arid regions – Guggul in the IUCN Red Data Book

as a critically endangered species. The plant does not survive after destructive gum-tapping technique. The shortage of plants has led to scarcity of guggul-gum leading to large scale adulteration in samples sold in open market. Currently two research projects are underway to address the problems of guggal. The first one aims at identification of high seed producing genotypes to get both germplasm for viable and quality seeds. The second one is based on the fact that technology for non-destructive natural guggulsterone production is not yet fully optimized, but has great potential. Therefore, i*n vitro* production of guggulsterone-rich cell biomass from plant source in a bioreactor format is being carried out. It will enable up-scalability of the technology once standardized.

Tecomella undulata is an out breeding species and exhibit distinct and morphological variation in the color of the floral parts. Three distinct morphotypes of flower color (yellow, orange and red) are reported in this species. Therefore, to differentiate three flower color variants of *Tecomella undulata* with respect to its timber quality, phenology and molecular diversity level work is in progress.

Three clonal performance trials of Casurina have been established in Gujarat. Initial date reflects that clones of interspecific hybreed (C. *equisetifolia x C. junghuhiniana)* are having good performance.

Identification of juvenility characteristics of *Azadirachta indica*, *Ailanthus excelsa* and *Tecomella undulata* in order to improve the rooting potential of these economically important tree species is also underway which aims to find morphological and biochemical markers of juvenility for better rooting potential.

2.3.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During **2018-19**
Plan	-	6	-
Externally Aided	1	3	-
Total	1	9	-

2.3.2 Conservation of Forest Genetic Resources: NIL

2.3.3 Tree Improvement

1. Development of Seed Production Area and Haploid plants in *Commiphora wightii* (Arnott)- A rare and threatened medicinal plant. 2016-19.

PI: Dr. U.K. Tomar, Scientist-F, NMPB Project

Achievments: *Commiphora wightii* is slow growing, endangered, medicinally important plant. Plant is valued for oleogum resin exudate produced from its bark. It produces two types of seeds viable black and non-viable white seed. It's seed germination and natural regeneration is poor. Therefore, seed studies were conducted to identify maximum seed producing genotypes to get better germplasm for viable and quality seeds.

Seeds of *Commiphora wightii* (guggul) were collected from 647 genotypes at Deesa, Gujarat in two successive years. In first year, 9.27% genotypes produced more than 80% black seed. In second consecutive year, 4.02% genotypes produced more than 80% black seed. Seed data of two years indicates that total eight genotypes (A0201, A0301, A0303, A0404, A0901, A0904, C0202, C0516) produces more than 80% black seeds in both the years.

Seven genotypes showed more than 20 % black seed germination from 647 genotypes in first year. Highest black seed germination (43.93%) was observed in C0207.

Seed parameter studies (seed colour, seed lobe and seed weight) (fig. 1) of 1642 seeds from 6 progeny and 3 clones showed that all the genotypes bearing two lobed seeds. Only clonal genotypes C2 and C3 produced tri and tetra lobed seeds (fig. 2). It was also observed that seed weight of black seed (0.04±0.01) was significantly higher (P=0.000) as compared with brown (0.03±0.01) and white (0.02±0.01) seeds.

Benefits of the project:

Out-come of project will result in establishment of seed production Area to get better germplasm for viable and quality seeds. It can also be treated as Genetic Resource of Guggul plants for future improvement and Breeding Programme.

Genetic contribution of seed viability through laboratory and field experiments will be useful to stakeholders who are interested in raising large scale plants of Guggul through seeds.

Fig. *Commiphora wightii* seed categorised according to lobes and colour

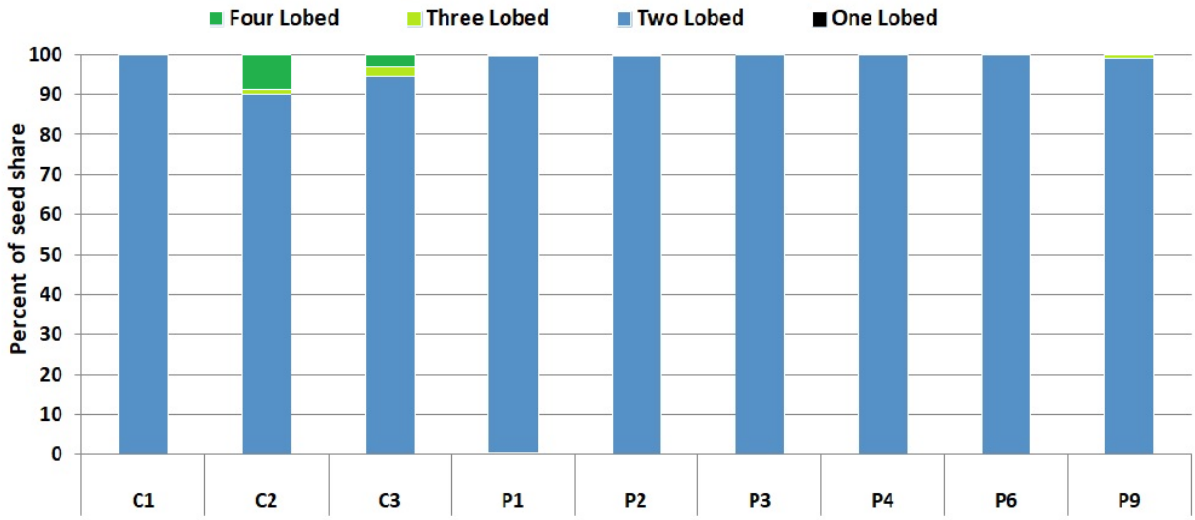


Fig 11. Percentage of four lobe-classes in seed samples in different clones and family of *Commiphora wightii*

2. Genetic Improvement of *Azadirachta indica* (Neem) through Transgene Pyramiding for Enhancement of Cold Endurance. 2017-22

PI: Dr Tarun Kant, Scientist-F, ICFRE Project

Achievements: Experiments on further optimization of *in vitro* cultures of neem were fruitful. Good shoot multiplication was achieved from leaf-derived callus. The multiple shoots were further sub-cultured for growth and elongation. The elongated shoots were consistently produced. *In vitro* rooting was also achieved. Intermittent callus formation observed during rooting is being worked around. The two *Agrobacterium*-strains (GV-3101 and LBA-4404) are being maintained at AFRI as stocks and through culturing. Both the *Agrobacterium* strains were successfully transformed with the pCAMBIA1304 plasmid vector which contains genes for selectable marker - *gusA* and *gfp*. Neemcalli after 3 days of Agrobacterium co-cultivation on modified co-cultivation (MCCM) medium were incubated in X-Gluc solution at 37°C from a few minutes to overnight

and scored for evidence and extent of GUS activity. Transient expression of β-glucourinidase gene was observed as blue patches on callus surface and inside upon sectioning, indicating positive transformation events.

Benefits of the research project: Neem is medicinally and economically important tree with an established market of medicinal products and bio-pesticides world over. By extending the range of its growing region to even the colder regions, new industries dependent on neem products will come up in such areas, generating job opportunities, boosting the regional economy and creation new markets. Moreover, since there is a cross talk between the abiotic-stress tolerating genes, the transgenic cold-enduring neem is also expected to show better tolerance towards other abiotic stresses like drought and salinity. Such plants may also have better growth performance, which will be evaluated in future.

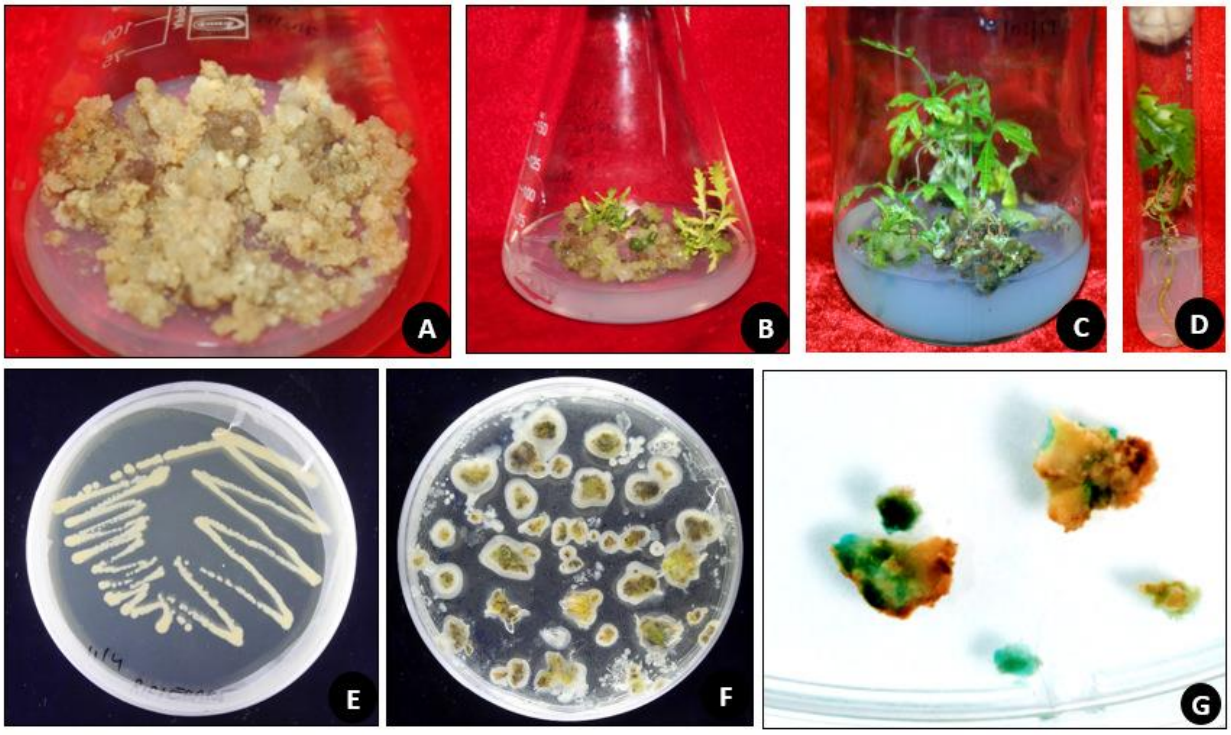


Fig 12: Genetic improvement of neem through transgenic approach. **A**. Fast growing leaf-derived callus of neem; **B**. Shoot morphogenesis from callus; **C**. Shoot multiplication and elongation; **D**. *In vitro* rooting; **E.** *Agrobacterium* culture; **F**. Cocultivation of neem calli with *Agrobacterium* suspension; **G**. Positive GUS gene expression in co-cultivated cultures.

3. Studies on phenology, molecular analysis and wood properties of *Tecomella undulata* with respect to three flower color morphotypes. 2017-20

PI: Mrs. Desha Meena, Scientist-C, ICFRE Project

Achievements: To study the density and distribution pattern of *Tecomella undulata*, (Rohida) ten quadrants of 30*30m^2 were laid down at fourteen populations identified from Nagaur, Sikar, Churu, Bikaner, Jalore, Pali, Jaiselmer, Barmer and Jodhpur district of Rajasthan. Based on the survey it was observed that the density of orange colour morphotypes was high in comparison to yellow and red morphotypes. Phenological data (pod size, leaf size, flowering pattern and percentage) were also recorded with respect to different flower colour morphotypes. Accordingly the pod size (length and width) varies from 19.8 to 29.35cm and 0.5 to 1.38cm (Orange), 16.18 to 31.0cm and 0.56 to 1.36cm (Yellow) and 16.4 to 29.5cm and 0.95 to 1.39cm (Red) respectively. Similarly leaf size (length and width) varies from 7.0 to 12.5cm and 1.3 to 2.6cm in orange morphotypes, 5.9 to 10.5cm and 1.2 to 2.5cm in yellow morphotypes and 5.5 to 12.0cm and 1.2 to 2.7cm in red morphotypes. With this leaf samples were collected from 45 marked trees and genomic DNA was isolated and purified using the modified 2% CTAB method. Further the preliminary screening of 45 Scot markers was completed, out of which 32 primers were shortlisted based on the amplification and reproducibility of the bands.

Figure 13: Laying down of quadrates at different sites

Benefit of the research project: These studies are essential to *Tecomella undulata* long term breeding programme. The study will generate useful information about the level of synchrony within and between the three morphotypes of *Tecomella undulata*. Studies on wood parameters will reveal whether the variations exist within these three morphotypes or not. Similarly, identification of DNA markers will be useful to differentiate flower colour variants at an early stage.

4. Identification of Juvenility Markers to Improve Rooting Potential of some Important Tree Species. 2016-20.

PI: Dr. S.K. Rajput, ACTO, ICFRE Project

Achievements: The project refers to the identification of juvenility characteristics of *Azadirachta indica*, *Ailanthus excelsa* and *Tecomella undulata* in order to improve the rooting potential of these economically important tree species. Therefore, the project is planned to find morphological and biochemical markers of juvenility for better rooting potential.

- Leaflet numbers per leaf was identified as juvenility marker in Ardu and Neem. Seedlings begins with three leaflet number in both Ardu and Neem. The number increases with age of seedling reaches maximum upto 21 in neem and 29 in case of ardu. The appearance of three-leaflet number in coppice shoots indicates their juvenile nature in both species.
- The treatment of irrigation, compost (5 kg/plant) and 2% NPK 19:19:19 (Treatment 3) was best for the coppiced shoot number as well as length. The results revealed that the irrigation increases the coppice shoot length significantly as compared with the control. However, use of compost with irrigation does not improve the shoot length in respect to irrigation. Shoot length further enhanced with the addition of NPK with irrigation and compost. The similar pattern was recorded in coppice shoot number. ANOVA test revealed significant difference ($f = 5.390$, $p = 0.006$) in coppice shoot length due to treatments. Whereas, no significant difference ($f = 1.723$, $p = 0.190$) was found in coppice shoot number.
- Total protein and chlorophyll estimation were performed between seedling, coppice and mature leaf samples of Neem and Ardu. The highest total protein was found in mature leaf of both Neem (8.24 ± 1.38 %) and Ardu (8.07 ± 0.27 %). The differences between these three samples were also found significant in both Neem ($p = 0.000$) and Ardu ($p = 0.013$). The chlorophyll content was higher in seedlings (24.08 ± 1.05 µg/ml) of Neem while in case of Ardu it was higher in coppice shoots (16.38 ± 0.48 µg/ml). But, highly significant differences ($p = 0.000$) between chlorophyll content of seedlings, coppice and mature leaf samples in both Neem and Ardu.
- The rooting in coppiced shoot cuttings were obtained in Ardu and Neem. In both the species middle portion of the shoot with CD 1.52 ± 0.19 cm in Ardu and 0.7 ± 0.21 cm in Neem, showed maximum rooting of 10.42% and 21% respectively. In rohida, the rooting was very poor and cuttings were dried after callusing.

Benefits of the research projects

Project outcomes will be helpful for developing technique of macro and micropropagation for field foresters and end users of three important species

Azadirachta indica, Tecomella undulata and *Ailanthus excelsa* by identifying juvenility markers for better rooting potential.

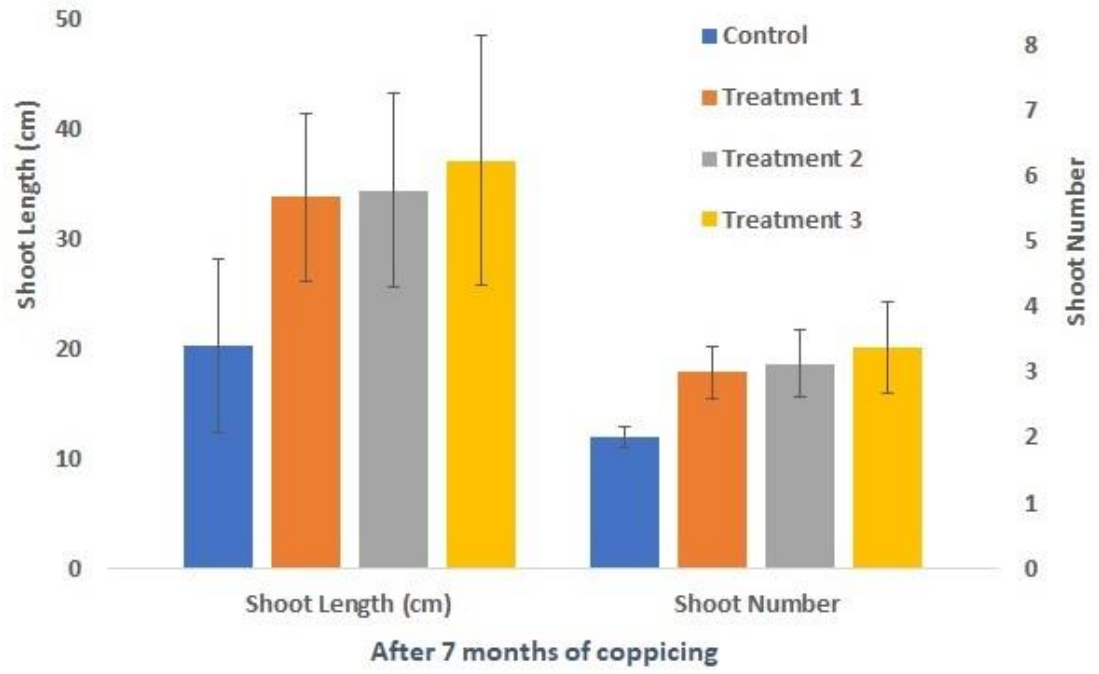


Fig 14 : The effect of different treatments on coppice shoot length in Ardu.

Fig 15: Rooting in middle portion of the juvenile shoot cuttings of A: *Azadirachta indica* (Neem) and B: *Ailanthus excelsa* (Ardu).

5. Multilocational clonal trials of Casuarina species for multiple end uses in Gujarat state.

PI. A.Durai, ACTO, ICFRE Project

Three field trials of clones of Casuarina were established in Rajkot, Habatpur and Hathab in Gujarat. Among these Rajakot is inland and Habathpur is saline area and Hathab is coastal area. The clonal trails were established with total 30 clones of which thirteen clones belonged to *Casuarina equisetifolia,* twelve clones belonged to *Casuarina junghuhiniana* and five clones belonged to hybrid between these two species. Initial survival rate and growth data were collected at six months after planting. The initial assessment revealed that clones of inter specific hybrids between *Casuarina equisetifolia* and *C. junghuniana* are performing better in all three places. In these three trials 100% survival was observed at Rajkot (inland area),and 60% survival was observed at Hathab (coastal) and Hebathpur (Saline area) at six months after planting.

Fig 16: Casuarina clonal trial, at Hathab, Bhavnagar(Coastal area)

Fig 17: Casuarina clonal trial at VVK, Rajkot. (Inland area)

Benefits of the research:

1. Identification of suitable species and clones of Casuarina for planting in coastal and inland areas of Gujarat.
2. Financial gains achieved: Nil
3. Patents generated : Nil
4. Vernacular names added • –/Not required
5. Commercialization of technologies: Nil

2.3.4 Vegetative Propagation:

6. Screening of DNA markers to Distinguish Male and Female *Ailanthus excelsa* trees for Higher Biomass Production.

PI: Dr. U.K. Tomar, Scientist-F, ICFRE Project

Achievements: *Ailanthus excelsa* (Simarubiaceae) is a fodder and timber yielding tree species of arid region. This species is dioecious in nature and female trees have shown better growth performance as compare with male trees. Therefore identification of molecular markers can be useful for separation of plants on the basis of gender at very early stage of nursery.

- Genomic DNA was extracted from leaf samples of 52 (26 Male and 26 female) Ardu trees from plantation at CAZRI, Jodhpur. Tested 42 RAPD and 20 ISSR primers, out of which only 13 RAPD and 6 ISSR primers were found polymorphic and henceforth selected for identification of male and female trees. One of the RAPD primer showed private band which was found 73.07% females of CAZRI field, but not in male samples. Likewise, one private band was observed in male samples (90%) of Deesa using ISSR primer. These private band were found to be site specific.
- Morphological parameters such as clear bole height and specific leaf area (SLA) were studied for 20 male and 20 female trees of CAZRI plantation. Analysis of these studies revealed significant ($p<0.05$) difference of average clear bole height (CBH) in male (1.09 ± 0.47 m) as compare with female trees (0.793 ± 0.367 m). Likewise, male trees also have higher average SLA (7.20 ± 2.40 mm^2/g) as compare with female trees (7.00 ± 1.862 mm^2/g), but statistically insignificant (p-0.781). Microscopic studies were also done for trichome number in 11 male and 11 female trees. Analysis of the result showed that average trichome number was higher in male trees (9.24±2.04/mm^2) as compare with female trees (7.50±3.08/mm^2) and statistically it was significant ($p<0.01$).
- Isozyme (Peroxidase, Catalase and Acid Phosphatase) pattern were studies on 25 male and 25 female Ardu tree sample for selectively suitable biochemical marker. None of

these isozymes found suitable as biochemical marker to distinguish gender in this tree species.

Benefit of the project: - Identification of gender specific morphological and DNA markers in this species will help in the improvement of fodder and timber production.

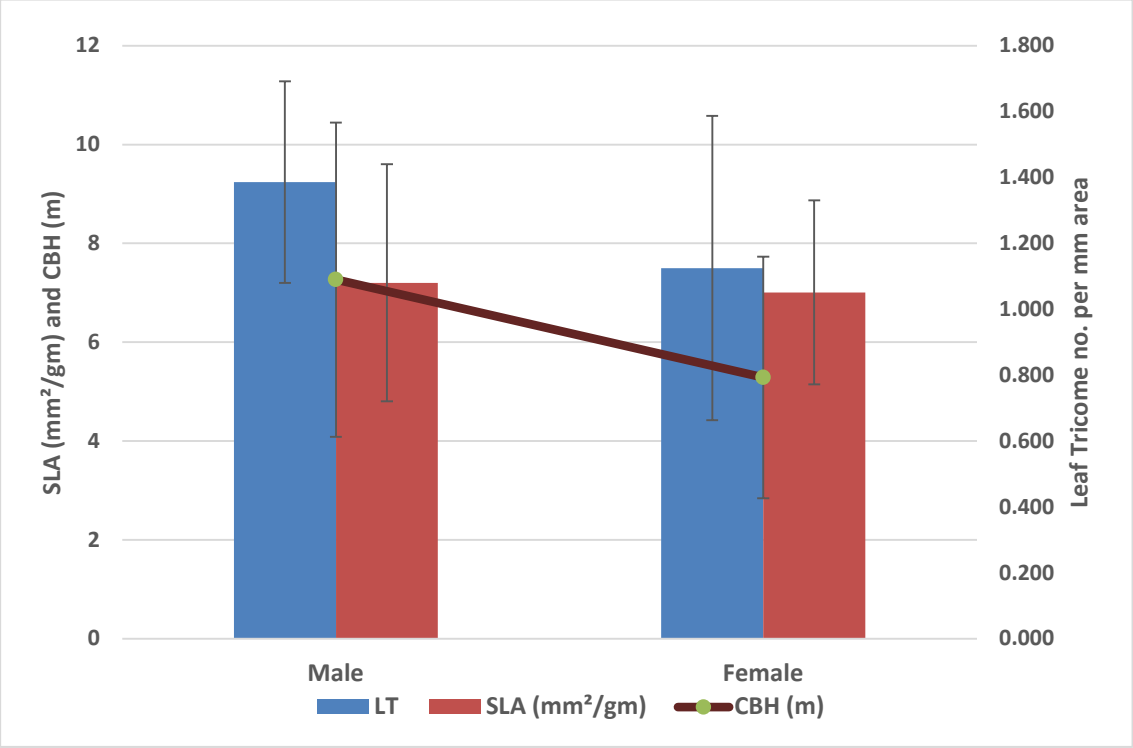


Fig 18: Average specific leaf area (SLA), Clear Bole Height (CBH) and Leaflet trichome number in male and female *Ailanthus excelsa* tree**.**

2.3.5 Biotechnology

7. Development of tissue culture protocol for economically important bamboo- *Schizostachyum dullooa* (kite bamboo)

PI- Dr. Sarita Arya, Scientist-G, ICFRE Project

Achievements:

Schizostachyum dullooa commonly known as Dolu bamboo used in kite making in Gujarat due to its long internodes. Presently it is transported in bulk from north east to Gujarat. The present project aims for the development of vegetative multiplication technology through tissue culture. This will make possible production of *S. dullooa* bamboo to be used for plantation purpose. Nodal segments were collected from Ukai, Gujarat state and Agartala and were used as an explant for micropropagation. Nodal segments were washed with detergent and surface sterilized with 0.1% bavistin, streptomycin and tetracycline and rinsed with distilled water after this explants were sterilized with 0.1% $HgCl_2$ for 6-8 min and were washed 3-4 times with autoclaved distilled water. Sterilized explants were inoculated on Murashige & Skoog Medium

supplemented with different concentrations of BAP with 0.7% agar (solidifying agent) and 3% sucrose (as carbon source) and pH of medium was kept 5.8. After 2 weeks proliferated shoots were subcultured on fresh MS medium supplemented with cytokinin. Proliferated shoots were excised and transferred on fresh MS medium for multiplication. Best axillary bud break was achieved on MS medium supplemented with 5.0 mg/l BAP. *In vitro* shoot multiplication was achieved on MS medium supplemented with 2.5mg/l BAP. Experiments are ongoing for large scale *in vitro* shoot multiplication. Protocol developed will be used for production of this economically important bamboo.

Benefits of the research project: Large-scale plantlets of dolu bamboo can be produced through tissue culture technique once the protocol is developed. Field trials may be established at Gujarat.

Fig 19: Tissue culture of Dolu Bamboo: A. Mother clum of *Schizostachyum dullooa* at Gujarat. B. Offsets established at AFRI Nursery. C & D. Shoots proliferated from nodes. E & F. *In vitro* shoot multiplication.

8. Clonal propagation, characterization and biochemical analysis of *Leptadenia reticulata*– a threatened medicinal plant

PI- Dr. Sarita Arya, Scientist-G, NMPB Project

Achievements:

Developing tissue culture protocol for multiplication of *Leptadenia reticulate (Jivanti/Dodi)*. Surveyed and selected plants of *Leptadenia reticulata* from Jodhpur, Barmer and Manaii village, Pali District, Udaipur, Mehsana and Anand Agriculture University, Gujarat. The plants were established in the shade house and field. Nodal segments were used as an explant for micropropagation work. Seeds were also collected from the selected plants. 80-90% bud break response and 2-3 shoots proliferated from nodal segments on modified MS medium (Ammonium Nitrate and Potassium Nitrate were reduced to half, KH_2O_4 and $MgSO_4$ were doubled, 150 mg/l Ascorbic Acid, 90 mg/l Citric Acid and 80 mg/l Adenine) supplemented

with 5.0 mg/l BAP. Best *in vitro* shoots multiplication was obtained on modified MS medium supplemented with 2.0 mg/l BAP + 0.5 mg/l Kinetin + 0.1 mg/l IAA. Best in vitro rooting was obtained on 1/4th MS medium supplemented with 2.0 mg/l IBA and 100 mg/l activated charcoal. Best *ex vitro* rooting was obtained by pulse treating *in vitro* raised shoots with 200 mg/l IBA for 3min. *In vitro* and *ex vitro* rooted plantlets were transferred to bottles containing soilrite and moistened with 1/2 strength MS medium. Various explants (Leaves, flowers, intermodal segment and immature seeds) were used for callus induction. Callus initiation is obtained on modified MS medium (150 mg/l Ascorbic Acid, 90 mg/l Citric Acid) supplemented with different concentrations of 2,4-D. Maximum callus induction was obtained on modified MS medium supplemented with 2.0 mg/l 2,4-D. Optimum callus proliferation was achieved on modified MS medium supplemented with 0.5 mg/l 2,4-D + 0.5 mg/l BAP. Callus obtained from leaves and internodal segments resulted in organogenesis. Best results were obtained on modified MS medium (150 mg/l Ascorbic acid, 90 mg/l Citric Acid, 100 mg/l Adenine Sulphate, Ammonium Nitrate and Potassium Nitrate reduced to 3/4th) supplemented with 0.5 mg/l BAP and 0.1 mg/l NAA. Organogenesis in callus raised by leaves was found to be best as compared to the internodal callus. Callus obtained from flowers and immature seeds resulted in somatic embryogenesis. Best results were obtained on modified MS medium (150 mg/l Ascorbic acid, 90 mg/l Citric Acid, 100 mg/l Adenine Sulphate, Ammonium Nitrate and Potassium Nitrate reduced to 3/4th) supplemented with 0.5 mg/l BAP and 0.1 mg/l NAA. Germination of somatic embryos was best obtained on hormone free MS medium.

Benefits of the research project: There is high scope of identifying superior genotypes having high contents of bioactive compounds which can be clonally multiplied and field tested.

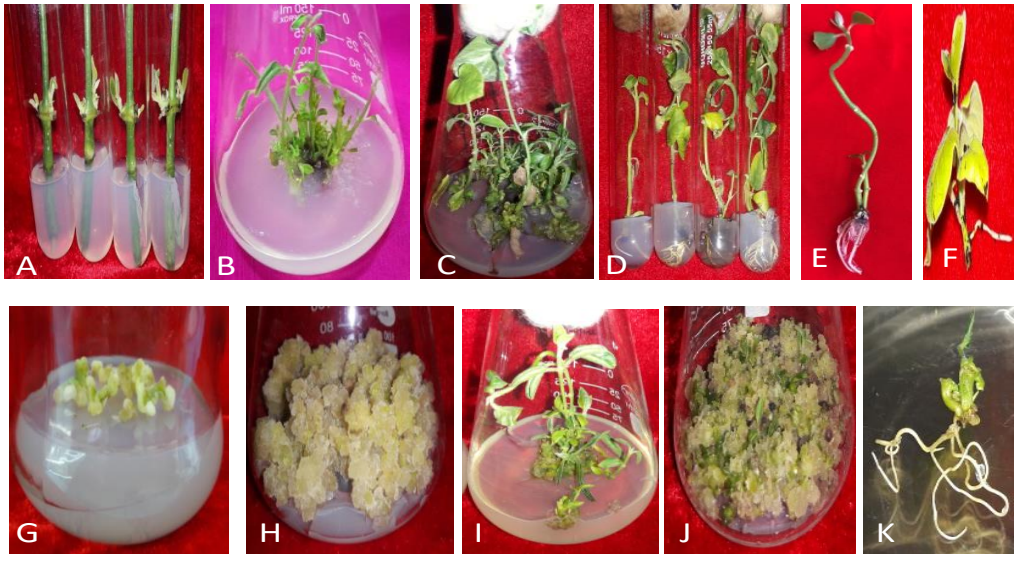


Fig 20: Tissue culture studies on *Leptadenia reticulata*: A- Bud break, B & C- *In vitro* shoot multiplication, D & E- *In vitro* rooting, F- *Ex vitro* rooting, G- Induction of callus, H- Proliferation of callus, I- Organogenesis, J- Somatic embryogenesis, K- Germination of somatic embryos

9. Non-destructive *in vitro* Production of Pharmacologically-active Natural Extract Containing Guggulsterones – A Potent Cardio-protective and Anti-cancer Drug from *Commiphora wightii* (Guggul) Using Bioreactor

PI: Dr Tarun Kant, Scientist-F, ICFRE Funded

Achievements: The callus cultures were successfully established from guggul immature fruits. The cultures were then used to establish the suspension cultures in 250 ml flasks. The cells started to multiply under suspension state. The growth parameters were studied in suspension cultures in both hormone supplemented and hormone free media. The inoculum so produced was then used as seeding material to initiate the 5L bioreactor cultures. Different parameters (like speed of impeller, frequency of aeration, and composition of medium) were studied during the establishment phase of bioreactor. Biomass accumulation rate of guggul cells and cell-aggregates was recorded. Ethyl acetate extraction of guggulsterones was carried out and HPLC standard curves were established. The work is progressing well on optimization of bioreactor parameters for achieving high growth rate of guggul cell biomass.

Benefits of the research project: The project envisages development of a technology that can give natural guggulsterone from the plant, for possible commercial exploitation yet without destroying its dwindling natural populations. And at the same time it will be helpful in conservation of the endangered species.

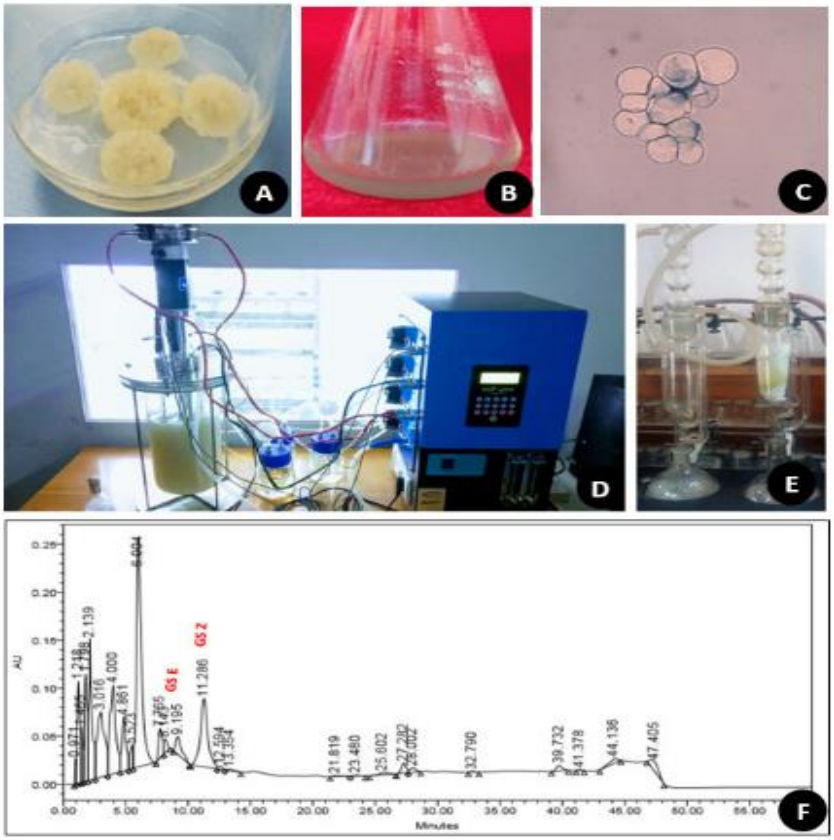


Fig 21: Guggul culture and bioreactor: **A**. *Commiphora wightii* (guggul) callus cultures; **B**. suspension cultures; **C**. microscopic view of actively growing guggul cells in suspension culture; **D**. Bioreactor with actively growing cell biomass; **E**. extraction of guggulsterone from cell biomass over soxhlet; **F**. HPLC analysis of guggulsterone E & Z

2.4 Forest Management

2.4.1 Overview

2.4.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2018-19
Plan	-	-	-
Externally Aided	-	-	-
Total	-	-	-

2.4.2 Sustainable Forest Management (SFM): NIL

2.4.3 Forest Economics: NIL

2.4.4 Forest Biometrics: NIL

2.4.5 Participatory Forest Management: NIL

2.4.6 Policy and Legal Issues: NIL

2.4.7 Information and Communication Technology (ICT)

2.5 Wood Products

2.5.1 Overview

2.5.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2018-19
Plan	-	-	-
Externally Aided	-	-	-
Total	-	-	-

2.5.2 Wood and other Lignocellulosic Composites: NIL

2.5.3 Wood Processing: NIL

2.5.4 Value Addition and Utilization

2.5.5 Wood Chemistry: NIL

2.5.6 Pulp and paper: NIL

2.6 Non-wood and Forest Products (NWFPs)

2.6.1 Overview

A Reconnaissance survey was undertaken to document the current cultivation practices and market dynamics of Isabgol and Sonamukhi (Senna). It was found that RI-1 variety of Isabgol is sown in large areas in Jodhpur Division. On an average , the yield ranges from 9.00-12.55 quintals of seeds per hectare. It was recorded that the per hectare seed requirement of Sonamukhi under irrigated conditions varied from 8-10 kg seeds and 15-20 kg seeds respectively. Seed yield depended on rainfall and average yield varies from 8 to 12 q/ha. Generally, three harvestings are being done in a year. There are around 105 processing units of Senna and 40 exporters in Rajasthan. Most of the processing units are locatd in Phalodi.

2.6.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2018-19
Plan	-	1	-
Externally Aided	-	-	1
Total	-	1	1

2.6.2 Resource Development of NWFPs

1. Project: Studies on estimation of Agro-economics, market price spread and gap analysis in cultivation and processing of Senna and Isabgoal in Jodhpur Division of Rajasthan (NMPB, New Delhi)

PI : Sangeeta Tripathi, ACTO

Preliminary survey revealed that RI-1 variety of Isabgol is generally sown by 90 % farmers in Jodhpur Division. However, few farmers used their own seeds while some farmers purchase seeds from private companies like Weston, Urmi and Avni. RI-1 variety is sold at Rs. 120/ha and it yields 12-16 qt. seeds/ hectare where as the treated seeds of private companies cost around @Rs. 200-250/- per kg. 4 kg seed is required for sowing in 1 ha area. On an average 9.00-12.55 quintals of seeds of Isabgol per hectare was obtained by farmers depending on variety and cultural operations. The straw is used as cattle feed and double straw yield is obtained than the seed yield.

Collection ,Processing and Storage Methods:

No proper collection, processing and storage methods. Harvested crop is collected and left in open space in sunlight for 5-6 days or until processing. Chances of crop damage are frequent at this stage. Untimely rain may destroy the harvested crop or crop may absorb moisture from atmosphere and may get damaged.

Existing value chain: Though farmers sell the seed either in the local mandi /APMC or to the village level traders, however, all stock finally goes to Unjha mandi, in Gujarat from where they are purchased by processors. From here, the channel divides into three parts:

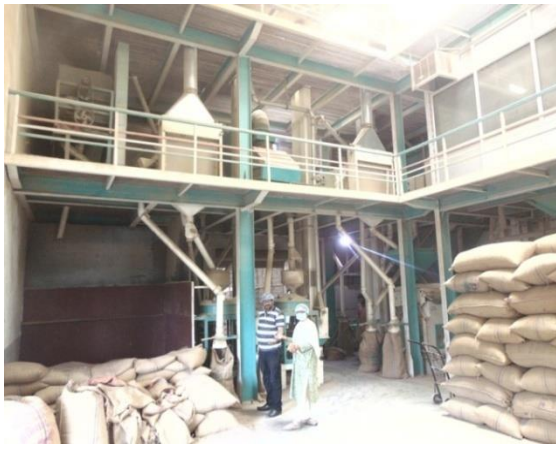
The 1st part is for domestic markets- where pharma/healthcare companies take the Isabgol either from the processor directly or through distributors and sell it in their branded and packed form.

The 2nd channel ends up with export market which is eventually 90% of the total market share of production. Both the processors and distributors engage in export of Isabgol.

The third channel is animal feed sector, where the animal feed processors take the balance part of the seed to use it as animal feed. They again distribute it through their channel after mixing with other feed materials.

Isabgol harvesting in Farmers Field

Auction of Isabgol in APMC



Isabgol Processing in Factory

Separation of extraneous particles from Isabgol

Figure: 22

Sonamukhi : Existing Value chain: Farmers sell the seed and pods either directly to the processor or to the village level traders, who in turn, collects the raw material from all the nearby farmers and sell it to the processor. However, all stock finally goes to Phalodi & Sojat processing unit. The processors pays the Mandi Tax on the material they purchase either directly from farmers or Middlemen.

After processing, pharma/healthcare companies take the Senna either from the processor directly or through distributors and sell it in their branded and packed form.

Fig: 23.Sonamukhi in farmers field

Fig 24: Grading of Sonamukhi leaves and other material after processing

2. **Capacity building of VFPCs/SHGs through *v*alue addition of selected underutilized NTFPs for enhanced livelihood opportunities in arid and semiarid Rajasthan.**

PI: Sangeeta Triapathi

Several villages in two districts namely, Pali (103 villages) and Sirohi (24 villages)districts of Rajasthan were surveyed for documentation of collection, use and marketing of seven NTFPs in rural livelihood with (mean± S.D.)

Table 1 Collection, use and marketing of some NTFPs in Pali and Sirohi districts of Rajasthan.

S. No.	Name of NTFP species	Parts of NTFP being collected	Quantity collected per year in Kg (Mean± S.D.)	Prevailing market rate (Rs./Kg)	Value added Products from NTFPs
1	*Tamarindus indica*	Fruits	(51.25 ± 5.04)	30-40	Juice and Pickle from Pods
2	*Momordica dioica*	Fruits	(35.31± 15.68)	40-60	Dried fruits storage and pickle
3	*Leptadaenia reticulata*	Pods	(19.25 ± 6.04)	80-100	Pickle from Pods
4	*Cordia gharaf*	Fruits	(21.12 ± 2.36)	600-800	Murraba from Fruits
5	*Feronia limonia*	Fruits	(30.50 ± 5.25)	40-50	Murabba/Chutni/Pickle/Jam from fruits

6	*Butea monosperma*	Leaves	As & when required	--------	Pattal Dona (Leaf Plate)
7	*Butea monosperma*	Flowers	(18 .50 ± 2.25)	40-50	Herbal Gulal

Value Addition: *Feronia limonia* fruits were collected and analysis of moisture %, total sugar, protein and ash contents was carried out. Two products namely pickle and murrabba were prepared from collected fruits. The products were preserved and no microbial growth was observed up to five months. Further study is under progress.

Fig 25: Value Added products of *Feronia limonia*

Value Addition of *Tamarindus indica* : Fresh tamarind pods were collected and prepared squash, Chutni and Jam. No microbial growth was observed after three months. Further study is under progress.

Fig 26: Squash

Fig 27: Chutni

Fig 28: Jam

Value Addition of *Diospyros melanoxylon* : Fresh tendu fruits (Timru) were collected and prepared squash, Jam. Microbial growth was observed after one week. Work is in progress to increase the shelf life.

Fig 29:Jam

Fig 30:Squash

2.6.3 Sustainable Harvesting and Management: NIL

2.6.4 Chemistry and NWFPs, Value Additional and Utilization: NIL

2.6.5 Biofuels and Bioenergy: NIL

2.7 Forest Protection

2.7.1 Overview

AFRI has undertaken seven research projects involving insect-pest and pathological problems in nursery and plantations. In this 61 pests and predators from seedlings of 35 tree species have been identified from forest nurseries of Rajasthan. Ten to 30% infestation of leaf blight disease from seedlings of 4 tree species and root rot disease from seedlings of 2 tree species up to 30 per cent have also been recorded. Integrated management through use of botanical extract and chemicals was successful in reducing mortality in Neem seedling due to snails and slugs. Another important study was status of flower gall of Khejri that was more severe in Phalaudi, Osian and Lohawat areas resulting in only 10-20 percent pod formation. The effect of consortium of *Azotobacter* spp., *Rhizobium*, *Piriformospora indica*, and VAM) was studied on Neem, Khejri, Isabgol and Senna. These microbes increased yield/ growth and vigour of the plant. Soil samples were collected from different areas. Two isolates of *Azospirillum*, one of *Azotobacter* and one isolate of *Bacillus* have been isolated from the soils collected from different agroclinatic regions while the soil was also used for trapping of *Rhizobium* by sowing seeds of Khejri and babul. *Glomus, Acaulospora, Gigaspora, Sclerocystis* and *Scutellospora* spp. have been observed in the rhizospher soils of *Dendrocalamus strictus* and *Bambusa bambos*.

2.7.1.2 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During **2018-19**
Plan	1	4	-
Externally Aided	--	-	-
Total	1	4	-

2.7.2 Insects pests, diseases and control

Project 1: Diversity of insect pollinators and their role in fruit/ pod production of *Acacia senegal, Capparis decidua* and *Prosopis cineraria* (Tricuta) in Rajasthan

PI: Dr. Shiwani Bhatnagar, Scientist-D

Data on diversity and population abundance of pollinator insects on *P.cineraria, A. senegal* and *C.decidua* was collected. Insect pollinators visiting the blossoms were collected, properly pinned and placed in the display showcase. Insect pollinators were recorded during morning to evening hours of a day. The number of visits made by insect pollinator and the time spent by insect pollinator were recorded during flowering period.The foraging insects were found maximum between 10.00h to 12.00h.

On *Acacia senegal* 42 species of insect pollinators belonging 5 families and 11 genus of order Hymenopteran;4 families:7 genusof order Coleopterans; 6 families:14 genus of order Lepidopteran;2 families:2 genus of order Diptera and 1 family:1 genus of order Hemiptera were observed.

On *C.decidua* 27 species of insect pollinators belonging to 5 families: 9 genus of order Hymenopteran; 3 families: 7 genus of order Lepidopteran; 1 families: 1 genus of order Diptera; 1 family: 1 genus of order Coleopteran and 1 family:1genus of order of Hemiptera were recorded.

On *P.cineraria* 36 species of insect pollinators were observed belonging to 8 families: 16 genus of order Hymenopterans; 2 families: 2 genus of order Diptera and 3 families:7 genus of order Lepidopteran were recorded.

Honeybees (*A. dorsata and A. florea*) foraged extensively within a single canopy, generally moving between flower heads that were close together and are important & efficient pollinators. The most abundant pollinator in *C.decidua*, *A. senegal and P.cineraria* were *A.florea* among Hymenopteran insect. No fruit set was observed in the bagged inflorescence (pollinator exclusion). However where specific insect pollinator was released in the bags, fruit setting was observed in case of *P.cineraria, Acacia senegal* and *C. decidua*. Data on fruit setting, fruit parameters was also recorded.

1. The scientific names are required to be supplemented with vernaculars in parenthesis-supplemented: *Prosopis cineraria* (Khejri), *Capparis decidua* (Kair) and *Acacia Senegal* (Kumat).
2. Technologies developed in project: nil
3. Benefits of the research projects: Project will be beneficial in finding out role of insect pollinators in fruit/pod production of Khejri, Kair and Kumat.
4. Financial gains achieved: nil
5. Patent secured: nil
6. Commercialization of technologies: nil

Project 2: Development of Integrated management strategy against flower gall inducers of *Prosopis cineraria* (L.) Druce *(AFRI-37/FPD/ ICFRE/2017-21)*

PI: Dr. Shiwani Bhatnagar , Scientist-D

In heavily infested trees 9-12 galls per inflorescence were noticed. Galls varied in size from few mm to 34 mm in diameter. Heavily infested inflorescence spikes were completely devoid of pods or only 2-3 pods per inflorecence were seen. The gall infested trees had large number of unorganized, round, oblong and spindle-shaped galls. These were initially green and soft but on maturation became firm to hard at outer shell and brown in colour when dried.

It was observed that on younger trees of girth class 70-100cm, average no. of galls per inflorescence was higher in comparison to trees of girth class 130-160 cm. Flowers on normal inflorescence ranged from 41-72 per spike with 12-16 pods per inflorescence.

Average no. of gall per inflorescence was higher at Phalodi (6.66) followed by Lohawat (4.96) in comparison to Average no. of gall per inflorscence at Khejarli (0.63) and Guda Bishnoiya (0.59). Also on younger trees of girth class 70-100cm average no. of galls per inflorescence was higher in comparison to trees of girth class 130-160 cm at all the sites under study.

Experiments laid out on management of khejri galls at five sites using botanicals, entomopathogens, miticides and lopping.

1. The scientific names are required to be supplemented with vernaculars in parenthesis-supplemented: *Prosopis cineraria* (Khejri).
2. Technologies developed in project: nil
3. Benefits of the research projects: Project will be beneficial in managing the problem of flower galls of Khejri through integrated management approach.
4. Financial gains achieved: nil
5. Patent secured: nil

Commercialization of technologies: nil

Project 3: Integrated pest and disease management (IPDM) of important tree species in nurseries of Rajasthan", 2016-2021

PI Mrs. Seema Kumar, Scientist-E

Month-wise distribution of Diseases/Pests (%) were prepared for 121 different plant species which were screened for pest and diseases in forest nurseries and around of the districts surveyed so far. A total of 22 potential insect pests and 1 species of non-insect pest recorded on 28 tree species seedlings with mild to severe infestation. Defoliators were the dominant among insect pest represented by 18 species. Important hemipteran sap suckers were *Nezara viridula* (Pentatomidae), *Coridius janus* (Dinidoridae), *Dysdercus cingulatus* (Pyrrhocoridae), *Chrysocoris* sp. (Scutelleridae), scale insect. Important lepidopteran defoliators were *Ariadne merione* (Nymphalidae) & *Colotis etrida* (Pieridae) on *Salvadora persica, Cassia fistula, Syzygium cumin & Capparis deciduas; Eurema blanda* (Pieridae) on *Albizzia lebbeck, Cassia siamae, Terminalia arjuna; Catopsilia pyranthe* and *Catopsila pomona* (Pieridae) recorded on *Cassia siamea*, *Cassia fistula, Salvadora persica* and *Agele marmelos* tree species; *Catochrysops strabo* & *Euchrysops cnejus* (Lycaenidae) on *Prosopis cineraria, Danaus chrysippus* (Nymphalidae) on *Ficus racemosa, Albizzia lebbeck, Belenois aurota* (Pieridae) on *Casia fistula, Agele marmelos.* Besides four species of hymenoptera: *Megachile* sp., (Megachilidae); *Xylocopa fenestrata* and *Xylocopa aestuans* (Apidae) and *Vespa orientalis* (Vespidae) were also recorded from various nurseries.

One species of Diptera collected from nurseries of Chittorgarh, Pratapgarh, Banswara and Dungarpur identified belonging to family Diopsidae and one species of Coleopteran defoliator collected from neem and sandal seedlings from Jodhpur identified as *Myllocerus* species. One species of coleopteran defoliator belonging to

family Bruprestidae *viz. Sternocera sternicornis orientalis* Syn. *Sternocera basalis* recorded from *Prosopis cineraria, Ashoka* spp., *Ralia* sp., *Tecomella undulata.*

Two species of biological predator *Coccinella septumpunctata*, *Cheilomenes sexmaculata* (Coccinellidae) found in association with sap suckers on *Adonium* sp., *Shisham* and *Citrus* species were also recorded. Insectivorous aves recorded as biological control agents from in and around forest nurseries, Jodhpur. Nest of insectivorous bird *Orthotomus sutorius* (Common Tailorbird) recorded on *Agele marmelos, Terminalia Arjuna, Terminalia cattapa* with four eggs which were later predated by *Eudynamys scolopaceus* (Koel) and nest broken. Nesting was again recorded on *Agele marmelos* with four eggs which 100% hatchability. Regular monitoring and removal of weeds.

Shifting of seedlings to different nursery bed, Mechanical plucking and removal of infested leaves, etc. and in case of severe infestation: -Spray of Monocrotophos (2ml/l) + Bavistin (2gm/l) + Powermin (2 ml/l) at forth- nightly intervals recommended for control. Identification of insect pests collected earlier, documentation of host range is in progress.

Besides five species of Lepidoptera, three species of hymenoptera, two species of predatory coleoptera and thirty-five species of aves identified from Raj Bhawan, Jaipur. Besides nesting of Indian Grey Hornbill (*Ocyceros birostris*) on neem tree (*Azadirachta indica*) and feeding chicks with fruits of lucky bean tree (*Putranjiva roxburghii*) was also recorded from Raj Bhawan, Jaipur.

The important diseases recorded were Leaf blight disease and shot hole recorded from neem (*Azadirachta indica*) (25%); Leaf blight disease recorded from Shisham (*Dalbergia sissoo*) (20%); Arjun 70 (%); Gunda (*Cordia* species) (15%); Jamun (35%) from AFRI model nursery and Root rot disease recorded from *Cordia* sp. (15%). The Causal Organisum *viz., Alternaria sp.; Colletotrichum sp.; Fusarium* sp.; *Rhizoctonia bataticola;* and *Sclerositium sp.* were recorded.

2.7.3 Mycorrhizae, rhizobia and other useful microbes

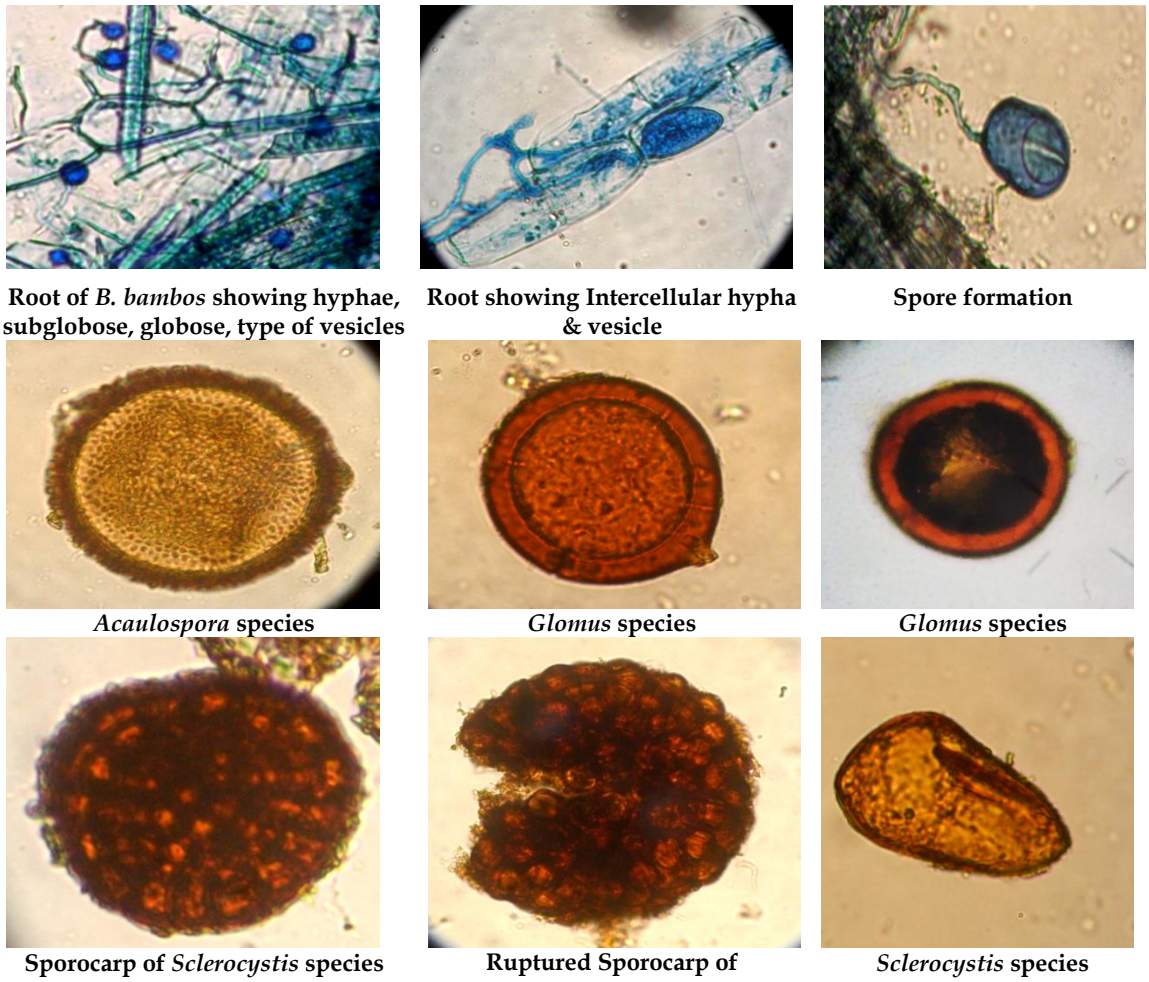
Project 4: Selection of efficient AM fungi, PSBs and *Azospirillum* for productivity enhancement of *Dendrocalamus strictus* & *Bambusa bambos* (XVI Plan.AFRI-25/FPD/ICFRE/2016-20**)**

Principal Investigator : Dr. Neelam Verma, ACTO

Rhizosphere soil & root samples of *Dendrocalamus strictus* and *Bambusa bambos* were collected from different districts of **Gujarat** *viz.*, Dahod, Rajpipla, Chhota Udaipur, Dang, Valsad & Navsari and later examined in lab. The important genera were identified as *Glomus, Acaulospora, Gigaspora Sclerocystis* and *Scutellospora.* Among these five genera, *Glomus* occurred most frequently. The different species of *Glomus* were

recorded as *G. aggregatum, G. fasciculatum, G. mosseae* etc. Out of which, *Glomus* species was dominant species in nurseries as well as in plantation sites.
The spore population varied from site to site and ranged between 191 to 450 propagules per 100 gm soil of *D. strictus* and 188 to 463 propagules per 100 gm rhizosphere soil of *B. Bambos* from **Gujarat,** while Root colonization were 76 to 87 per cent which also varied from site to site and Mass multiplication of inoculum is in progress.
Nursery experiment was laid out on selection of efficient AM fungi, PSBs and *Azospirillum* for productivity enhancement of *D. strictus* in AFRI Model nursery. The Experimental Design was Completely Randomized Design (CRD). The treatments were 16 with or without combination of different biofertilizers with control. No. of replications were three (03) and no. of seedlings per replications were 24. Growth parameters *viz.,* initial seedling height were recorded.

PLATE



Root of *B. bambos* showing hyphae, subglobose, globose, type of vesicles

Root showing Intercellular hypha & vesicle

Spore formation

***Acaulospora* species**

***Glomus* species**

***Glomus* species**

Sporocarp of *Sclerocystis* species

Ruptured Sporocarp of *Sclerocystis* species

***Sclerocystis* species**

Figure: 31

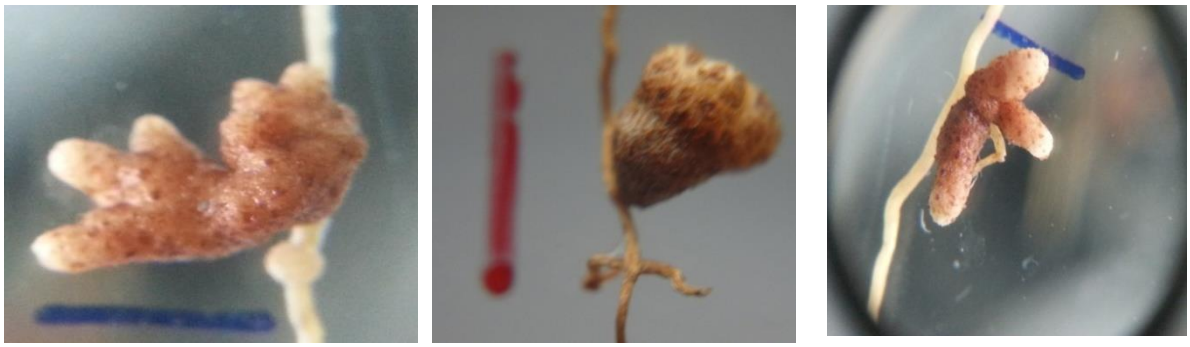
1. *Dendrocalamus strictus* (Solid Bamboo) and *Bambusa bambos* **(**Indian Thorny Bamboo**)**
2. Benefit of The Project: The study under this project will provide first hand information of AM technology to end users to apply eco-friendly use of biofertilizer to enhance the productivity of (*Dendrocalamus strictus* and *Bambusa bambos*).

Project 5: Evaluation of plant growth promoting (PGP) activity of *Rhizobium* from native legumes and development of consortia with other PGP rhizobacteria

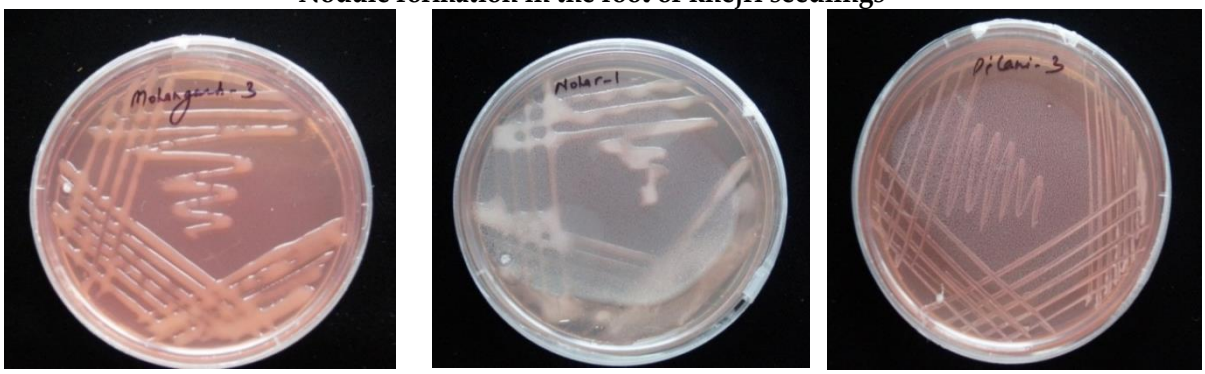
PI: Dr. Sangeeta Singh, *3 Year, 2017-2020*)

Eighty four isolates of *Rhizobium* have been isolated from Khejri nodules using trapping technique. The isolates showed characteristics pink pigmentations on YEMA medium. Biochemical characterization shows that there are 14 strains which can tolerate upto 3% NaCl. Three strains can solublise phosphorus and thus these strains can not only fix atmospheric nitrogen but can also provide phosphorus to the plants. Out of these 84 strains 3 strains showed positive chitinase activity which implies that these strains can be exploited as biological control agent for management plant pathogenic fungus since cell wall of fungus is made up of chitin. Most of the strains showed adaptability in the range of pH 5 to pH11 and are suitable to be used in the saline soil of Rajasthan. Ten Isolates of *Azotobacter* has been isolated from the soil collected from Rhizosphere of khejri and in laboratory condition they are showing compatibility with the Rhizobium strains.

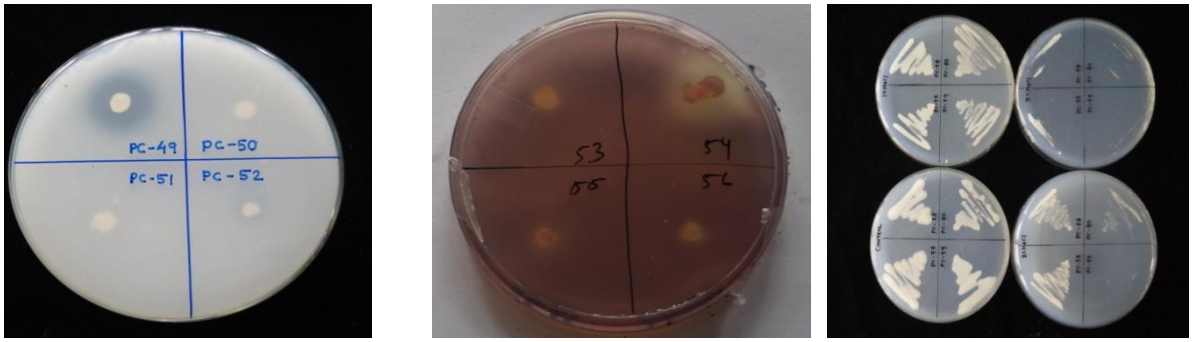
PLATE



Nodule formation in the root of khejri seedlings



Different isolates of Rhizobium



Phosphate solublization activity **Chitinase activity** **NaCl Tolerance study**

Figure: 32

2.7.4 Weeds and Invasive species: NIL

2.7.5 Forest Fire and Grazing: NIL

3. Education Vistas/Activities

3.1. FRI University (Applicable for FRI, Dehradun only): **N.A.**

3.2 Training organized:

S.No.	No. of Trainings	Durations	No. of participants
1.	Training for other Stakeholders Under Umbrella Scheme titled ‘’Forest and livelihood Resources’’	3 days	35
2.	Training for other stakeholders under Umbrella Scheme titled ‘’Role of forests in soil and water conservation’’	3 days	35
3.	Training and Capacity Building for personnels of other services under Umbrella Scheme titled," Forestry in Climate Change and Mitigation"	3 days	34
4.	Training and Capacity Building for personnel of other services under Umbrella Scheme titled, "Biodiversity and Ecosystem Services"	3 days	36
5.	Training on “Innovations in Forestry” under VVK Bikaner (Rajasthan) at KVK Pali	3 days	45
6.	Training on “Innovations in Forestry” under VVK Rajkot (Gujarat) at GFRI, Gandhinagar	3 days	41
7.	“Waste management: Solid waste & Bio-medical waste” sponsored by Ministry of Environment, Forest & Climate Change, New Delhi under Green Skill Development Training Programme (GSDP)	(11/12/2018 to 04/02/2019). 57 Days	17
8.	Training programme on **“NTFP (Plant origin): Value Addition & Marketing”** was organized under **Green Skill Development Programme (GSDP)** at Jodhpur & Nagore districts of Rajasthan.	17 Days	20
9.	‘Standard for Trees outside Forest (TOF)’ jointly organized at AFRI, Jodhpur on 12th May 2018, by AFRI, Jodhpur and Network for Certificate and Conservation of Forests’ (NCCF)- a non-profit organization, Delhi.	1 day	
10.	‘Assessment of biological diversity and people perception for developmental plan and awareness generation in different	8 days	

	community reserve areas in Jodhpur district' one each at Jamba (5th September 2018), Lohawat (6th September 2018), Bhikamkor (7th September 2018), Sathin (10th September 2018), Olvi (11th September 2018), Palasani (12th September 2018), Dhawa (13th September 2018) and Rohincha Kala (15th September 2018).		
11.	'Strategies for conservation and management of wildlife' in the project 'Assessment of biological diversity and people perception for developmental plan and awareness generation in different community reserve areas in Jodhpur district' at AFRI, Jodhpur on 28th September 2018.	1 day	
12.	'Intellectual Property Awareness in Forestry Research'–a lecture delivered by Dr. Gargi Charavarti, Assot. Prof. NLU, Jodhpur. 20th Feb 2019.	1 day	
13.	"Management of Small Botanical Gardens" under Green Skill Development Programme from 15th January to 13Th February 2019	30 days	11
14.	One Week Compulsory IFS Training Programme was organized at AFRI from 17th to 21st December, 2018.	05 days	19

3.3 Visit Abroad: **NIL**

3.4 Participation in Seminar/Symposia/Workshop/Trainings

- Dr Tarun Kant attended the CERTIFICATE COURSE IN SKILL DEVELOPMENT 2018 entitled "**Advanced MolecularTechniques for pathogenic and beneficial microbes**" Organized from 29/10/2018 to 3/11/18 at CSIR's Centre for Cellular and Molecular Biology (CCMB), Hyderabad
- Dr. Sarita Arya and Dr. I.D. Arya attended the International Conference on Trends in Plant Sciences and Agrobiotechnology. IIT Guwahati, Feb 14-16, 2019.
- Dr. Maheshwar T Hegde attended the 14th National Silvicultural Conference organized at IWST Bangalore during 3-5th December 2018. A poster paper was presented with title **"Growth performance of Red Sanders (*Pterocarpus santalinus* L. f) outside natural forests and under plantation across various climate and edaphic conditions".**
- Dr. Maheshwar T Hegde Attended the training **"Sandal-wood : seed handling, nursery and plantation technology"** organized by the IWST Bangalore from 10th December 2018 to 14th December 2018
- Dr. Maheshwar T. Hegde Scientist F Head S& FM Division attended two weeks NIAS-DST Training Programme on **"Science & Technology: Global**

Development and Prospective" from 21st Jan to 1st February 2019, organized at National Institute of Advanced Studies (NIAS), Bangalore.

- Dr.N.K.Bohra attended National Workshop on Recent advances in Statistical methods and application in Forestry and Environment Sciences held at ICFRE FROM 23-25th May 218
- Dr.N.K. Bohra participated in workshop on Possiblities of collaborative forestry research with universities and research Institution ar RFWTI, Jaipur on 15th March 2019.
- Dr.N.K Bohra participated and presented paper in National Conference on Smart Agriculture and Food securities held at National University, Jaipur from 19-20 January 2019
- Dr.N.K.Bohra participated in National workshop on Securing Wood Demand through Enhancing Productivity of planted Forests held at IFGTB, from 29-30th January.
- Seema Kumar. 2018. Participated in Stakeholders' Consultation Workshop to discuss Draft Trees Outside Forests (TOF) Certification Standard held at Arid Forest Research Institute, Jodhpur on 12 May 2018.
- Dr. Neelam Verma, ACTO delivered lecture on, **"Diseases and their managemen in NTFP yielding plants"** in Green Skill Development Training Programme (GSDP) **on "NTFP (Plant origin): Value Addition & Marketing"** from 23/07/2018 to 08/08/2018 organized at AFRI, Jodhpur.
- Dr. Neelam Verma, ACTO delivered lecture on **"Diseases and their management in Nurseries**" in **Green Skill Development Training Programme (GSDP)** on "Management of Small Botanical Gardens" on 12 Feb., 2019
- Mrs. Seema Kumar, Scientist-E & Dr. Neelam Verma, ACTO attended one day workshop on **"Strategies for conservation and management of wildlife"** at AFRI Conference Hall, Jodhpur on 28th September, 2018
- Dr. Sangeeta Singh, S-E attended Advanced molecular techniques for pathogenic and beneficial microbes at CCMB Hyderabad from 29 September-3 October, 2018
- Sh. Uma Ram Choudhary participated in IFS compulsory training on " Advances in RS, GIS and GNSS application in forestry" organized at Indian Institute of Remote Sensing (IIRS), Dehradun from 27-31st Aug 2018.
- Bilas Singh, G. Singh and Mahipal Bishnoi (2019). Paper presented in the 13th International Conference on "Development of Drylands: Converting Dryland Areas from Grey into Green" at CAZRI, Jodhpur INDIA Title of presentation was "Effects of Acacia nilotica trees on arable crops production and soil fertility in different agro climatic zones of Rajasthan". Abstract pp 93.

4. Extension Panorama/Activities:

4.1 Van Vigyan Kendra (VVKs) and Demo Village (DVs)

EXTENSION ACTIVITIES 2018-19

I. PROGAMS UNDER PRAKRITI

S. No.	Name of KV/JNV	Date	No. of participatnts /Detail	Lecture
1.	KV no. 1 A.F.S Jodhpur	26.11.18	180 students of Class 8th	Direct Indirect Benefits of Trees and Environment Conservation
2.	Jawahar Navodaya Vidyalaya Tilwasni, Jodhpur	27.11.18	513 students from class 6th to 12th	Forest and Environment Conservation
3.	KV B.F.S Jodhpur	20.12.18	42 students of Class 10nth and 11th	Direct Indirect Benefits of Trees and Environment Conservation
4.	KV at I.I.T Jodhpur	20.12.18	55 students of 8th and 9th	Forest and Environment Conservation
5.	Kendriya Vidyalaya Army No.1 Jodhpur	28.1.19	120 students of class 9th and 11th	Forest and Environment Conservation
6.	Kendriya Vidyalaya Army No. 2 Jodhpur	29.1.19	272 students of class 6th, 7th and 8th visited AFRI Jodhpur	
7.	Jawahar Navodaya Vidyalaya Jojhawar, Pali	30.1.19	487 students from 6th to 12th	Forest and Environment Conservation and Exhibition
8.	Kendriya Vidyalaya Army Banad, Jodhpur	31.1.19	118 students from 9th and 11th class	Forest and Environment Conservation and Exhibition
9.	Jawahar Navodaya	25.2.19	Principal and	

	Vidyalaya, jaswantpura		Staff visited AFRI Jodhpur	
10.	Kendriya Vidyalaya A.F.S. Jodhpur	27.2.19	985 students from class 1 to 11th	Forest and Environmental Conservation and Exhibition
11.	KV no. 3, Gandhi Nagar Cantt. Gandhi Nagar, Guajarat	8.3.19	45 students of class V, VI and VI	Forest and Environment Conservation and Exhibition

II **. Training organized**

Sl. No.	Date	Title	No. of Participants	Funding Agency
1.	8-10 October 2018	"Forest and Livelihood Resource"	35	MOEF &CC
2.	11-13 October 2018	"Role of Forest in Soil and Water Conservation"	35	MOEF &CC
3.	16-18 January 2019	" Forestry in Climate Change and Mitigation"	34	MOEF &CC
4.	22-24 January 2019	"Biodiversity and Ecosystem Services"	36	MOEF &CC
5.	12th-14th February, 2019	"New Technology in Forestry''(VVK Raj.)	45	ICFRE
6.	6th to 8th March 2019	"New Technology in Forestry"(VVK Guj.)	45	ICFRE

III. Environmental Days Celebrated

1. International Biodiversity Day on 22.5.18
2. Environment Day programs

a. Paricharcha on 15.5.18 on topic "Environmental & Plastic Pollution"
b. Plastic Free Cleanliness Drive on 19.5.18
c. Plantation program at Govt. Senior Secondary School Chainpura, Jodhpur. A lecture on "Environment and Plastic Pollution" was also delivered to 129 teacher participants of workshop being organized there.
d. Painting Competition for school students on 4.6.18.
e. Environment Day Celebration on 5.6.18.

3. International Yoga Day on 21.6.18
4. Van Mahotsava Celebration on 27.7.18
5. International Day of Forests on 21.3.19

IV. Participation in Rally/ Day Celebration

a. 9.4.18 – Jal Sanrakshan Rally organized at Chopasani Housing Board, Jodhpur
b. 22.4.18 – Earth day Celebration at Herbal Garden, Jodhpur by Mehrangarh Pahadi Paryavaran Vikas Samiti
c. 22.5.18 - International Biodiversity Day organized by SFD Jodhpur and Rover Scout
d. 1.6.18 - "Beat Plastic Pollution Rally organized by Desert Regional Center ZSI, Jodhpur

V. Radio Talk

Radio Talk on "Paryavaran Santulan Mein Aam Aadmi Ki Bhumika" broadcasted on 26.7.18
Radio Talk on " Paryavaran se Jude Hamare Teej Tyohar" broadcasted on 8.11.18

VI. Participation in Farmer's Fair

S. No.	Institute	Participated	Duration	Place
1.	Paschimi Rajasthan Udyog Hastshilp Utsav 2019	participated	4rth to 14th January 2019	Jodhpur
2.	District level Kisan Mela at CAZRI, Jodhpur	participated	28.1.19 (one day)	Central Arid Zone Research Institute, Jodhpur

VII. Visit of AFRI Premises (Extension and Interpretation Center) in 2018-19

Different groups of visitors including forest officials, farmers, students and others visited " Extension and Interpretation Centre" at AFRI and learned demonstrated technologies during April 2018 to March 2019.

S. No.	**Visitors Group**	**No. of visitors**
1.	Students	1154
2.	Forest Field Functionaries (IFS Probationers, State Forest Officers RFO etc.)	424
3.	Scout Guide and Rover Ranger	251
4.	Farmers	90
5.	KVK Trainees	60
6.	Surveyor Trainees	50
7.	Members of Sudanese Delegation	44
8.	Indian Accounts and Audit Service Officers	24
	Total	**2064**

Fig 33: An awareness programme under Prakrti at Navodya Vidyalya

Fig 34: A Field visit under Umbrella Scheme

Fig 35: Awareness programme under prakarti at Kendriya Vidyalaya (Army)

Fig 36: Field Exposure Visit of farmers & foresters at VVK in Pali (Rajasthan)

4.2 Technologies transferred:

2195 visitors in 40 groups visited Extension and Interpretation Centre, AFRI.

Serial No.	Name of Visitors/Group	Date	No. of Visitors
1.	State Forest Service Officers from CASFOS, Burnihat, Assam	3.4.18	31
2.	Sudanese Delegates from Butana Integrated Rural Development Program	25.4.18	24
3.	Sudanese Delegates from Butana Integrated Rural Development Program	7.5.18	22
4.	Rover Rangers/Scout Guides from Rajasthan Rajya Bharat Scout Guide Mandal, Mukhyalaya, Jodhpur	22.5.18	20
5.	Scout Guides from Division Level, Abhiruchi Kendra, Shahpura, Jodhpur	25.5.18	117
6.	Indian Audit and Accounts Service Probationers, Batch 2017	20.7.18	27
7.	Trainees of Surveyor Refreshor Course of Maru Van Prashikshan Kendra, Jodhpur	7.08.18	51
8.	Trainees of one year Diploma course in Agriculture Extension Service for Input Dealer from KVK, CAZRI	30.08.18	41
9.	Students of Aishwarya College of Education, Jodhpur	7/9/18	51
10.	Range Forest Officer Trainees of 2018-19 batch of Gujarat Forest Ranger College, Rajpeepla, Gujarat	21/9/18	35
11.	Farmers from Chittorgarh under ATMA project	3.10.18	47
12.	Students from G.G.U.P School, Shashtri Nagar, Jodhpur	4.10.18	5
13.	Range Forest Officer Trainees of 2017-19 batch of CASFOS, Burnihat	12.10.18	34
14.	Pre-primary students of Lucky International School, Jodhpur	24.10.18	58
15.	B.Sc Agriculture Students from College of Agriculture, Amreli, Gujarat	26.10.18	37
16.	Students of 8^{th}, 9^{th}, 11^{th} and 12^{th} class of Vidhya Public Senior Secondary School,	30.10.18	191

	Jodhpur		
17.	Students of 3- 7th and 10th class of Vidhya Public Senior Secondary School, Jodhpur	1.11.18	246
18.	Range Forest Officer Trainees of Karnataka State Forest Academy, Dharwad	8.11.18	45
19.	Students of 10th and 11-12th Science class from Balmandir Vishisht Purv-Prathmik and Balika Uchch Madhyamik Vidyalaya, Shashtri Nagar, Jodhpur	26.11.18	75
20.	B.Sc (Agriculture) Students of , College of Sericulture (UASCB) Karnataka, University of Agricultural Sciences (UAS) Bengaluru	27/11/18	38
21.	Forest Training Center, Chhail, Himachal Pradesh	7.1.19	48
22.	Shri AAI JEE Mahila Mahavidhylaya, Bilara, Jodhpur	10.1.19	38
23.	Scout and Scouters of Prakriti Adyyan Shivir, Jodhpur	20.1.19	135
24.	Skill Development Trainees of KVK, CAZRI, Jodhpur	22.1.19	21
25.	10 Post graduate students and 3 Ph. D. scholar from Aligarh Muslim University, Aligarh	28.1.19	15
26.	Students of Kendriya Vidyalaya Army No. 2, Jodhpur	29.1.19	272
27.	Students from G.D. Memorial College, Jodhpur	31.1.19	21
28.	State Forest Service Trainees form CASFOS, Coimbatore	5.2.19	41
29.	Students of A.B.M Secondary School, Jodhpur	7.2.19	68
30.	B.Sc (Forestry) students from Sher-E- Kashmir University, Banihama	7.2.19	26
31.	Farmers from Chittorgarh ATMA project	15.2.19	46
32.	Indian Forest Service, Probationers 2018-20 batch	16.2.19	33
33.	Indian Forest Service, Probationers 2018-20 batch	20.2.19	39
34.	Principal/Teachers and Office Superintendent from Jawhar Navodya Vidyalay, Jaswantpura, Jalore	25.2.19	4
35.	Range Forest Officer trainees from Kundal Academy of Development, Administration and Management, Kundal Maharashtra	27.2.19	32
36.	B.Sc (Forestry) students and Ph.D. Scholars	27.2.19	35

	from H. N. B. Garhwal University		
37.	Range Forest Officer Trainees from Forest Training Institute, Sundar Nagar (Himachal Pradesh)	27.2.19	32
38.	Range Forest Officer Trainees from Forest Training Academy, Haldwani	10.3.19	27
39.	B. Sc Students from Horticulture and Forestry College Jhalarapatan, Jhalawar (Rajasthan)	16.3.19	25
40.	Range Forest Officer Trainees from Telangana Forest Training Academy	26.3.19	41
		Total	**2195**

S. No.	Name of KV/JNV	Date	No. of participants /Detail	Topic of Lecture
1	KV no. 1, A.F.S, Jodhpur	26.11.18	180 students of Class 8th	Direct Indirect Benefits of Trees and Environment Conservation
2	Jawahar Navodaya Vidyalaya, Tilwasni, Jodhpur	27.11.18	513 students from class 6-12th Class	Forest and Environment Conservation
3	KV, B.S.F., Jodhpur	20.12.18	42 students of Class 10-11th Class	Direct Indirect Benefits of Trees and Environment Conservation
4	KV, I.I.T Jodhpur	20.12.18	55 students of 8-9th Class	Forest and Environment Conservation
5	Kendriya Vidyalaya, Army No.1, Jodhpur	28.1.19	120 students of class 9th and 11th	Forest and Environment Conservation
6	Kendriya Vidyalaya, Army No. 2, Jodhpur	29.1.19	272 students of class 6-8th visited AFRI Jodhpur	
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8	Kendriya Vidyalaya Army, Banad, Jodhpur	31.1.19	118 students from 9th and 11th class	Forest and Environment Conservation / Exhibition
9	Jawahar Navodaya Vidyalaya, Jaswantpura	25.2.19	Principal and Staff (4nos) visited AFRI Jodhpur	
10.	Kendriya Vidyalaya, I. A.F., Jodhpur	27.2.19	985 students from 1-11th class	Forest and Environmental Conservation / Exhibition
11	KV no. 3, Gandhi Nagar Cantt. Gandhi Nagar, Gujarat	8.3.19	45 students of class V, VI and VI	Forest and Environment Conservation / Exhibition

4.3 Research publications

Research articles published by the institute:

S.No.	Number of research artilcs published in scientific journals and books/proceedings		
	National Journal	Foreign Journal	Chapter in book/Proceedings
1.	9	3	4

Research articles presented in seminar/conference / workshops and abstracts and popular articles published by the Institute:

S.No.	Number of artilcs presented in Seminar/Conference / Workshops and abstracts and popular articles published		
	Article Presented	Abstract published	Popular article
1.	NIL	11	5

Books and Booklets, brochure/pamphlets published by Institute:

S.No.	No. of books and booklet, brochures/ pamphlets published	
	Books	Booklets/Brochures/ Bulletins/Pamphlets
1.	NIL	

4.4 Seminar/Symposia/Workshop organized:

Sr. No.	**No. of Seminars/Symposia/ Workshops meeting organized**	**Days**
1.		
2.		

4.5 Consultancies:

Project: Designing, development and performance of urban forestry model for new campus of Rajasthan High court, Jodhpur

Wide-ranging tree planting programmes in cities and towns are increasingly put into operation as a strategy to improve the urban environment. Trees provide multiple benefits in the urban areas that include reduction of air temperatures, improved air quality, mitigation of storm-water run-off, and provision of enhancing biological diversity. The project 'Designing, Development and Performance of Urban Forestry

Model for New Campus of Rajasthan High court, Jodhpur' was implemented by Arid Forest Research Institute, Jodhpur during 2016-19. In this 605 plants of 19 tree species with varying morphological and phenological characters were planted along the boundary wall as well as roads sides of the newly constructed High Court Campus for intended ecosystem services. Though varying in nature, the species found least successful at the site are *Jacaranda mimosifolia, Plumeria alba* and *C. lanceolatus*, whereas *S. album* did not survive. Best performing species are *Adansonia digitata*, *Azadirachta indica, Bauhinia purpurea, Cassia fistula, Dalbergia sissoo, Millingtonia hortensis, Mimusops elengi, Pongamia pinnata* and *Spathodia campanulata.* Conclusively, plantation activities should be done accordingly to obtain operational ecological and societal benefits both. For further maintenance of the plantation suggestive measures are provided while submitting the project report.

Callistemon lanceolatus

Dalbergia sissoo

Delonix regia

20–month-old *Millingtonia hortensis*

36 month old *Millingtonia hortensis*

20–month-old *Azadirachta indica*

36 month old *Azadirachta indica*

Figure 37: Growth of different species planted at new High Court site of Jodhpur city.

4.6 Technical Services:

4.6 Technical Services

- G. Singh (2017). Participated in an interactive meeting for declaration of biosphere reserve in Rajasthan organized at Jaipur on 12th April 2017.
- G. Singh (2018). Technical visit on for 'Development of Smriti Van I Sikar involving Desert Plants' on 14th July 2018.
- G. Singh (2018). Participated in an expert meeting of MJSA Impact Assessment for Phase II Meeting –Increase in Green Cover on 13th July 2018.

4.7 Activities of Rajbhasha:

राजभाषायी गतिविधियाँ

शुष्क वन अनुसंधान संस्थान,जोधपुर में हिन्दी सप्ताह (14-20 सितंबर,2018) का आयोजन किया गया जिसमें 'हिन्दी दिवस' के दिन संगोष्ठी में संस्थान कर्मियों ने राजभाषा हिन्दी पर अपने विचार रखे। सप्ताह में हिन्दी टिप्पण - आलेखन, हिन्दी प्रश्नोत्तरी, हिन्दी टंकण (सामान्य व सारांश),राजभाषा बोध एवं स्वरचित कविता पाठ प्रतियोगिताएं आयोजित हुईं। समापन समारोह के मुख्य अतिथि श्री गौतम अरोरा, मण्डल रेल प्रबंधक, उ.प.रे. व अध्यक्ष नराकास, जोधपुर थे। इस अवसर पर मुख्य अतिथि ने राजभाषा प्रोत्साहन योजना एवं हिन्दी प्रतियोगिताओं के विजेता कर्मियों को पुरस्कार प्रदान किए।

इसके अतिरिक्त संस्थान में विभागीय राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का आयोजन भी नियमित रूप से किया गया तथा संस्थान कर्मियों हेतु कामकाज में हिन्दी को बढ़ावा देने के लिए हिन्दी कार्यशालाओं का भी आयोजन हुआ।

क' क्षेत्र स्थित संस्थानो में उत्कृष्ट प्रदर्शन हेतु भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद का **राजभाषा प्रोत्साहन पुरस्कार 2017-18** शुष्क वन अनुसंधान संस्थान, जोधपुर को प्रदान किया गया।

Fig 38: हिन्दी प्रश्नोत्तरी प्रतियोगिता में भाग लेते संस्थान कर्मी

Fig 39: हिन्दी टिप्पण आलेखन प्रतियोगिता का दृश्य

Fig 40: मुख्य अतिथि का स्वागत करते हुए संस्थान निदेशक डॉ. इन्द्र देव आर्य

Fig 41: हिन्दी सप्ताह के समापन समारोह में मंचासीन मुख्य अतिथि अध्यक्ष, नराकास

Fig 42: हिन्दी सप्ताह -2018 के दौरान सभागार में उपस्थित संस्थान कर्मी

Fig 43: हिन्दी कार्यशाला

Fig 44: राजभाषा तिमाही बैठक की अध्यक्षता करते हुए डॉ. इन्द्र देव आर्य

4.8 Awards and Honours: Nil

4.9 Special Activties (such as Van Mahotsava, Forestry Day and Other occasion)

1. International Biodiversity Day on 22.5.18
2. Environment Day
    a. Paricharcha on 15.5.18 on topic ''Environmental & Plastic Pollution''
    b. Plastic Free Cleanliness Drive on 19.5.18
    c. Plantation program at Govt. Senior Secondary School Chainpura, Jodhpur. A lecture on ''Environment and Plastic Pollution'' was also delivered to 129 teacher participants of workshop being organized there.
    d. Painting Competition for school students on 4.6.18.
    e. Environment Day Celebration on 5.6.18.
3. International Yoga Day on 21.6.18
4. Van Mahotsava Celebration on 27.7.18
5. International Day of Forests on 19.3.19
6. G. Singh (2018). Presentation of the research findings of the projects funded by SFD, Rajasthan during RAG meeting of Rajasthan Forest Department at Jaipur during 28-29th June 2018.
7. G. Singh (2018). Presentation of the projects 'Study of Flora and Fauna of Raj Bhavans of Rajasthan' to AddPCCF (Silviculture) and signing of MOU for the implementation of the project at Jaipur on 13th August 2018.
8. G. Singh (2018). Participation in national Workshop on 'Land Degradation Neutrality (LDN) Target Setting' organized by MoEFCC, New Delhi on 4-5th December 2018 at MoEF & CC office, New Delhi.
9. G. Singh (2018). Attended an expert meeting related to area identification under "Deemed Forests" as committee member on 21st December 2018 at Van Bhavan, Jaipur.
10. G. Singh (2018). Key note address on 'Biological diversity and livelihoods in western Rajasthan' in two days regional legal awareness workshop on 'Biological diversity law in Rajasthan' organized at National Law University, Jodhpur in collaboration with UNDP and National Law School of India University, Bangalore.
11. G. Singh (2019). Panel Expert in one day workshop on 'Climate Change and Desertification: Renewable Energy' organized jointly by ENVIS, CAZRI Jodhpur and TERI, New Delhi at Jaisalmer on10th January 2019.
12. G. Singh (2019). Participated and presented 'Possibilities of collaborative research with

Universities and research institutions' held on 15th March 2019 at Jaipur.

13. S.R. Baloch (2019). Participated in three days training on" Valuation/Quantification of Ecosystem Services" organized by Statistical Division of ICFRE, from 6th to 8th March, 2019, at ICFRE Dehradun

14. S.R. Baloch (2018). Panel Expert in the Selection Committee held on 20st & 21nd June 2018, ENVIS CAZRI, Jodhpur under Green Skilled Development Programme funded by MoEF & Climate Change Govt. of India.

15. **सतर्कता जागरूकता सप्ताह**: सत्यनिष्ठा व पारदर्शिता की जवाबदेही को बढ़ावा देने के लिए प्रतिबद्ध शीर्ष संस्थाएं केन्द्रीय सतर्कता आयोग के निर्देशानुसार हर वर्ष की भांति इस वर्ष भी सभी अधिकारियों एवं कर्मचारियों को भ्रटाचार को रोकने और उस पर नियंत्रण के लिए सहभागी बनाने के लिए 29 अक्टूबर, 2018 से 3 नवम्बर, 2018 तक सतर्कता जागरूकता सप्ताह का आयोजन शुष्क वन अनुसंधान संस्थान (आफरी), जोधपुर में किया गया । सप्ताह की शुरूआत में दिनांक 29. 10.2018 को आफरी के सतर्कता अधिकारी डॉ. जी. सिंह ने संस्थान के समस्त अधिकारियों एवं कर्मचारियों को सतर्कता सबंधी शपथ दिलायी । इस वर्ष शपथग्रहण ई–प्रतिज्ञा के रूप में संपन्न हुआ । जिसमें संस्थान के समस्त अधिकारियों एवं कर्मचारियों ने भाग लिया । जो अधिकारी अथवा कर्मचारी किसी कारणवश उक्त ई–प्रतिज्ञा में शामिल नही हो पाये तो उन्होनें अपना निजी ई–प्रतिज्ञा लिया । उपरोक्त क्रम में दिंनाक 30.10.2018 को दो पोस्टर प्रतियोगिताएँ **''भ्रष्टाचार रहित भारत''** विषय पर आफरी अधिकारियों/कर्मचारियों एवं विद्यालयों के छात्र/छात्राओं हेतु आयोजित की गयी। दिंनाक 31.10.2018 को निबंध प्रतियोगिता **''हमारा उद्धेश्य भ्रष्टाचार मुक्त देश''** विषय पर आयोजित की गयी। जिसमें संस्थान के कर्मचारियों एवं शोधार्थीयों ने भाग लिया। इसी क्रम में दिंनाक 01.11.2018 को **''देश की प्रगति एवं नैतिकता''** विषय पर वाद विवाद प्रतियोगिता का आयोजन किया गया, जिसमें संस्थान के कर्मचारियों एवं शोधार्थीयों ने भाग लिया। दिंनाक 02.11.2018 को ''**भ्रष्टाचार से मुक्ति के साथ नवीन भारत बनाने में हमारा सहयोग**'' विषय पर एक व्याख्यान रखा गया। विभिन्न प्रतियोगिताओं के विजेताओं को पारितोषिक वितरण का कार्यकम भी रखा गया । श्री आर.के.जैन, मुख्य वन संरक्षक, वन विभाग, जोधपुर इस कार्यक्रम के मुख्य अतिथि एवं वक्ता थे। इस कार्यक्रम के दौरान सतर्कता अधिकारी डा.जी.सिंह ने सतर्कता संबंधी नियमो, क्रियाकलापों एवं दिशा निर्देशों के बारे में विस्तृत जानकारी देते हुए इस संबंध में समय समय पर विभिन्न जानकारियों के प्रेषण एवं पारदर्शिता तथा सुशासन संबंधी जानकारी प्रदान की ।

मुख्य अतिथि महोदय द्वारा विभिन्न प्रतियोगिताओं के सभी विजेताओं को पारितोषिक वितरण किया गया। इस अवसर पर संस्थान की डॉ. रंजना आर्या, वैज्ञानिक–जी ने भी संस्थान के अधिकारियों एवं कर्मचारियों को संबोधित किया एवं अपील की कि सभी अपना कार्य पूर्ण, मेहनत, लग्न व निष्ठा से करे एवं सभी कार्यों में सतर्क एवं जागरूक रहे साथ ही जनसहभागिता को बढ़ाने में मदद करें। मुख्य अतिथि द्वारा भ्रष्टाचार उन्मूलन में हमारा योगदान पर संस्थान के अधिकारियों एवं कर्मचारियों को संबोधित किया गया । मुख्य अतिथि महोदय ने यह बताया कि सरकारी कार्यप्रणाली में जनसहभागिता के साथ–साथ हमारी अपनी भूमिका भी काफी महत्वपूर्ण है । हम खुद अपने में भी सुधार लाकर भ्रष्टाचार उन्मूलन अपना सहयोग दे सकते हैं। व्याख्यान के शीर्षक को उन्होने कई उदाहरणों द्वारा भी समझाने का प्रयत्न किया जिसमें हमारी भागीदारी बढ सकें और हमारा देश भ्रष्टाचार मुक्त हो सके ।

5. Administration and Information Technology

Introduction

5.1. Information Technology

The existing IT infrastructure was maintained properly. The leased line provided by the National Knowledge Network (NKN) was maintained and 24x7 internet connectivity was provided to the users. Several video conferencing sessions were organized during the year. The Hindi and English website of the institute was updated regularly throughout the year. The reports of the important events held at the institute were uploaded on the institute as well as on the ICFRE website. The PIMS and payroll modules of the IFRIS were run successfully throughout the year. Four new computers with UPS and printers were procured. Aadhar based Biometric attendance system with CCTV was maintained at the institute. An online portal for new recruitments for various posts at AFRI was developed with the help of RISL, a Government of Rajasthan owned company. Other routine tasks related to the Information Technology were performed during the year.

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:

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

The charter has been prepared based on the seven steps mentioned in Sevottam. Considering the ICFRE's mandated mission "To generate, preserve, disseminate advance knowledge, technologies and solutions for addressing issues related to forests and promote linkages arising out of interactions between people, forests and environment on a sustained basis through research, education and extension", AFRI is enduring its forestry research for conservation of biodiversity and enhancement of bio-productivity in Rajasthan, Gujarat and Dadra & Nagar Haveli with special emphasis on arid and semi-arid regions. Keeping the National Forestry Research Plan (NFRP) in

view, AFRI has identified its thrust areas based on the inputs and active participation of different stakeholders. The institute is implementing its research endeavors after duly recognizing the user's needs. Main research focus of the institute includes:

1. Soil, water and nutrient management,
2. Development of technologies for afforestation of stress sites,
3. Seed handling, nursery, plantation techniques and management,
4. Planting stock improvement and biotechnology,
5. Biofertilizers and biopesticides,
6. Phytochemistry, non-wood forest products
7. Biodiversity conservation and climate change,
8. Agroforestry and JFM,
9. Forestry education & extension.

Different procedures have been formulated for identifying the research problems of dry areas; formulating the projects based on the problems; and dissemination of the research results and technologies to the end users. In order to identify the research problems, institute level interaction workshops were organized involving various stakeholders like officials of state forests departments of Rajasthan and Gujarat , scientist of other sister organization like CAZRI and University, progressive farmers and NGO's. Based on the research problems highlited during discussions are taken under projects formulations the scientists after the thorough review of scientific literature.

The projects are then sent to the external experts for evaluation and their suggestions. After incorporating the suggestions/modifications, the projects are presented before the Research Advisory Group (RAG) meeting. After including suggestion of RAG members, if any, revised projects are prepared and progress of the ongoing projects are presented in the Research Policy Committee (RPC) meeting for approval. After the approval of projects, the funds are allotted and the projects are executed by the scientists.

The technologies developed through the projects are extended/ demonstrated to the end users with the help of demonstration trials, extension trainings, Van Vigyan Kendras, Demo villege, printed material, radio talk, workshops, conferences and the publications uploaded to the website of the institute.

5.2.1.2 Action taken to implement the Charter

To fulfill the charter, research projects were prepared addressing the research mandate of the institute and submitted for funding to various donor agencies for implementing the Charter. Three new projects were approved for initiation in the next financial year by RPC held in Februray, 2018. Several extension trainings were held during the year for dissemination of the research results of the various projects executed in the institute. The research results of the projects, the technologies developed by the institute and the events held at the institute were continuously updated on the website of the institute. In addition to these, environmental awareness programs were organized by the institute in the form of World Environment Day, Biodiversity Day and World Day for Combating Desertification and Van Mohotsava. The details of these have been mentioned above in this report.

5.2.1.3 Details of Training Programmes, Workshops, etc. held for proper implementation of Charter: Mentioned above under point No. 3.2 & 4.9.

5.2.1.4 Details of publicity efforts made and awareness campaigns organized on Charter for the Citizen/Clients: Various events were organized, manuscript published and talks delivered by AFRI officials during different events, conferences, workshops helped in publicity efforts made and awareness campaigns organized on Charter for the Citizen/Clients. The details are given under point No. 4.9.

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:

All the new projects and progress made in the ongoing research projects were presented to the internal and external experts of the RPC, who gave their comments on the quality of the new projects and the progress made in the ongoing projects. The experts prioritized the new projects and expressed their satisfaction on the progress of the ongoing projects.

5.3 Welfare measures for the SC/ST/Backward /Minority communities

To promote the general interest of SC/ST/OBC employees and to work for their collective betterment, development and upliftment, AFRI SC/ST/OBC Employees Welfare Association was formed. As per the DOPT's guidelines for various social groups, Liaison Officers had been nominated as below:

Sl.No.	Name of officer & Post	Liasion Officer
1.	Sh. N. Bala, Scientist-F	Liasson Officer for (SC/ST/OBC)
2.	Sh. Shiv Lal Chouhan, RO-I	Liasson Officer for SC.
3.	Smt. Desha Meena, Scientist-B	Liasson Officer, ST
4.	Sh. Anil Singh Chouhan,RA-II	Liasson Officer, OBC
5.	Under Secretary	Member

127th Birth anniversary celebrated of Baba Saheb Dr. B. R. Ambedkar in AFRI, Jodhpur

To spread the message of equality and harmony among the various sections of the society the SC/ST/OBC Employees Welfare Association of A.F.R.I made their efforts to celebrate the Dr. Ambedkar Jayanti on 14th April 2018 to commemorate the birthday of Baba Saheb Ambedkar. Dr. I.D. Arya Director, A.F.R.I presided over the program to pay homage to Baba Saheb Ambedkar on his 127th Birth anniversary. Dr. Ranjana Arya Scientist-G, Dr. G. Singh, Scientist-G & Head Dr. U.K. Tomar, Scientist-F, Dr. Tarun Kant Scientist-F, Sh. K.C. Gupta Hindi Officer and Sh. K.R. Choudhary, ACTO, Sh. Sawai Singh MTS, Miss. Priya Singh and Miss Ayushi Baloch also addressed the gathering on the ideals of Dr. Bhim Rao Ambedkar and his teacher Jyotiba Fule. Sh. N. Bala Scientist-F and Chief Liason Officer of the AFRI Cell and Sh. S.R. Baloch, Scientist-

C and Secretary SC/ST/OBCs Employees Welfare Association addressed about the immense contribution of Dr. Bheem Rao Ambedkar for the down trodden people of India. Scientist/Officers/Staff of AFRI had assembled for the program.

127th Birth anniversary celebrated of Baba Saheb Dr. B R Ambedkar in AFRI, Jodhpur
Figure: 45

6. Annexures

1. RTI

Names and addresses of public information officers and appellate authorities under the right to information act 2005 in ICFRE and its institutes

Headquarters / Institutes	Appellate Authorities	Public InformationOfficers	Subject matter(s) allocated
Arid Forest Research Institute	Sh. M. R. Baloch,IFS Director, AFRI Email: dir_afri@icfre.org Phone : 0291-2742549 FAX : 0291-2722764	Shri K.C.Gupta Email guptakc@icfre.org Phone : 0291-2729122 FAX : 0291-2722764	All matters related to AFRI, Jodhpur

Right to Information Act, 2005

During 2018-2019 total 53 variety application were received affine u/s 6(3) and directly to PIO as well as online under right to information Act. 2005. Opening balance of application as on 01-04-2018 was 04. Out of total 57 variety applications number any information was refused and information of calculation of the amount arrived at for photocopy was provided to applicants. PIO, AFRI, Jodhpur has furnished information to all applicants except 04 as they have not turned up about photocopy charges. During the year the appellate authority had not received any appeal regarding RTI. Quarterly returns of RTI have been furnished regularly to the secretary, ICFRE, Dehradun.

2. **Information on Vigilance cases: NIL**
3. **Information on Audit objections:NIL**
4. **Nodal Officer (E-mail and Postal Address):**

Sh. Shivlal Chauhan, STO,
P.O. Krishi Upaz Mandi, New Pali Road, Jodhpur, 342005,
Arid Forest Research Institute,
Email: groupco_afri@icfre.org, dir_afri@icfre.org
Phone: 0291-2742549, 2729104, Mob.:9414110722, FAX: 0291-2722764

5. **Intellectual Property**

5.1 Patent Property - NIL

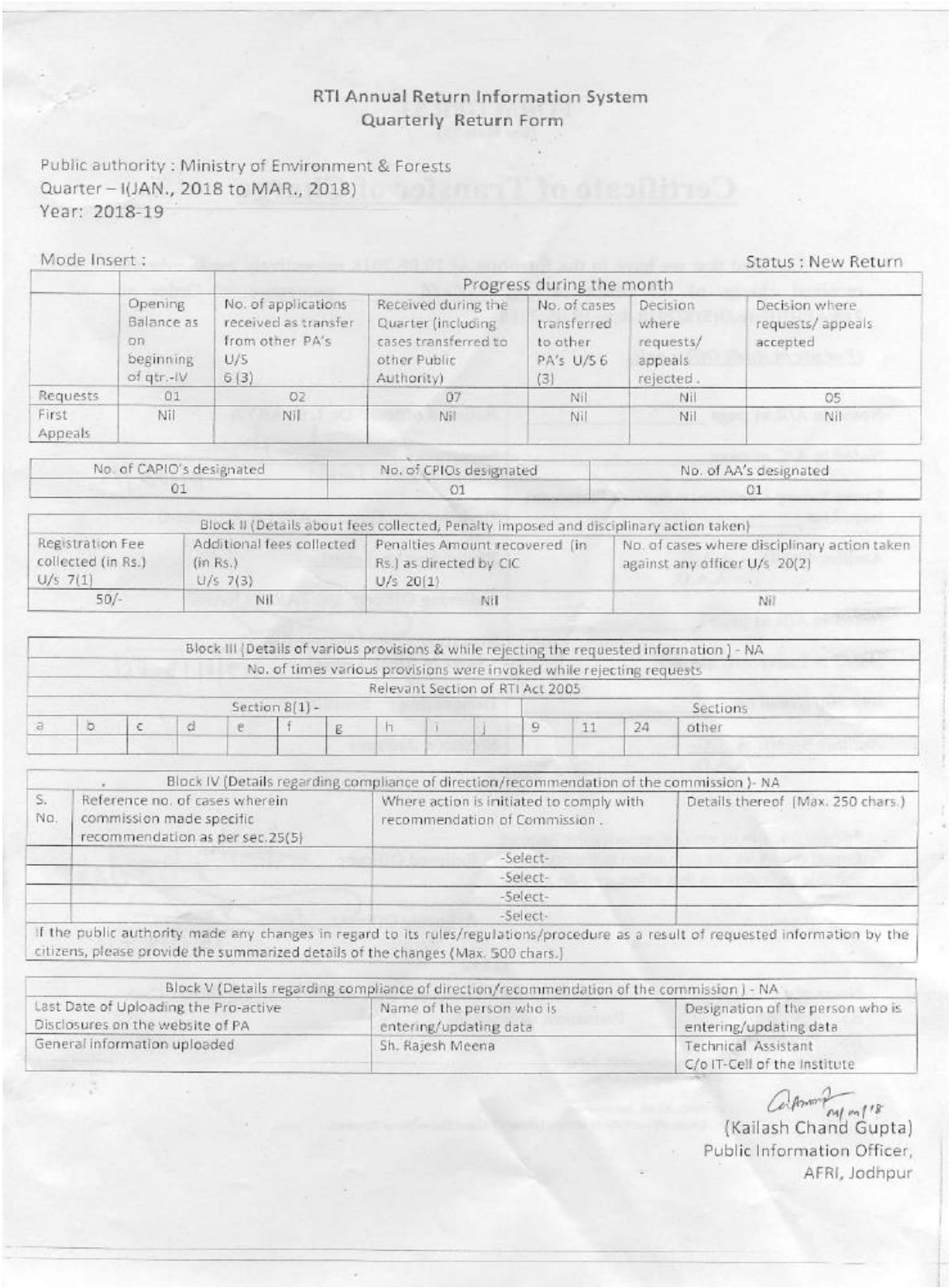
5.2 Others-NIL

List of Abbreviations

AF&ED	Agroforestry and Extension Division
AFRI	Arid Forest Research Institute
AM	Arbascular Mycorrhiza
ARS	Agriculture Research Station
AICP	All India Co-ordinated Project
CAZRI	Central Arid Zone Research Institute
CETP	Common Effluent Treatment Plant
CIT	Chartered Institute of Technology
CSOs	Clonal Seed Orchards
CTAB	Cetyl Tri-methyl Ammonium Bromide
DEMO	Demonstration
DFO(WL)	Divisional Forest Officer (Wild Life)
DRDO	Defence Research Development Organization
DST	Department of Science & Technology
DNH	Dadra & Nagar Haveli
DNA	Deoxy Ribo Nucliec acid
DVs	Demo Village
EC	Electrical Conductivity
ENVIS	Environmental Information System
ET	Evapo- Transpiration
FED	Forest Ecology Division
FGTB	Forest Genetics and Tree Breeding
FPD	Forest Protection Division
FSI	Forest Survey of India
FRI	Forest Research Institute
FYM	Farmyard Manure
GM	Genetically Modified
GEF	Global Environmental Facilities
GIS	Geographic Information System
GoI	Govt. of India
GPS	Global positioning system
HoD	Head of Division
HFRI	Himalayan Forest Research Institute

ICFRE	Indian Council of Forestry Research & Education
ICBN	International Conference on Bio-technology & Nano-technology
IBA	Indole butyric Acid
ICAR	Indian Council of Agriculture Research
ICRAF	International Council for Resrach on Agroforestry
IES	Indian Engineers Service
IFFCO	Indian Farmers Fertiliser Cooperative Limited
IFRIS	Indian Forestry Research Information System
IFS	Indian Forest Service
IT	Information Technology
ISSR-PCR	Inter Simple Sequence Repeat-Polymerase Chain Reaction
KVK	Krishi Vigyan Kendra
LCM	Leaf Compost Manure
Mg	Mega Gram (10^6 g)
mM	Milli mole
MoU	Memorandum of Understanding
MoEF&CC	Ministry of Environment, Forest & Climate Change
NAA	Naphthalene Acetic Acid
NFRP	National Forestry Research Plan
NKN	National Knowledge Network
NSFDDE	National Scheduled Castes Finance and Development Corporation
NTFP	Non-Timber Forest Product
NWFP	Non-Wood Forest Product
OBC	Other Backward Class
PIMS	Personnel Information Management System
PSB	Phophorus Solubilizing Bacteria
PAR	Photosynthetic Active Radiation
RAG	Research Advisory Group
RFD	Rajasthan Forest Department
RIMS	Research Management Information System
RPC	Research Priority Committee
RSFD	Rajasthan State Forest Department
RSR	Root to Shoot Ratio
RTI	Right To Information
SAAER	The Society for Agriculture and Arid Ecology Research

SC	Scheduled Caste
SFD	State Forest Department
SFS	State Forest Service
SLEM	Sustainable Land And Ecosystem Management
SPAs	Seed Production Areas
SPSS	Statistical Package for Social Science
SSP	Single Super Phosphate
SSOs	Seedling Seed Orchards
ST	Scheduled Tribe
SWC	Soil Water Content
TREE	Training, Research, Extension & Education
TDS	Total Dissolved Solids
TERI	The Energy and Resources Institute
UT	Union Territory
UNCCD	United Nations Convention to Combat Desertification
UV	Ultra Violet
VAM	Vesicular Arbuscular Mycorrhiza
VMG	Vegetative Multiplication Garden
VVK	Van Vigyan Kendra
VFPMC	Village Forest Protection & Management Committee
ZSI	Zoological Survey of India



RTI Annual Return Information System
Quarterly Return Form

Public authority : Ministry of Environment & Forests
Quarter – I(JAN., 2018 to MAR., 2018)
Year: 2018-19

Mode Insert :

Status : New Return

		Progress during the month				
	Opening Balance as on beginning of qtr.-IV	No. of applications received as transfer from other PA's U/S 6 (3)	Received during the Quarter (including cases transferred to other Public Authority)	No. of cases transferred to other PA's U/S 6 (3)	Decision where requests/ appeals rejected .	Decision where requests/ appeals accepted
Requests	01	02	07	Nil	Nil	05
First Appeals	Nil	Nil	Nil	Nil	Nil	Nil

No. of CAPIO's designated	No. of CPIOs designated	No. of AA's designated
01	01	01

Block II (Details about fees collected, Penalty imposed and disciplinary action taken)			
Registration Fee collected (in Rs.) U/s 7(1)	Additional fees collected (in Rs.) U/s 7(3)	Penalties Amount recovered (in Rs.) as directed by CIC U/s 20(1)	No. of cases where disciplinary action taken against any officer U/s 20(2)
50/-	Nil	Nil	Nil

Block III (Details of various provisions & while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1) -										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the commission) - NA			
S. No.	Reference no. of cases wherein commission made specific recommendation as per sec.25(5)	Where action is initiated to comply with recommendation of Commission .	Details thereof (Max. 250 chars.)
		-Select-	
		-Select-	
		-Select-	
		-Select-	
If the public authority made any changes in regard to its rules/regulations/procedure as a result of requested information by the citizens, please provide the summarized details of the changes (Max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the website of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General information uploaded	Sh. Rajesh Meena	Technical Assistant C/o IT-Cell of the Institute

(Kailash Chand Gupta)
Public Information Officer,
AFRI, Jodhpur

(Jan, 2018 to Mar, 2018)

RTI Annual Return Information System
Quarterly Return Form

Public Authority : Ministry of Environment, Forests & Climate Change
Quarter – II(April, 2018 to June, 2018)
Year: 2018

Mode Insert : Status : New Return

		Progress during the month				
	Opening Balance as on beginning of qtr.-II	No. of applications received as transfer from other PA's U/S 6 (3)	Received during the Quarter (including cases transferred to other Public Authority)	No. of cases transferred to other PA's U/S 6 (3)	Decision where requests/ appeals rejected .	Decision where requests/ appeals accepted
Requests	05	04	07	Nil	Nil	14
First Appeals	Nil	Nil	Nil	Nil	Nil	Nil

No. of CAPIO's designated	No. of CPIOs designated	No. of AA's designated
01	01	01

Block II (Details about fees collected, Penalty imposed and disciplinary action taken)			
Registration Fee collected (in Rs.) U/s 7(1)	Additional fees collected (in Rs.) U/s 7(3)	Penalties Amount recovered (in Rs.) as directed by CIC U/s 20(1)	No. of cases where disciplinary action taken against any officer U/s 20(2)
40/-	220/-	Nil	Nil

Block III (Details of various provisions & while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1) -										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the commission)- NA			
S. No.	Reference no. of cases wherein commission made specific recommendation as per sec.25(5)	Where action is initiated to comply with recommendation of Commission .	Details thereof (Max. 250 chars.)
		-Select-	
		-Select-	
		-Select-	
		-Select-	
If the public authority made any changes in regard to its rules/regulations/procedure as a result of requested information by the citizens, please provide the summarized details of the changes (Max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the website of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General information uploaded	Sh. Rajesh Meena	Technical Assistant C/o IT-Cell of the Institute

05/07/18

(Kailash Chand Gupta)
Public Information Officer,
AFRI, Jodhpur

(April, 2018 to June, 2018)

RTI Annual Return Information System
Quarterly Return Form

Public Authority : Ministry of Environment, Forests & Climate Change
Quarter – III(July, 2018 to Sept., 2018)
Year: 2018

Mode Insert : Status : New Return

		Progress during the month				
	Opening Balance as on beginning of qtr.-III	No. of applications received as transfer from other PA's U/S 6 (3)	Received during the Quarter (including cases transferred to other Public Authority)	No. of cases transferred to other PA's U/S 6 (3)	Decision where requests/ appeals rejected .	Decision where requests/ appeals accepted
Requests	00	07	01	Nil	Nil	06
First Appeals	Nil	Nil	Nil	Nil	Nil	Nil

No. of CAPIO's designated	No. of CPIOs designated	No. of AA's designated
01	01	01

Block II (Details about fees collected, Penalty imposed and disciplinary action taken)			
Registration Fee collected (in Rs.) U/s 7(1)	Additional fees collected (in Rs.) U/s 7(3)	Penalties Amount recovered (in Rs.) as directed by CIC U/s 20(1)	No. of cases where disciplinary action taken against any officer U/s 20(2)
10/-	12/-	Nil	Nil

Block III (Details of various provisions & while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1) -										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the commission)- NA			
S. No.	Reference no. of cases wherein commission made specific recommendation as per sec.25(5)	Where action is initiated to comply with recommendation of Commission .	Details thereof (Max. 250 chars.)
		-Select-	
		-Select-	
		-Select-	
		-Select-	
If the public authority made any changes in regard to its rules/regulations/procedure as a result of requested information by the citizens, please provide the summarized details of the changes (Max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the website of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General information uploaded	Sh. Rajesh Meena	Technical Assistant C/o IT-Cell of the Institute

09/10/18
(Kailash Chand Gupta)
Public Information Officer,
AFRI, Jodhpur

RTI Annual Return Information System
Quarterly Return Form

Public Authority : Ministry of Environment, Forests & Climate Change
Quarter – IV (Oct., 2018 to Dec., 2018)
Year: 2018

Mode Insert : Status : New Return

		Progress during the month				
	Opening Balance as on beginning of qtr.-IV	No. of applications received as transfer from other PA's U/S 6 (3)	Received during the Quarter (including cases transferred to other Public Authority)	No. of cases transferred to other PA's U/S 6 (3)	Decision where requests/ appeals rejected .	Decision where requests/ appeals accepted
Requests	04	12	09	Nil	Nil	25
First Appeals	Nil	Nil	Nil	Nil	Nil	Nil

No. of CAPIO's designated	No. of CPIOs designated	No. of AA's designated
01	01	01

Block II (Details about fees collected, Penalty imposed and disciplinary action taken)			
Registration Fee collected (in Rs.) U/s 7(1)	Additional fees collected (in Rs.) U/s 7(3)	Penalties Amount recovered (in Rs.) as directed by CIC U/s 20(1)	No. of cases where disciplinary action taken against any officer U/s 20(2)
50/-	04/-	Nil	Nil

Block III (Details of various provisions & while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1) -										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the commission)- NA			
S. No.	Reference no. of cases wherein commission made specific recommendation as per sec.25(5)	Where action is initiated to comply with recommendation of Commission .	Details thereof (Max. 250 chars.)
		-Select-	
		-Select-	
		-Select-	
		-Select-	
If the public authority made any changes in regard to its rules/regulations/procedure as a result of requested information by the citizens, please provide the summarized details of the changes (Max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the website of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General information uploaded	Sh. Rajesh Meena	Technical Assistant C/o IT-Cell of the Institute

09/01/2019
(Kailash Chand Gupta)
Public Information Officer,
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Research publications

Sr. No.	Foreign Journals
1.	Mala Rathore (2019). Potential of leaf protein concentrates from arid plants for human nutrition. Int. J. Current Advanced Research .8(2B), 17216
2.	Mala Rathore. (2019). Biochemical responses in leaves of healthy & infected khejri trees to infestation. Int. J. Agr. & Bio. Res .35, 68
3.	Sharma,S.K., Arya,I.D., Tewari,S., Arya,S. and Yadava, M.P.S. 2018. Clonal plantations play a key role to increase agroforestry production enriching farm communities: Indian experiences. Forestry research and Engineering: International Journal, 2(6): 306-311.

Sr. No.	National Journals
1.	Research Paper entitled "Factors affecting Rooting Potential in Stem Cuttings of *Ailanthus excelsa* Roxb." L.S. Saini, T.R. Rathore, S.K. Rajput and U.K. Tomar* (Communicated in Indian Forester)
2.	B. Singh, **G. Singh** and T.S. Rathor (2018). The Effects of Woody Hosts on *Santalum Album* L. Tree Growth under Agroforestry in Semi.
3.	**G. Singh**, P.R. Nagora, Deepak Mishra, Parul Haksar, Sneha Gola and Taipy Dandapath (2018). Influence of human, livestock population and land use systems on soil characteristics and soil organic carbon stock in western Rajasthan. *Annals of Arid Zone*, **57**(3&4): 97.
4.	Baloch, S.R., Limba, N.K. and Khan, A. (2018). Livelihood of local communities Forest Resources Dependency in Forest Fringe Villages of Pali District, Rajasthan, India. ACME Intellects International Journal of Research Management Social Science & Technology, 22: 18.
5.	VP Tewari and Bilas Singh (2018). Total Wood Volume Equations for *Tectona grandis* Linn F. Stands in Gujarat, India. *Journal Forest and Environmental Science*, 34 (4): 313-320.https://doi.org/10.7747/JFES.2018.34.4.313.
6.	Mala Rathore. (2018). Variation in nutritional value of *Grewia tenax* fruits from different regions of Rajasthan, India. J of Phytology.10, 12-14.
7.	Choudhary, M.,Gehlot, A., Arya I.D. and Arya,S. 2018. Influence of different auxin treatment on *ex vitro* rooting and *in vitro* regenerated microshoots of *Terminalia arjuna* (Arjun). Journal of Pharmacognosy and Phytochemistry. 7(5):3019-3082.
8.	Mishra B, Kant T. A simple, inexpensive, scalable and low maintenance hydroponics system for growing halophyte: *Lepidium sativum* L. (Brassicaceae), ideal for manipulating salt stress and inferring gene expression levels. *I. J. Plant Physiol.*23(4): 760–771 (Springer). DOI: 10.1007/s40502-018-0422-4.
9.	Bhatnagar, S., Khan A.U., Vishnoi, G., Rathore, L. S., Kumar, Bundesh, and Singh, S. 2018. Inflorescence gall problem of *Prosopis cineraria* in Rajasthan. Plant Archives, Vol. 18 No.2 October.

Sl. No.	Chapter in Books/proceedings
1.	Singh, G. (2018). Traditional agroforestry systems for global warming adaptation in Arid Rajasthan. In: Climate Change and Agroforestry, Pandey, C. B., Gaur, M. K. and Goyal, R. K. (Eds.), pp. 325-344, New India Publishing Agency, New Delhi.
2.	G.Singh and D.K. Mishra (2018). Compensatory Afforestation in Rajasthan: An Evaluation.

	Scientific Publisher (India), Jodhpur. 570p.
3.	Ashwani Kumar, G. Singh and U.K. Tomar (2019). A Monograph on Marwar Teak (*Tecomella Undulata* (Sm.) Seem). Bishen Singh Mahendra Pal Singh, Dehradun. 237p (In press).
4.	Sangeeta Singh, Shiwani Bhatnagar, Sunil Choudhary, Bindu Nirwan, Kuldeep Sharma and N.K. Bohra. Fungi as Bio control agent: an alternate to chemicals. Book chapter submitted for publication in book entitled "Fungi and their Role in Sustainable Development: Current Perspectives", Editors- Praveen Gehlot and Joginder Singh. Published by Springer Nature Singapore Pte Ltd. Pp 23-33. https://doi.org/10.1007/978-981-13-0393-7_2

Sl. No.	**Article presented**
	--NIL--

Sl. No.	**Abstract published**
1.	Bilas Singh, G. Singh and Mahipal Bishnoi (2019). Paper presented in the 13th International Conference on "Development of Drylands: Converting Dryland Areas from Grey into Green" at CAZRI, Jodhpur INDIA during February 11-14, 2019. Title of presentation was **"**Effects of *Acacia nilotica* trees on arable crops production and soil fertility in different agro climatic zones of Rajsthan". Abstract pp 93.
2.	Bilas Singh (2018). Volume equations for *Prosopis cineraria* plantation in the IGNP area in hot arid region of Rajasthan, India. Abstract published in 14th National Silvicultural Conference - Forest & Sustainability: securing a common future. Indian Institute of Wood Science and Technology, Bengaluru. 03-05 December 2018. pp 92.
3.	Maheshwar T Hegde 2018. Growth performance of Red Sanders (*Pterocarpus santalinus* L. f) outside natural forests and under plantation across various climate and edaphic conditions. 14th National Silvicultural Conference Forest & Sustainability: Securing a Common Future December 03-05 2018. Institute of Wood Science and Technology Bengaluru. Abstracts P 29.
4.	N.K.Bohra, A.Durai and Maheshwar T.Hegde 2019. Performance of Sandalwood under Various Agri Models in Rajasthan and Gujarat. National workshop on Securing Wood Demand through Enhancing Productivity of planted Forests held at IFGTB, from 29-30th January. P111
5.	Arya, S., Kanwar, N., Kataria, V. and Arya, I.D. 2019. Establishment of efficient *in vitro* regeneration protocol of *Leptadenia reticulata*: A threatened medicinal plant. International Conference on Trends in Plant Sciences and Agrobiotechnology. IIT Guwahati, Feb 14-16, pp. 181.
6.	Desha Meena, Aastha Sharma and Anil Singh. Preliminary screening of SCoT primers for differentiating the three flower color morphotypes of *Tecomella undulata* to be held on 3-7 January, 2019 organized by 106th Indian Science Congress in Agriculture and Forestry Section at LPU, Jhalandar, Punjab.
7.	Mala Rathore and Hemant Kumar (2018). *Haloxylon salicornicum* - A Source of Nutrition in Arid Rajasthan. Abstract published in 2nd International conference on Advances in Agricultural, Biological and Applied Sciences for Sustainable Future (ABAS-2018)' held at Swami Vivekanand Subharti University, Meerut, on October 20-22, pg.58.

8.	Mala Rathore and Sonali Bhagat (2018).Influence of different drying methods on nutritional quality of Important Arid Zone Fruits (Kair & Sangri). Abstract published in Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2018) held at Rajasthan Agricultural Research Institute, Durgapura, Jaipur, on 28–30 October, pg. 38.
9.	Mala Rathore, Sonali Bhagat and Hemant Kumar (2018). *Effect of different storage containers on the quality of kair and Sangri* Abstract published in International seminar on Recent Trends and Experimental approaches in Science, Technology , Nature & Management, held at FDDI, Jodhpur, 23rd – 24 December
10.	Mala rathore & Sonali Bhagat (2019). Processing, Preservation and Value Addition of Capparis decidua fruits for their improved utilization in western Rajasthan. Abstract published in 13th International Conference on Development of Drylands held at CAZRI, Jodhpur on Feb 11-14, pg. 284.
11.	Bilas Singh, G. Singh and Mahipal Bishnoi (2019). Effects of *Acacia nilotica* trees on arable crops production and soil fertility in different agro climatic zones of Rajasthan". Abstract pp 93. Paper presented in the 13th International Conference on "Development of Drylands: Converting Dryland Areas from Grey into Green" at CAZRI, Jodhpur India. 11-14 Feb., 2019.

Sl. No Popular articles:

1. बिलास सिंह (2016). गुजरात राज्य में सागौन वृक्षारोपण में उत्पादकता अध्ययन तथा वृद्धी एवं उपज प्रतिरूपण । आफरी दर्पण 14(1 – 2) : 1-2 .
2. बिलास सिंह एवं जी. सिंह (2017). राजस्थान के शुष्क क्षेत्रों में संसाधनों के प्रबंधन से कृषि वानिकी प्रणाली के उत्पादन में वृद्धी। आफरी दर्पण 15 (1-2): 4-5 ।
3. संगीता त्रिपाठी (2018): हरित कौशल विकास प्रशिक्षण कार्यक्रम; आफरी दर्पण; जुलाई – सितम्बर , 2018
   संगीता त्रिपाठी (2018): राजस्थान के पाली जिले के सोजत में ग्रामीण आजीविका में नीम का योगदान; आफरी दर्पण; जुलाई-सितम्बर, 2018 ।
4. इमली का मूल्य संवर्द्धन एवं ग्रामीण अर्थव्यवस्था में उसका योगदान, राजभाषा वैज्ञानिक संगोष्ठी, रक्षा प्रयोगशाला, जोधपुर, 14-15 मार्च, 2019 :पाठ संख्यां 14 ।
5. कुमार, सीमा. 2019 राजस्थान की वानिकी पौधशालाओं के हानिकारक जीव जंतु एवं उपयुक्त कीट प्रबंधन, स्मारिका, राजभाषा प्रकाशन एवं जन संपर्क अनुभाग, डिफेन्स प्रयोगशाला, जोधपुर. पीपी. 11-12.

Sl. No	Books
1	--Nil--