# Annual Report
## 2021-22


# Arid Forest Research Institute

**P.O. Krishi Upaz Mandi, New Pali Road, Jodhpur-342005**
Web: afri.icfre.gov.in e-mail: dir_afri@icfre.org

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# ARID FOREST RESEARCH INSTITUTE, JODHPUR

## Annual Report 2021-22

## Overview

AFRI has productively executed both plan as well as externally funded projects of different funding agencies of Government of India. During 2021-2022, significant progress was made in the one plan projects and one externally funded projects that were ongoing. Out of this, three plan projects and one externally aided project (funding agency: NMPB) have been successfully completed, whereas five new projects (3 SFD CMPA funded and each from plan and DBT) were initiated during this period.

Under the theme of "Ecosystem Conservation and Management", a plan project entitled was completed during the financial year that highlighted the importance of plantation of *Eucalyptus camaldulensis* and *Vachellia tortilis*, and maintenance of *E. camaldulensis* regeneration through coppicing in the IGNP canal area. The plantation of these species led to a positive increment in soil properties, including SOC, $NH_4$-N, $NO_3$-N and $PO_4$-P, and a decrease in soil pH. Under the theme of "Forest Productivity", two plan projects were executed during the financial year. The project aimed at studying crop yield, soil fertility and gum production in *Acacia senegal* based traditional agroforestry system in arid region of Rajasthan was completed during the financial year and yielded important findings regarding the tree density most suitable for agroforestry (20–30 trees.ha$^{-1}$) with better growth parameters, gum yield that can be obtained per tree (90–1050 gm per tree) and crops yielding highest economic returns in the Kharif (Pearl millet) and Rabi seasons (cumin). Another project aimed at developing suitable agroforestry models in IGNP command area of Western Rajasthan was initiated wherein agroforestry models were established on farmer's field and parameters including growth and survival of various species, cost of cultivation and soil samples parameters (pH, EC and SOC) were recorded.

Under the theme of "Genetic Improvement" activities pertaining to four projects were undertaken during the financial year. The project aimed at developing technology for non-destructive natural guggulsterone production funded by the external agency NMPB was completed with a successful development of fed batch culture prototype to grow contamination-free guggulsterone-rich callus of *C. wightii* which yielded a 4-fold increase in callus rich in multiple bioactive compounds. In the plan project intended to isolate and clone the vacuolar $Na^+/H^+$ antiporter gene – *NHX1* from *Prosopis juliflora* and *Salvadora persica* and to carry out functional validation of the cloned genes, cDNA was prepared from the extracted RNA while specific gene primers for amplification of the fragment of *PjNHX1*were also optimized. Under one project funded by RFD focused on improving survival rate in Kair *(Capparis decidua)* under field planting conditions by architecting root biomass and *in situ* moisture management, field surveys were conducted in Rajasthan for seed collection of *Capparis decidua*. The procured seeds were then sown in different potting medium and in different sized containers, of which 50% were $GA_3$-treated and other 50% seeds were non-treated. Up to 70% germination was observed in *Capparis* seeds, however, with respect to $GA_3$ treatment, no effect was observed on germination. Another RFD-funded project intended to develop Seed Production Areas (SPAs) of important target tree species of Western Rajasthan, i.e., *Tecomella undulata, Zizyphus mauritiana, Zizyphus nummularia, Salvadora persica*

*and Salvadora oleoides*, was initiated during the year. Field surveys were conducted in Rajasthan under this project for identification of natural plantations of these species.

Under the theme of "Non-Wood Forest Products" progress was accomplished in selection of Candidate Plus Trees (CPTs) of 2 out of 4 target broad-leaved species of Rajasthan. Surveys that were conducted lead to successful selection of 51 CPTs of *Madhuca indica* in MeenTaleti (Sirohi district) and 10 CPTs of *Butea monosperma* in Siyawa (Sirohi District), along with identification of Seed Production Area (SPA) of *Anogeissus pendula* in Bundi district.

The problem of flower gall formation was found to be differential with respect to observed areas, with a higher average no. of flower gall per inflorescence at Phalodi followed by Lohawat in comparison to Osian, Baori and Pipar sites, reducing the pod formation and affecting the yield of sangri. To address the problem of flower gall formation in Khejri, an important species of Rajasthan, under the theme of "Forest Protection", important findings were made towards developing an Integrated approach for controlling this problem. Management trials conducted at these five different sites (done at bud initiation stage) with botanicals, chemicals and entomopathogenic fungi to selected Khejri trees showed that treatments with Abamectin Putranjeeva, Hingota and *Metarhizium* were effective in management of Khejri flower galls. Experiments were also conducted on the efficacy of Tree pal and Crawl clean on seed insect pest bruchid *Caryedon serratus* and *Patialus tecomella* insect pest of *Tecomella undulata*. Additionally, insect pollinator diversity was assessed on the marked transect in Sitamata Santuary using crown trap, light trap and yellow pan trap. Work was also conducted to study the disease incidence of two major pathogens of Shisham across Rajasthan and Gujarat and samples were collected for isolation of these pathogens. Soil samples of healthy tree (CPTs) were also collected and geo-location recorded. *Trichoderma* isolates were prepared to study their antagonistic effect on pathogens.

Out of 31 All India Coordinated Research Projects (AICRP) and one National Programme on Conservation and Development of Forest Genetic Resources (FGR), sanctioned to ICFRE and its institutes, AFRI is a part of a total 22 AICRPs as well as in FGR programme and has been carrying out relevant research under the programmes. Among all, two AICRPs (AICRP-24 and AICRP-26) are being implemented by AFRI, Jodhpur based NPCs.

During the financial year, a major accomplishment was made in the form of release of three clones (AFRI-DS-1, AFRI-DS-2 and AFRI-DS-4) of *Dalbergia sissoo* for commercial cultivation in semi-arid agro-ecological belt in Gujarat. These are fast-growing and are fairly tolerant to diseases and insect pests. They are expected to give at least 60–75% better timber yield, thus providing an additional income of ₹ 50,000 per year to the farmers as compared to planting unimproved planting stocks. AFRI successfully established high-tech nurseries atVVKs in Bichhwal, Bikaner (Rajasthan), Kalka Mata Nursery, Udaipur (Rajasthan), Chhipardi Beedi, Rajkot (Gujarat) and Rudana Nursery, Khanwel, Silvasa (Dadra & Nagar Haveli and Daman). Various training programmes were also organized at these VVKs for farmers and field functionaries. Production of Neem compost by collecting fallen leaves was done and it was distributed to end users. Also, as a routine, a number ofspecies were produced at AFRI nursery for providing QPM to various stakeholders. Extension programmes focusing on demonstration on value addition in form of making herbal gulal and jam from some underutilized non-timber forest products were also arranged. The beneficiaries included the SHGs, villagers and NGOs in tribal areas of Sirohi district. They were provided training on the practices of making herbal gulal from *Butea monosperma* and jam from *Diospyros melanoxylon*.

Various trainings, workshops and webinars were organized on various themes and topics for the benefit of scientists, technical staff and project fellows. Several notable meetings were organized to dwell on important matters such as the establishment of VVKs and Demo Village, signing of MoUs, progress of projects and appraisal of new projects. A total of 44 booklets, posters & pamphlets were published at AFRI, Jodhpur. Total 33 of workshops/ seminars/ conference, etc., were attended by scientific staff of the institute. Several scientists submitted abstracts and posters in conferences and their abstracts were published in the abstract books of the respective workshop/seminar/conference. A total of 19 abstracts and 06 papers were published in reputed national and international journals, respectively.

## Summary of the projects

| Projects | Completed Projects | Ongoing Projects | New Projects Initiated During 2021-22 |
|---|---|---|---|
| **Plan** | 3 | 1 | 1 |
| **Externally Aided** | 1 | 1 | 4 |
| **Total** | 4 | 2 | 5 |

# 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 and 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 and 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.

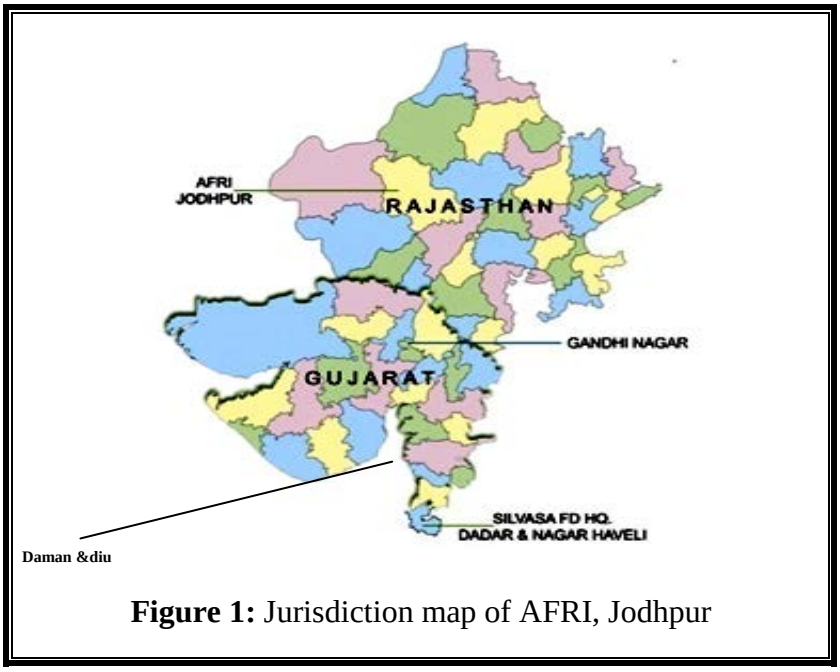


**Figure 1:** Jurisdiction map of AFRI, Jodhpur

## MoUs signed

1. MoU between AFRI & RFD to collaborate in applied research programs, capacity building and knowledge sharing on forests, biodiversity conservation, ecosystem, climate change vulnerability, climate change mitigation and adaption and livelihood of forest dependent communities.
2. MoU between AFRI & iCED to collaborate in applied research, programs, capacity building and knowledge sharing on forests, biodiversity conservation, ecosystem, climate change vulnerability, climate change mitigation and adaption, organizing joint seminars, workshops, conferences and sharing research publications.

3. MoU between AFRI and VGU for collaboration and promotion of basic and advance research in subject of Forestry, Botany, Zoology, Chemistry, Environmental Science and other allied subjects.
4. MoU between AFRI and JNVU, Jodhpur for collaboration and promotion of basic and advance research in subject of Forestry, Botany, Zoology, Chemistry, Environmental Science and other allied subjects.
5. MoU between AFRI and Rawta Ram under the project "Development of suitable agroforestry modes in IGNP command area of western Rajasthan".
6. MoU between AFRI and Sonu handicrafts for testing of potential biopesticides compounds from unexplored tree borne oil seeds and different tissues of potential wild plants through lab and field analysis
7. MoU between AFRI & DFO, Udaipur, RFD to establish VVK for promotion and extension of appropriate research by organizing training camp and demonstrations trials, field trials, establishment of nursery, etc.
8. MoU between PI (AICRP 24) and DFO, Bikaner for plantation on reactivated sand dune (12 ha. Area) at Udasar, Nokha range, Bikaner Forest Division.
9. MoU between Co-PI (AICRP -24) and DFO, Jaisalmer for plantation on degraded land (15 ha. area) at Karah Jhod range, Jaisalmer Forest Division
10. MoU was signed between PI (AICRP 17) and DFO, Pali, Rajasthan and Social Forestry Division Sabrakantha, Gujarat for plantation on forest land (2 ha each).
11. MoU between AFRI and Amity Food and Agriculture Foundation (Amity University Uttar Pradesh) for quantitative estimation of Azadirachtin content from *Azadirachta indica* (Neem) seeds (AICRP 26).

## Visit of dignitaries

1. Professor P.C. Trivedi, Vice-Chancellor of JNVU, Jodhpur visited AFRI on 27th July, 2021.
2. Sh. Arjun Ram Meghwal, Hon'ble Union Minister of State for Parliamentary Affairs & Culture, Govt. of India, visited AFRI, Jodhpur on 14th October, 2021.
3. Shri Sukhram Bishnoi, Hon'ble State Minister for Forest and Environment, Govt. of Rajasthan visited AFRI on 9th November, 2021.

## New initiatives

1. Development of seed production areas of economically important tree species of Rajasthan. PI: Dr. Desha Meena, Scientist C
2. Improvement of Survival Rate in Kair (*Capparis decidua*) under field planting conditions by architecting root biomass and in situ moisture management. PI: Dr. M.T. Hegde, Scientist F
3. Survey and Selection of Candidate Plus Trees and Identification of Seed Production Areas for Broad leaved Species of Rajasthan. PI: Smt. Sangeeta Tripathi, CTO

**RRCs organized:** Nil

# 2. Research Highlights

## A. CAMPA Activities

***Institutes are requested NOT TO INCLUDE progress made under CAMPA; progress will be obtained from Research and Planning Division, ICFRE.***

## B. Plan and External Projects

## 2.1 Ecosystem Conservation and Management

### 2.1.1 Overview

Under the theme of "Ecosystem Conservation and Management", a plan project entitled was completed during the financial year. The project was aimed at assessing the impact of harvesting on soil nutrients and carbon stock in canal side plantations of Indira Gandhi Nahar Pariyojana. This project highlighted the importance of plantation of two species, i.e., *Eucalyptus camaldulensis* and *Vachellia tortilis*, in the IGNP canal area. The plantation of these species exerted a positive impact on soil conditions via enhancement of SOC, NH4-N, NO3-N and PO4-P along with a decrease in soil pH as compared to those in the control plots. The project also underlined the importance of maintaining *E. camaldulensis* regeneration through coppicing as coppices have significantly higher rate of carbon sequestration as compared to the main crop.

#### 2.1.1.1 Projects under the Theme

| Projects | Completed Projects | Ongoing Projects | New Projects Initiated During the Year |
|---|---|---|---|
| Plan | 1 | - | - |
| Externally Aided | - | - | - |

### 2.1.2 Climate Change: Nil

### 2.1.3 Ecology& Environment:

**<u>Project 1:</u> Impact of harvesting on soil nutrients and carbon stock in canal side plantations of Indira Gandhi Nahar Pariyojana (ICFRE Funded Project)**

**PI: Dr. G. Singh, Scientist G (Retd.)**

This project aimed at studying the impact of tree 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 the plantations.

Ten plots of 0.1 ha area (five each for *E. camaldulensis* and *V. tortilis*) were laid out and five trees of different girth classes were harvested from each plot after enumerating and categorizing the trees into different girth classes. Harvested trees were measured for diameter at breast height (DBH) and total height (H) and fresh biomasses of stem (SB), branches (BB), and leaves (LB) were recorded at site. Dry biomasses were recorded after oven drying the samples in laboratory and total above-ground biomass (AGB) was taken as sum of dry biomasses of stem, branches and leaves. Soil samples were also collected in 0-25 cm, 25-50 cm and 50-75 cm soil layers in 2018, 2019, 2020 and 2021. This was to develop species-specific regional allometric models for estimating standing AGB, SB, BB, and leaf biomass (LB) of these species and assessing impacts of plantations and its harvesting on soil bulk density, soil water content and depletion in soil carbon stocks and nutrients. Different linear and non-linear models were fitted to establish relationship between dry biomasses of different components of *E. camaldulensis* and *V. tortilis* trees with diameter at breast height (DBH) and total height (H). Best allometric equations were selected based on the model performance

statistics. Although status of SOC and nutrients were low to moderate, but plantation of these species showed positive impact on soil conditions by enhancing SOC, NH4-N, NO3-N and PO4-P and decrease in soil pH as compared to those in the control plots. Soil nutrient status was high under *E. camaldulensis* as compared to the soil under *V. tortilis*. Coppice of *E. camaldulensis* produced only 23.1% of the biomass of the main crop, but rate of carbon sequestration in these coppice were 12.65 Mg C ha-1 year-1 in 39 months old and 10.41 Mg C ha-1 year-1in 28 months old coppice, that was significantly higher than the rate of carbon sequestration in main crop (5.36 Mg ha-1 year-1) and highlights the importance of maintaining *E. camaldulensis* regeneration through coppice.

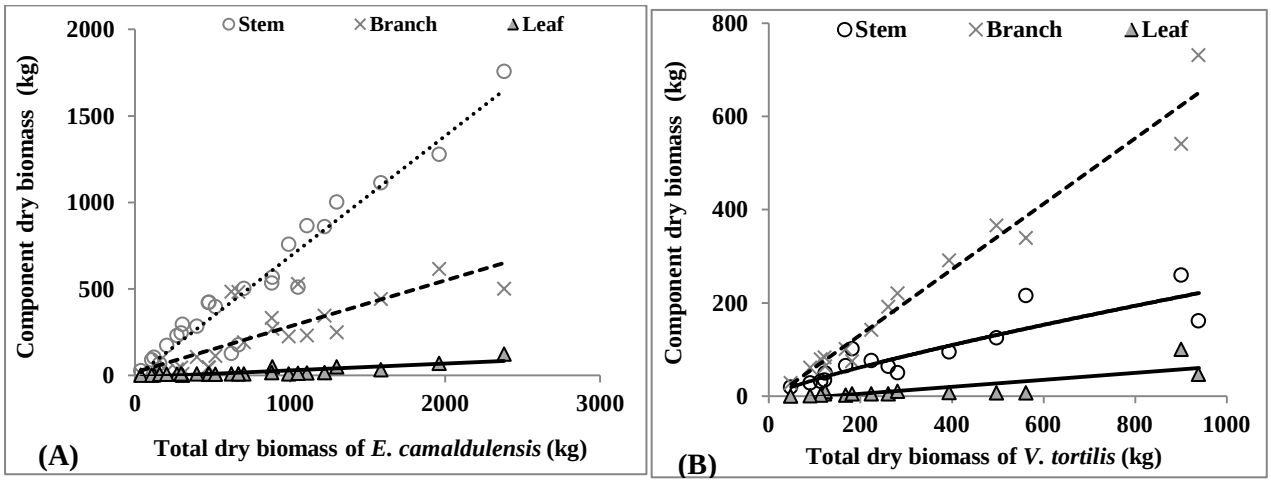


**Figure 2:** Biomass allocation in stem, branches and leaf & twigs in relation to total biomass in *E. camaldulensis* (A) and *V. tortilis* (B).

### 2.1.4 Biodiversity : Nil

### 2.1.5 Forest Botany : Nil

### 2.1.6 Tribals and Traditional Knowledge System : Nil

## 2.2 Forest Productivity

### 2.2.1 Overview

Under the theme of "Forest Productivity", two plan projects were executed during the financial year. One project was aimed at studying crop yield, soil fertility and gum production in *Acacia senegal* based traditional agroforestry system in arid region of Rajasthan. This project was completed during the financial year and yielded important findings regarding the tree density most suitable for agroforestry, gum yield per tree and crops yielding highest economic returns in the Kharif and Rabi seasons. Tree density of 20-30 trees.ha$^{-1}$ was found most suitable as it was associated with greatest height and DBH of *A. Senegal* trees with a non-significant crop yield reduction as compared to other tree densities. However, with respect to the canopy cover, there was a 772m$^2$.ha$^{-1}$ reduction at this tree density. Additionally, gum yield was found to range between 90 and 1050 gm per tree. Highest economic returns were provided by Pearl millet and cumin-based agroforestry systems in Kharif and Rabi season, respectively, both under irrigated conditions. Another project aimed at developing

suitable agroforestry models in IGNP command area of Western Rajasthan was initiated for which site selection and MoU signing with farmers was done. Thereafter, different agroforestry models were established on farmer's field and some maintenance activities were undertaken on site. Parameters including growth and survival of various species, cost of cultivation and soil samples parameters (pH, EC and SOC) were recorded.

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

| Projects | Completed Projects | Ongoing Projects | New Projects Initiated During the Year |
|---|---|---|---|
| Plan | 1 | 1 | - |
| Externally Aided | - | - | - |

### 2.2.2 Silviculture : Nil

### 2.2.3 Social Forestry, Agro-forestry/ Farm Forestry :02

**<u>Project 2:</u> Study on crop yield, soil fertility and gum production in *Acacia senegal* based traditional agroforestry system in arid region of Rajasthan (ICFRE Funded Project)**

**PI: Dr. Bilas Singh, CTO**

Sample plots of tree densities viz10-20, 20-30 and 30-40 tree.ha$^{-1}$ were laid out at nine sites on farm land in Sheregarh in Jodhpur, Jakhara (Bayatu) and Lilsar (Chohtan) in Barmer district and three sites on farm boundary in Didwana, Nagaur District.

Height and DBH of *A. senegal* tree were significantly ($p< 0.05$) greater at 20-30 trees.ha$^{-1}$ as compared to the other tree densities. Crop yield reduction did not differ between tree densities. However, when compared with total canopy cover (m$^2$.ha$^{-1}$), crop yield reduction was significantly low at canopy cover 544 m$^2$.ha$^{-1}$ (10-20 trees.ha$^{-1}$) as compared to canopy cover 772 and 1298 m$^2$.ha$^{-1}$ at higher tree density of 20-30 and 30-40 trees.ha$^{-1}$,respectively.

Gum yield ranged between 90 and 1050 gm per tree. Economic return was highest for Pearl millet (Rs. 28688.ha$^{-1}$) under irrigated condition and was lowest (Rs. 2360.ha$^{-1}$) in rainfed condition in Kharif season. In Rabi season, economic return was Rs. 18742-29581.ha$^{-1}$in cumin-based agroforestry system in irrigated condition. Seed production of *A. senegal* was 0.100-1.10 kg.tree$^{-1}$.


**Figure 3:** *A. senegal*-based traditional agroforestry system in arid region of Rajasthan. Intercropping of Mustard with *A. senegal* on farmers land in Barmer (A); Collection of gum of *A. senegal* by a farmer in Barmer (B).

**<u>Project 3:</u> Development of suitable agroforestry models in IGNP command area of Western Rajasthan (ICFRE Funded Project)**

**PI: Dr. Bilas Singh, CTO**

Three sites were selected on farmers land in IGNP command area, Bandha, Ramgarh, Jaisalmer**.** MoU was signed with the two farmers**.** Block plantation of Agri-silvi (2 ha), Agri-horti (1.5 ha) and Boundary plantation (300 RM) model on farmer's field were done and it were maintained through irrigation, soil working, weeding, anti termite treatment etc. Growth and survival were recorded. Survival recorded *Prosopis cineraria* (99%) and *Tecomella undulata* (99%) in Agri-silvi model whereas survival was 91% *Cordia myxa* and 89% grafted *Zizyphus moritiana* in Agri-horti model. Cost of cultivation was recorded from the farmers. Soil samples were collected for analysis. Collected soil samples analysed like pH, EC and SOC.

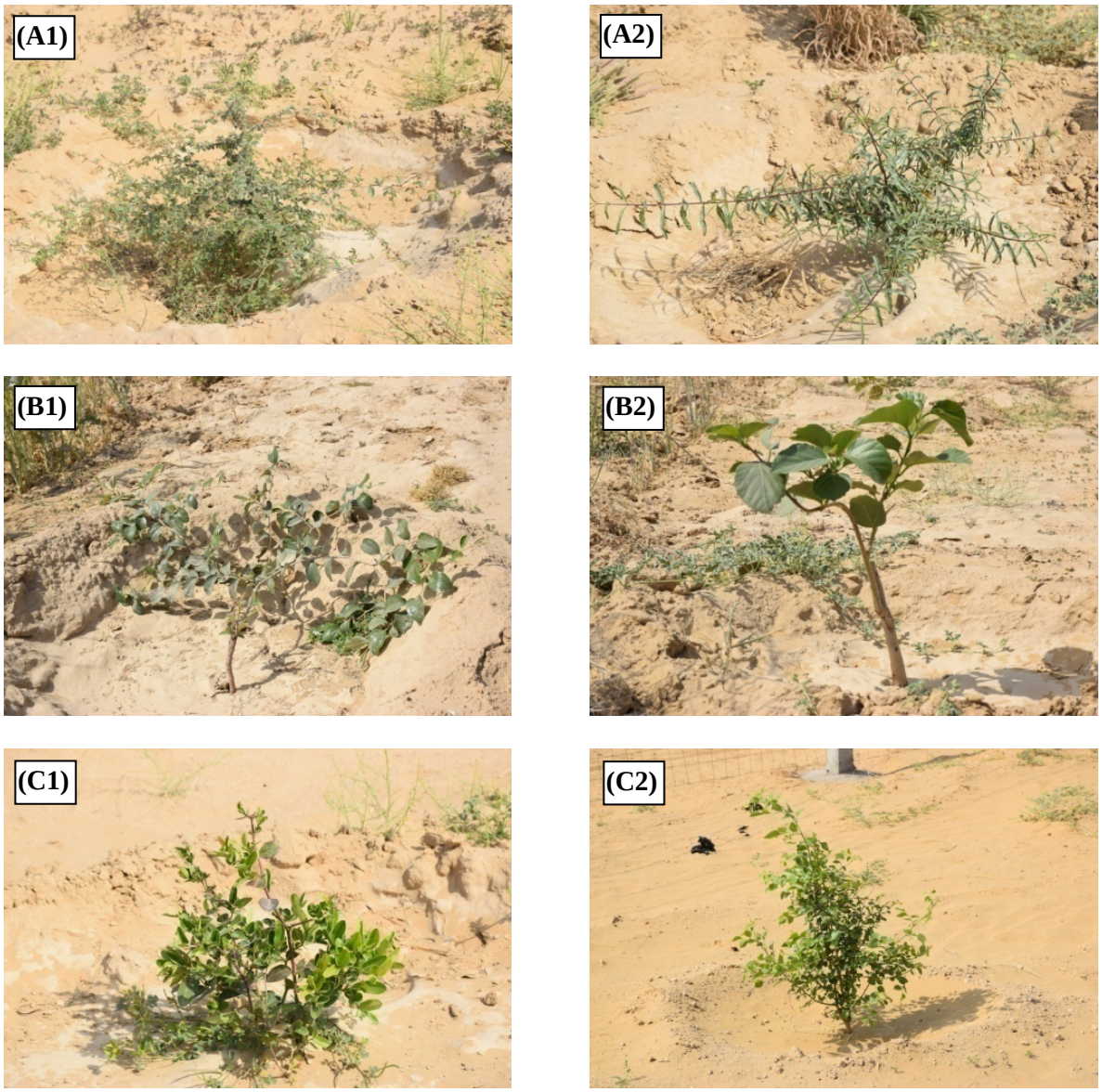


**Figure 4:** Species planted in Agri-silvi, Agri-horti and Boundary plantation models: *Prosopis cineraria* (A1), and *Tecomella undulata* (A2) in Agri-silvi model; *Zizyphus mauritiana* (B1) and *Cordia myxa* (B2) in Agri-horti; and *Carissa carandas* (C1) and *Dalbergia sissoo* (C2) in Boundary plantation at RMM, Ramgarh, IGNP command area, Jaisalmer.

### 2.2.4 Forest Soils & Land Reclamation:Nil

### 2.2.5 Watershed Management :Nil

## 2.3 Genetic Improvement

### 2.3.1 Overview

Under the theme of "Genetic Improvement" activities pertaining to four projects were undertaken during the financial year. In the plan project intended to isolate and clone the vacuolar $Na^+/H^+$ antiporter gene – *NHX1* from *Prosopis juliflora* and *Salvadora persica* and to carry out functional validation of the cloned genes via transgenic approach, some major achievements were made. RNA

was successfully extracted, quantified and checked for purification. cDNA was prepared from the extracted RNA and stored for future objective. Optimization of specific gene primers for amplification of the fragment of *PjNHX1* was done. In the project aimed at developing technology for non-destructive natural guggulsterone production funded by the external agency NMPB, in the final year of the project a fed batch culture prototype was developed to grow contamination-free guggulsterone-rich callus of *C. wightii* and yielded a 4-fold increase in callus rich in multiple bioactive compounds. Two projects were funded by Rajasthan Forest Department. One project was focused on improving survival rate in Kair *(Capparis decidua)* under field planting conditions by architecting root biomass and *in situ* moisture management. Under this, field surveys were conducted in Rajasthan for seed collection of *Capparis decidua*. The procured seeds were then sown in different potting medium and in different sized containers, of which 50% were $GA_3$-treated and other 50% seeds were non-treated. Up to 70% germination was observed in *Capparis* seeds, however, with respect to $GA_3$treatment, no effect was observed on germination. Another RFD-funded project intended to develop Seed Production Areas (SPAs) of important target tree species of Western Rajasthan, i.e., *Tecomella undulata, Zizyphus mauritiana, Zizyphus nummularia, Salvadora persica and Salvadora oleoides*, was initiated during the year. Field surveys were conducted in Rajasthan under this project for identification of natural plantations of these species.

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

| Projects | Completed Projects | Ongoing Projects | New Projects Initiated During the Year |
|---|---|---|---|
| Plan | - | 1 | - |
| Externally Aided | 1 | 1 | 1 |

### 2.3.2 Conservation of Forest Genetic Resources

**Project 4: Improvement of Survival Rate in Kair *(Capparis decidua)* Under Field Planting Conditions by Architecting Root Biomass and *in situ* Moisture Management (Rajasthan Forest Dept. Funded Project)**

**PI: Dr. M.T. Hegde, Scientist-F**

Field survey was carried out in 3 districts viz., Jaisalmer, Barmer and Nagour of Rajasthan for seed collection of *Capparis decidua*. The survey was continued in the month of February and March 2022 in 6 districts Jodhpur, Nagour, Bikaner, Pali, Jalore and Sirohi. Seeds have been collected from Jodhpur, Jaisalmer and Barmer.

RET (Root Elongation Tube) filled with different potting medium was prepared and seeds were sown in 150cc, 300cc, 500cc and root trainer extenders for these sizes, polybags 15 × 20cm and 20 × 25cm and 14.5” pots have been used as containers in nursery.

Seeds have been sown in different sized containers in AFRI nursery with 7 different treatments. The 50% seeds were $GA_3$ treated and other 50% seeds were non-treated. Data on germination are being recorded. There was no effect of $GA_3$ on germination. Up to 70% germination was observed in *Capparis* seeds.

### 2.3.3 Tree Improvement: Nil

### 2.3.4 Vegetative Propagation : Nil

## 2.3.5 Biotechnology

**Project 5: Cloning and Characterization of Salt Tolerance Conferring Vacuolar $Na^+/H^+$ Antiporter (*nhx*1) Genes from *Prosopis juliflora* (Sw.) DC. & *Salvadora persica* L. (ICFRE Funded Project)**

**PI: Dr. Tarun Kant, Scientist-F**

***Overview:***The Project intends to isolate and clone the vacuolar $Na^+/H^+$ antiporter gene – *NHX1* from *Prosopis juliflora* and *Salvadora persica* and to carry out functional validation of the cloned genes via transgenic approach. The antiporter in responsible to maintain $Na^+$ homeostasis (ion balance) in cytosol in the absence of which the plant cannot survive high salt concentration in soil solution.

***Achievement:*** RNA extraction from leaves of *Prosopis juliflora* and *Salvadora persica* have been achieved. Quantification of extracted RNA have been done, the yield of RNA ranged between 2 to 4 µg per 100 mg of fresh sample and the absorption ratio (A260/280) was 1.98 (close to ratio for pure RNA). cDNA have been prepared from RNA and stored for future objective. Actin primer were used as positive control and found to amplify the fragment of actin gene from *P. juliflora* and generated a band of 201 bp. Optimization of five specific gene primers has been done using Primer Blast. The designed primers were found specific for *NHX1* gene of *Prosopis juliflora*. These primers have been tested on cDNA of *P. juliflora* performing PCR. Out of five, four primers were found to amplify the fragment of *PjNHX1* gene, after agarose gel electrophoresis generated expected size-specific band.

***Benefits of the research project***: This work will lead to deciphering of complete gene sequence of vacuolar*NHX1* antiporter of *Prosopis juliflora* (*PjNHX1*) and *Salvadora persica* (*SpNHX1*). It will lead to development of the binary vector for plant transformation with *PjNHX1 as well as SpNHX1* gene constructs, which can be used for genetic improvement of crop plants through transformation approach in the future and will aid the ongoing genetic improvement effort to grow plants with higher productivity even under abiotic stresses conditions like salinity.

**Project 6: 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 (NMPB funded)**

**PI: Dr. Tarun Kant, Scientist-F**

***Overview***: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. Technology for non-destructive natural guggulsterone production is not yet fully optimized, but has great potential. The project envisages *In vitro* production of guggulsterone-rich cell biomass from plant source in a bioreactor format enabling up-scalability of the technology once standardized.

***Achievements:*** In the final year of the project a fed batch culture prototype was developed to grow the callus of *C. wightii*. A 4 litre glass vessel was used as the culture vessel to develop the prototype and callus culture conditions were optimized to grow contamination free cultures. Callus was initiated on Gamborg's B5 medium containing 0.5mg/l 2,4-D then callus was transferred to

hormone-free B5 medium to induce embryogenesis. To obtain embryonic callus for guggulsterone production, ~ 6 gms of non-embryogenic callus was placed on a circular disc in the vessel containing hormone-free Gamborg's B5 medium. Dried sample was added to the soxhlet apparatus for extraction of secondary metabolites and further HPLC and GC-MS analysis. The HPLC analysis of samples from natural population showed that leaf samples contain guggulsterone E (3.12 µg/g) and stem samples contain both guggulsterone E and Z (60.99 µg/g and 353.32 µg/g respectively). Samples from liquid culture (Hormone free Gamborg's B5) contain guggulsterone Z (2.51 µg/g) and embryogenic callus cultures contain guggulsterone Z (1.03 µg/g). Fed batch culture prototype was found to be good to grow the callus without any contamination and the callus was compact in nature. There was a 4-fold increase in callus by the end of the 60$^{th}$ day of inoculation. GC-MS analysis reveals many compounds in the callus like hexadecanoic acid, methyl ester also known as palmitic acid, 9-octadecanoic acid (Z)-, methyl ester known as oleic acid, 7,10,13-eicosatrienoic acid, methyl ester and hexadecanoic acid,14-methyl,methyl ester.

***Benefits of the research project***: The project has resulted in development of a bioreactors – both liquid and solid type that has the potential for producing guggulsterone-rich cell biomass from guggul plant material, for possible commercial exploitation yet without destroying its dwindling natural populations. And at the same time, it will be helpful in conservation of this critically endangered species.

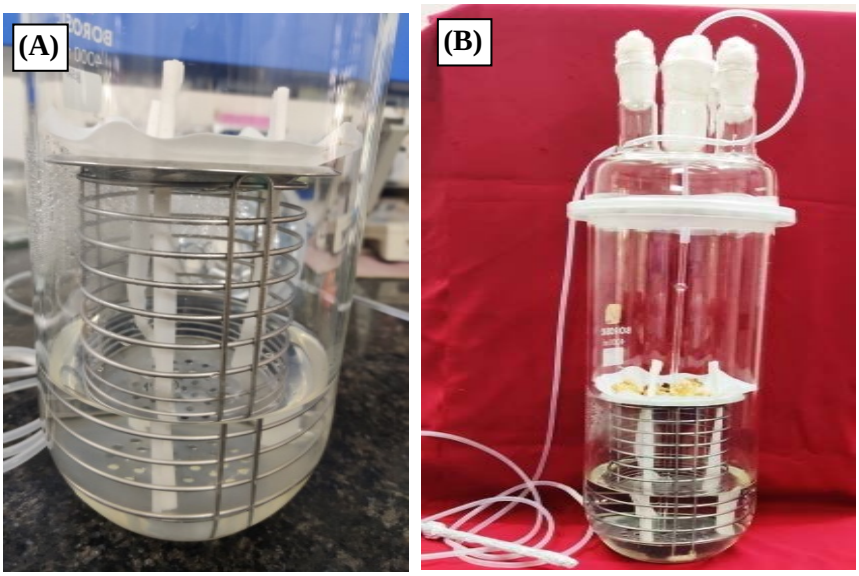


**Figure 5:** Solid state batch-fed bioreactor prototype developed by AFRI for production of guggulsterone-rich cell biomass (A & B).

**<u>Project 7</u>: Development of Seed Production Areas of important tree species of Western Rajasthan (SFD, Rajasthan funded)**

**PI: Dr. Desha Meena, Scientist C**

***Overview:*** Tree improvement is a stepwise process involving exploration, collection, evaluation, breeding, multiplication, distribution and conservation of genetic resources. Developing Seed Production Areas is one of the first steps in tree improvement programme that can be used to obtain genetically improved seeds for immediate planting. A stand of natural plant or group of stands periodically rogued and managed to enhance seed production is known as seed production area

(SPA). Based on the requirement of SFD, Rajasthan, project was formulated. Target species in the study are, *Prosopis cineraria, Tecomella undulata, Zizyphus mauritiana, Zizyphus nummularia, Salvadora persica and Salvadora oleoides.* Seed production area of these economically important tree species of arid and semi-arid region of Rajasthan are not available

***Achievements****:* Project was initiated in November 2021. Tour was conducted for survey and identification of natural plantation of *Salvadora persica, Salvadora oleiodes, Tecomella undulata, Prosopis cineraria, Zizyphus mauritiana, Zizyphus nummularia* in Jodhpur and Jalore district of Rajasthan.

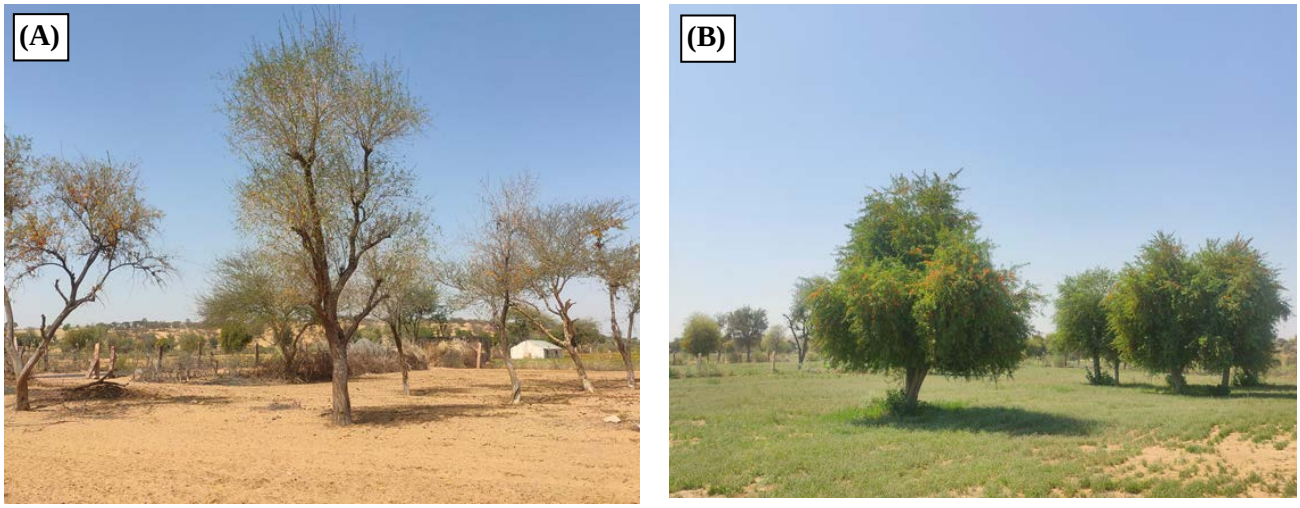


**Figure 6:** *Tecomella undulata* population in (A) Shergadh, Jodhpur and (B) Balesar, Jodhpur.

***Benefits of the research project***: Evaluation of seed stands of *P. cineraria, T.undulata, Z. mauritiana, Z. nummularia, S. persica,* and *S. oleoides* will help in identification of best seed production area for the operational planting programmes for the improved productivity. In long term, conservation and production of forest genetic resource of these targeted species will be highly valuable in enhancing productivity of the semi-arid and arid region.

## 2.4 Forest Management

### 2.4.1 Overview

#### 2.4.1.1 Projects under the Theme (in table as given at 2.1.1.1) : Nil

### 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): Nil

## 2.5 Wood Products

### 2.5.1 Overview

### 2.5.1.1 Projects under the Theme (in table as given at 2.1.1.1):Nil

### 2.5.2 Wood and other Lignocellulosic Composites : Nil

### 2.5.3 Wood Processing :Nil

### 2.5.4 Value Addition and Utilization:Nil

### 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

Under the theme of "Non-Wood Forest Products", progress was accomplished in selection of Candidate Plus Trees (CPTs) of 2 out of 4 target broad-leaved species of Rajasthan. Surveys that were conducted lead to successful selection of 51 CPTs of *Madhuca indica* in Meen Taleti (Sirohi district) and 10 CPTs of *Butea monosperma* in Siyawa (Sirohi District), along with identification of Seed Production Area (SPA) of *Anogeissus pendula* in Bundi district.

### 2.6.1.1 Projects under the Theme (in table as given at 2.1.1.1) :

| Projects | Completed Projects | Ongoing Projects | New Projects Initiated During the Year |
|---|---|---|---|
| Plan | - | - | - |
| Externally Aided | - | - | 1 |

### 2.6.2 Resource Development of NWFPs

**Project 8:Survey and selection of Candidate Plus Trees (CPT) and Identification of Seed Production Areas (SPA) and Broad Leaves Species of Rajasthan (Funded by SFD-CAMPA)**

**PI: Smt. Sangeeta Tripathi, CTO**

**Summary of the achievements under the Theme:** Identified SPA of *Anogeissus pendula* in Bundi district of Rajasthan. Identified SPA of *Madhuca indica* in Meen Taleti (Sirohi district), marked 51 CPT and recorded passport data of each CPT. Identified 10 CPT of *Butea monosperma* in Siyawa (Sirohi District).


**Figure 7:** Passport data recording and CPT marking of *Madhuca indica*: Marking of trees (A-C); Marked CPT of *Madhuca indica* (D)*;* and GPS map of marked CPTs at Meen village on Abu Road (Sirohi) (E).

**Research Benefit**: This study will be helpful in identifying and marking of SPA & CPTs of some broad-leaved species viz. *Madhuca indica, Anogeissus latifolia, A. pendula* and *Butea monosperma* of Rajasthan.

### 2.6.3 Sustainable Harvesting and Management: Nil

### 2.6.4 Chemistry of NWFPs, Value Addition and Utilization: Nil

### 2.6.5 Biofuels and Bioenergy: Nil

## 2.7 Forest Protection

### 2.7.1 Overview

To address the problem of flower gall formation in Khejri, an important species of Rajasthan, under the theme of "Forest Protection", under the ongoing project entitled "Development of Integrated management strategy against flower gall inducers of *Prosopis cineraria* (L.) Druce." significant achievements were made. Important findings suggested a higher average no. of flower gall per inflorescence at Phalodi followed by Lohawat in comparison to Osian, Baori and Pipar sites, reducing the pod formation and affecting the yield of sangri. Management trials conducted at these five different sites (done at bud initiation stage) with botanicals, chemicals and entomopathogenic fungi to selected Khejri trees showed that treatments with Abamectin Putranjeeva, Hingota and *Metarhizium* were effective in management of Khejri flower galls. Experiments were also conducted on the efficacy of Tree pal and Crawl clean on seed insect pest bruchid *Caryedon serratus* and *Patialus tecomella* insect pest of *Tecomella undulata*. Additionally, insect pollinator diversity was assessed on the marked transect in Sitamata Santuary using crown trap, light trap and yellow pan trap. Work was also conducted to study the disease incidence of two major pathogens of Shisham across Rajasthan and Gujarat and samples were collected for isolation of these pathogens. Soil samples of healthy tree (CPTs) were also collected and geo-location recorded. *Trichoderma* isolates were prepared to study their antagonistic effect on pathogens.

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

| Projects | Completed Projects | Ongoing Projects | New Projects Initiated During the Year |
|---|---|---|---|
| Plan | 1 | - | - |
| Externally Aided | - | - | - |

### 2.7.2 Insects pests, diseases and control

**Project 9: Development of Integrated management strategy against flower gall inducers of *Prosopis cineraria* (L.) Druce (ICFRE Funded Project)**

**PI:** Dr. Shiwani Bhatnagar, Scientist D

**Achievements:** Incidence of flower gall of Khejri was found to be more severe at Phalodi, Lowhawat and Osian in comparison to Baori and Pipar. It was observed that in heavily flower gall infested trees fewer pods and heavy gall formation (12-25 galls per inflorescence) was there on inflorescence spikes. Galls varied in size and shape forming oval and globular masses on inflorescence during the flowering season. On normal inflorescence 12-16 pods per inflorescence were observed. Average no. of gall per inflorescence was higher at Phalodi followed by Lohawat in comparison to average no. of gall per inflorescence at Osian, Baori and Pipar.

Under management trial two rounds of treatments were given at five different sites Phalodi, Lohawat, Baori, Pipar and Osian at bud initiation stage in last fortnight of February and First fortnight of March. Ten botanicals, chemicals and entomo-pathogenic fungi at an interval of 15 days were given to selected Khejri trees. Lopping experiment was conducted at five selected sites on selected trees to see the effect of lopping on incidence of gall formation.

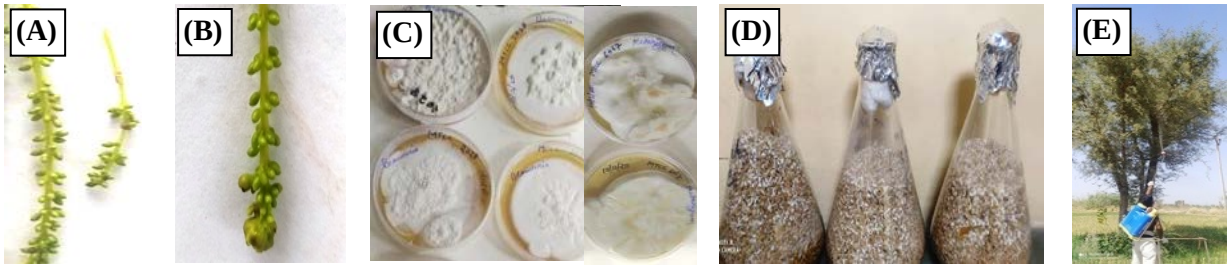


**Figure 8**: Management of flower gall formation in Khejri: Flower gall initiation (A) and development (B) in Khejri tree; Mass multiplication of entomopathogenic fungi (C-D); and Laying out of management trials (E).

### 2.7.3 Mycorrhizae, rhizobia and other useful microbes: Nil

### 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 HRD Trainings Organized :

Topics must be indicated in annexure while providing numerical information in the table given below:

| S. No. | Topic | Duration | | Participants | | Overall feedback of participants |
|---|---|---|---|---|---|---|
| | | Days | Date | Category | Number | |
| | Nil | | | | | |

3.3 Visits Abroad : Nil

## 3.4 Participation in Seminars/Symposia/Workshops/Trainings

| S. No. | Topic | Duration | | Participants from the Institute | |
|---|---|---|---|---|---|
| | | Days | Date | Category | Number |
| 1. | Webinar on Advancements in Teak cultivation: Genetic Resources & Technologies hoisted by IFGTB, Coimbatore | 01 | 16.07.2021 | Scientist | 01 |
| 2. | Training on Introduction to Remote Sensing, GIS and GNSS in forestry by Remote sensing Institute, Dehradun | 05 | 02.08.2021–06.08.2021 | Scientist | 02 |
| 3. | National Stakeholder's Consultation Workshop on Evaluation of the Working/Effectiveness of Forestry Extension System through the Van Vigyan Kendras and Recommendation for its Strengthening. | 01 | 26.08.2021 | Scientist | 01 |
| 4. | National Consultation workshop for the stakeholders on 'Development of Roadmap for Institutional and Policy Mainstreaming of Sustainable Land and ecosystem Management (SLEM) in India. | 01 | 27.08.2021 | Scientist | 01 |
| 5. | Workshop on Application and limitation of Forest Biotechnology in Propagation, Improvement & Conservation | 01 | 03.09.2021 | Scientist | 01 |
| 6. | IUFRO World Day-Digital Forest Service Forum 2021 Webinar | 01 | 29.09.2021 | Scientist | 01 |
| 7. | Efficiency of arbitrary and semi-arbitrary markers for assessing genetic diversity in natural populations of *Tecomellaundulata* – An important timber yielding tree species of Rajasthan.In Souvenir cum Abstracts/Proceedings: 3rd International conference on Global Initiatives in Agricultural Forestry and Environmental Technology Development Society (AETDS). | 02 | 17.10.2021–18.10.2021 | Dr. Tarun Kant (Scientist F) and Dr. Desha Meena (Scientist C) | 02 |
| 8. | Bioremediation of soil persistent pesticides by microbes: A novel approach for pesticide waste management. In Souvenir cum Abstracts/Proceedings: 3rd International Conference on "Global Initiative in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)" | 02 | 17.10.2021–18.10.2021 | Dr. Shiwani Bhatnagar (Scientist D) and Dr. Desha Meena (Scientist C) | 02 |
| 9. | "Co-expression Network Based Mining of 140 Cross-talking Salinity-implicated Genes from Trees" in 44th All India Botanical Conference of the Indian Botanical Society organized by Department of Botany, JNV University, Jodhpur | 01 | 19.10.2021 | Dr. Tarun Kant (ScientistF) | 01 |
| 10. | Capacity building workshop for state forest department for developing state REDD+ action plan | 02 | 21.10.2021–22.10.2021 | Sh.S.N.Murthy (Scientist B), Dr. Anjali Joshi (Scientist | 03 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | B) and Dr. Aditi Tailor (Scientist B) | |
| 11. | Online training in the “Economic valuation of forest” | 08 | 22.10.2021–29.10.2021 | Sh.S.N.Murthy (Scientist B) | 01 |
| 12. | National Conference on Clonal Forestry in Eco-restoration (NCCFER-2021) held at FRCER, Prayagraj | 02 | 10.11.2021–11.11.2021 | Dr. Tarun Kant (Scientist F), Dr. Desha Meena (Scientist C), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B) | 04 |
| 14. | ICFRE-IUFRO International Workshop on Forest and Landscape Restoration; session IV: FLR- Financing and Building Capacities. | 01 | 12.11.2021 | Dr. Tarun Kant (Scientist F) | 01 |
| 15. | Online training in the “Cultivation,processing techniques and management of NWFPs including medicinal plants” | 05 | 22.11.2021–26.11.2021 | Sh.S.N.Murthy (Scientist B) | 01 |
| 16. | Online training in the “Ecological Niche modeling” | 05 | 06.12.2021–10.12.2021 | Sh.S.N.Murthy (Scientist B) | 01 |
| 17. | Webinar on Nursery Techniques, cultivation and Management of Sandalwood | 01 | 10.12.2021 | Dr. M. T. Hegde (Scientist F) | 01 |
| 18. | Regional Research Conference on Vocal for local: Sustainable development of Non-Timber Forest Products for livelihood generation organized by TFRI, Jabalpur | 01 | 13.12.2021 | Scientist, CTO | 2 |
| 19. | Online training on "Forest Policy, Laws and Environmental Law" | 05 | 13.12.2021–17.12.2021 | Sh.S.N.Murthy (Scientist B), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B) | 03 |
| 20. | National Conference on “Value addition and marketing of NTFPs”, Organized by TFRI, Jabalpur. | 01 | 16.12.2021 | Dr. Shiwani Bhatnagar (Scientist D), Dr. Desha Meena (Scientist C), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B), Ms. Swati Prasad, Ms. Aastha Sharma | 06 |
| 21. | Webinar on Guidelines and procedures for Clone/Variety Release in Forestry Species | 01 | 06.01.2022 | Dr. M. T. Hegde (Scientist F) | 01 |

| | | | | | |
|---|---|---|---|---|---|
| 22. | DST sponsored online Training Program on "Natural Resource and Environment Management" organized by IIFM, Bhopal | 02 | 17.01.2022–21/01/2022 | Dr. Aditi Tailor (Scientist B), Sh. Tanmaya Kumar Bhoi (Scientist B) | 02 |
| 23. | Online training in the "High-tech forest nurseries for officials of Sri Lanka forest department" | 04 | 18.01.2022–21.01.2022 | Sh. S. N. Murthy (Scientist B) | 01 |
| 24. | Online training in the "Resource management and value addition of NTFPs" | 01 | 28.01.2022 | Sh.S.N.Murthy (Scientist B) | 01 |
| 25. | Interactive session and field visit to AFRI during meeting of NABARD officials | 01 | 14.02.2022 | Sh.S.N.Murthy (Scientist B) | 01 |
| 26. | DST-sponsored online Training Program on "Community Resourced Management" organized by IIFM, Bhopal between 21/02/2022 and 25/02/2022 | 05 | 21.02.2022–25.02.2022 | Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B) | 02 |
| 27. | One day PGR awareness programme under SCSP Scheme for SC community of Balesar tehsil of Jodhpur district of Rajasthan at ICAR-NBPGR, Regional station, Jodhpur | 01 | 28.02.2022 | Sh. S. N. Murthy (Scientist B) | 01 |
| 28. | Advances in smart agriculture & biodiversity conservation for sustainable development | 02 | 04.03.2022–05.03.2022 | Dr. N. K. Bohra (Scientist C) | 01 |
| 29. | One Week Compulsory Training Course for IFS Officers organized by AMITY University Noida through online mode on "The flourishing forest based handicraft industry of Western India – status, challenges and prospects". | 01 | 08.3.2022 | Dr. Tarun Kant (Scientist F) | 01 |
| 30. | One week HRD training for the ICFRE Scientists on "Wood Seasoning, Preservation and Composite Wood" at IWST, Bengaluru | 05 | 07.03.2022–11.03.2022 | Dr. M. T. Hegde (Scientist F), Dr. N.K. Bohra (Scientist C) Sh.S.N. Murthy (Scientist B) | 03 |
| 31. | Advanced training in molecular biology techniques and its application organized by TFRI | 05 | 21.03.2022–25.03.2022 | Dr. Pooja Sharma (Scientist B), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B), Sh. Deepak Kumar (Scientist B) | 04 |
| 32. | Role of wood science and technology in sustainable development of handicraft sector status and future prospects delivered by Sh. Ravi Veer Choudhary, Asst. Director**,** Handicraft, | 30 | 29.3.2022 | Scientists/Officers/ Technical Staff | 30 |

| | | | | | |
|---|---|---|---|---|---|
| | Ministry of textile GOI | | | | |
| 33. | Online meeting held for discussions on draft working plan of Rajsamand district, Rajasthan | 01 | 29.03.2022 | Scientist | 01 |

# 4. Extension Panorama/Activities

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

## 4.1. Trainings Organized :

| S. No. | Topic | Duration and Period | | Participants | | Overall feedback of participants |
|---|---|---|---|---|---|---|
| | | Days | Date | Category | Number | |
| a. Training under VVK | | | | | | |
| 1. | Training on Agroforestry and Nursery Management Training at VVK Bikaner | 03 | 06.03.2021–08.03.2021 | farmers and field functionaries | 84<br>31 forest staffs and 53 farmers | Very Good |
| 2. | Training on Agroforestry at VVK at Chhipardi Beedi, Rajkot (Gujarat) | 03 | 27.10.2021–29.10.2021 | Forest staff and Farmers | 39<br>(30 forest staffs and 9 farmers) | Very Good |
| 3. | Training on 'Role of forest for soil and water conservation' at KVK Udaipur | 03 | 23.03.2022–25.03.2022 | VFPC members/ Farmers/ Forest field workers | 47 Trainees | Very Good |
| b. Training under DV | | | | | | |
| | Nil | | | | | |
| c. Training under GSDP | | | | | | |
| | Nil | | | | | |
| d. Other Trainings (excluding HRD Training) | | | | | | |
| 01. | जैव उर्वरक के प्रकार, बनाने की विधियाँ, उपयोगिता एवं मूल्यवर्धन | 01 | 15.03.2022 | Farmers and SFD Officers | 43 Trainees | |
| | **GRAND TOTAL** | 10 | | | 203 | |

## 4.2 Report on the activities performed under following:

### 4.2.1 Van Vigyan Kendras (VVKs)

**State wise locations of established and proposed VVKs**

(a) Bichhwal (Bikaner), Rajasthan, **established**
(b) Chhipardi Beedi (Rajkot) Gujarat, **established**
(c) Rudana Nursery, Khanwel (Silvasa) Dadra & Nagar Haveli and Daman, **established**
(d) Kalka Mata Nursery(Udaipur), Rajasthan, **established**

Meetings were organized between AFRI officials with the members of Akhil Bhartiy Bishnoi Mahasabha at MuktidhamMukam (ABBMS), Tehsil Nokha, district Bikaner (Raj), for discussion ovcr setting up of the Environmental Awareness Centre at Mukam, Nokha, Bikaner under jurisdiction of the Indian Council of Forestry Research and Education, Ministry of Forest, Environment and Climate Change.

**(a) VVK at Bichhawal Nursery, Bikaner (Rajasthan)**

Meetings were conducted with Rajasthan Forest officials regarding VVK works. Under Rajasthan VVK, high-tech nurseries (at Bichhwal Bikaner with its satellite facility at Mohangarh) of SFD Rajasthan were maintained during 2021-22.

**(b) VVK at Chhipardi Beedi, Rajkot (Gujarat)**

**(i)**Meetings organized between AFRI official and additional PCCF (Research), and DCF (Research) & Nodal Officer (VVK) at GFRI, Gandhinagar regarding research demonstration, renovation of Hi-Tech nursery, high quality raising seedlings and training works for financial year 2021-22.

**(c) Kalka Mata Nursery, Udaipur**

**(i) Establishment of VVK**

Couple of meetings were organized between AFRI and RFD for discussion over establishment of New VVK at Udaipur in Aravali region of Rajasthan. VVK site was finalized to be established at Kalka Mata Nursery, Udaipur. An MoU was signed between AFRI and DFO (S), Udaipur on 4$^{th}$ October, 2021 for the same. Farmer's training was organized between 22-25$^{th}$ March, 2022 at the new VVK in Udaipur.

### 4.2.2 Demo Village (DV)

**Demo village, 1445 Rd, IGNP area, Mohangarh (Jaisalmer)**

**Establishment and strengthening:** Area of 5 ha of Demo village site was fenced. A Choukidar hut and gate were constructed and an iron sign board was prepared. Earth water channel was also prepared for irrigation of plantation. Demo village was inaugurated by Sh. M. R. Baloch, Director, AFRI, Jodhpur in the presence of Sh. S.R.V. Murthy, CCF, Jodhpur Circle.

**Figure 9:** Fencing work at Demo village, 1445 RD, IGNP area, Mohangarh, Jaisalmer

### 4.2.3 Tree Growers Mela (TGM) : Nil

### Extension Activities Under Plan

### 4.2.4 Prakriti

Prakriti programme is to provide platform for school children to learn practical skills towards sustainable use of resources. It also aims to promote awareness about forests and environment and stimulate interest among students of Kendriya Vidyalay and Jawahar Navodya Vidyala in maintaining the balanced. Under this programme, various activities were conducted. Brief details of activities are:

| S. No. | Name of KV/JNV | Date | Participants | Activity |
|---|---|---|---|---|
| 1. | KV No. 02Udaipur. | 05.08 .2021 | Principal and staff | A meeting was held among Sh. Dhana Ram, Sh. Anil Singh Chouhan (STO), Principal Sh. O.P.Yadav and Vice Principal Sh. Pradeep Choudhary of the Kendriya Vidyalaya No. 2 Udaipur under Prakriti Programme. Newly published extension materials was provided to them for school library. Plantation techniques were also demonstrated to school staff. |
| 2. | KV, BSF, Ramgarh, Jaisalmer | 22.09. 2021 | Principal, Teachers and 12 students of class $9^{th}$ and $10^{th}$ | AFRI team with Sh. Deepak Kumar (ScientistB), Sh. Dhana Ram (STO) and Sh. A.S. Chouhan (STO) visited BSF, KV Ramgarh, Jaisalmer (Raj.) under Prakriti Programme. A meeting was held with Shri Shankar Singh, Principal and Sh. SriKant Sharma, TGT and discussion was held regarding the programme. Extension materialswere provided to them to promote environmental awareness. A live demo of plantation technique was givento the staff and students of class $IX^{th}$& $X^{th}$. |
| 3. | KV, No. 01, Gandhinag ar (Gujarat) | 28.10. 2021 | Teachers and 50 students of class $11^{th}$Science | A meeting was held between AFRI team comprising Sh. Deepak Kumar (Scientist B) and Sh. Dhana Ram (STO) and Sh. B.S. Sharma, PGT under Prakriti Programme. A short movie film showcasing AFRI activities was played for students of class $11^{th}$ and staff. Newly published extension material was provided them for school library. Plantation techniques were also demonstrated to Students and |

| | | | | |
|---|---|---|---|---|
| | | | | school staff. |
| 4. | KV, (BSF), Dabla, Jaisalmer | 16.12. 2021 | Principal, Teachers and 61 students of School | Smt**.** Anita**(**IFS, Head Extension), Smt. Bhawana Sharma (ScientistD) and Sh. Dhana Ram (STO) visited Kendriya Vidhyalay (BSF), Dabla, Jaisalmer under Prakriti Programme and discussed with Principal, Sh. Yogendra Sharma and Sh.Navratan Meghwal, PGT (Biology) about the Programme. Smt. Bhawana Sharma delivered a lecture on "Forest and Environment awareness" to the 61 students of class $10^{th}$ and class $11^{th}$.A short movie film showcasing AFRI activities was played. AFRI team provided extension promotional material to Principal Shri Yogendra Sharma for reference. |
| 5. | KV (AFS), Jaisalmer | 10.02. 22 | Principal, Teachers and 220 students of class $6^{th}$ to $12^{th}$ | Sh. Anil Singh Chouhan and Sh Dhanaram (STOs) from AFRI, visited Kendriya Vidyalaya School (AFS), Jaisalmer, under the Prakriti Program. A short movie film showcasing AFRI activitieswas shown to students and teachers. Team also demonstrated plantation techniques to the students and teachers. Extension material published by AFRI was handed over to Sh. Sushil Kumar, Principal and Sh. Radheshyam Kuldeep, Vice Principal. |

## 4.3 Technologies transferred:

1290 visitors in 27 groups visited Extension and Interpretation Centre, AFRI.

| S. No. | Name of Visitors/Group | Date | No. of Visitors |
|---|---|---|---|
| 1. | Visit of IFS officer of Rajasthan Cadre | 23.07.2021 | 07 |
| 2. | Virtual tour of SFS Officer Trainees (2019–2021 Batch) from Central Academy for State Forest Service (CASFOS), Burnihat(Assam) | 25.07.2021 | 38 |
| 3. | Visit of Vice Chancellor of JNVU Prof. P.C. Trivedi with his team | 27.07.2021 | 06 |
| 4. | Visit of Officer Trainees (OTs) (Batch 2020), India Audit and Account Service | 30.07.2021 | 27 |
| 5. | Visit of a group of Foresters/Forest guard trainees of regular basic traning programm in supervision of Sh. Prem Singh and Shri Manak Lal Suthar to see the Interpretation Centre of AFRI | 28.08.2021 | 22 |
| 6. | Visit of A group of IFS Officer trainees (Batch 2020–2021) from Indira Gandhi National Forest Academy, Dehradun | 14.09.2021 | 33 |

| | | | |
|---|---|---|---|
| 7. | Visit of two groups of Input Dealers from KVK, CAZRI & DAESI program and ATMA, DAESI Jodhpur to see the Interpretation center, Seed Lab and Nursery of AFRI | 17.09.2021 | 39 |
| 8. | Visit of a group of Indian Forest Service Probationers (Batch 2020–2022) from Indira Gandhi National Forest Academy (IGNFA), Dehradun, visited the AFRI | 24.09.2021 | 34 |
| 9. | Visit of Hon'ble Sh. Arjun Ram Meghwal,Union Minister of State for Parliamentary Affairs & Culture, Govt. of India,with his team | 14.10.2021 | 10 |
| 10. | Visit of a group of 33 SFS officers trainees (Batch 2021–2023) from CASFOS, Dehradun, with Sh. Amlendu Pathak, IFS. | 16.10.2021 | 34 |
| 11. | Visit of Officer trainees of RFO (Batch 2021–2023), Rajpipla (Guj.) as a part of West India Tour | 26.10.2021 | 25 |
| 12. | Visit of Foresters/Forest guard trainees from Forest Training Institute, Jodhpur under Forestry Management Course | 10.11.2021 | 22 |
| 13. | Visit of Foresters/Forest guard trainees from Forest Training Institute, Jodhpur under Forestry Management Course | 24.11.2021 | 22 |
| 14. | Visit of Foresters/Forest guard trainees from Forest Training Institute, Jodhpur under Forestry Management Course | 30.11.2021 | 31 |
| 15. | Visit of a team of FROs along with their Officer-Incharge Dr. V. S. Senthil Kumar, IFS fromCentral Academy for State Forest Service, Coimbatore | 02.12.2021 | 37 |
| 16. | Visit of Foresters/Forest guard trainees from Forest Training Institute, Jodhpur under Forestry Management Course | 07.12.2021 | 28 |
| 17. | Visit of a team of 41 member of Dpty. rangers/Forest guards with faculty member Sh. Praminder Singh, DCF and Shri Taradatt, Ranger from Forest Training Institute, Chail, State Forest Deparment, Himachal Pradesh | 09.12.2021 | 43 |
| 18. | Visit of Foresters/Forest guard trainees from Forest Training Institute, Jodhpur under Forestry Management Course | 15.12.2021 | 31 |
| 19. | Visit of a group of RFO Trainees with faculty member from Karnataka Forest Academy, Dharwar (First visit) | 27.12.2021 | 39 |
| 20. | Visit of a group of RFO Trainees with faculty member from Karnataka Forest Academy, Dharwar(Second visit) | 31.12.2021 | 41 |

| | | | |
|---|---|---|---|
| 21. | Visit of dignitories for the Fifth Bimonthly Structural Meeting of Districts Development Managers, Rajasthan Region, NABARD | 14.02.2022 | 30+7 |
| 22. | Visit of a group of students of B.Sc. from Nakoda Pashvnath Jain Mahavidhyalay, Jodhpur with Dr. Shailja Varshney and other faculty members on National Science Day | 28.02.2022 | 123 |
| 23. | Visit of Sh. Abhishek Surana, CEO, Zila Parishad, Jodhpur and his team | 28.02.2022 | 03 |
| 24. | Visit of a group of 55 students and 5 teachers of Government Higher Secondary School North Dhani, Lohawat, Jodhpur | 09.03.2022 | 60 |
| 25. | Visit of a group of FRO Trainees (Batch 2020–2022) with faculty member from Uttarakhand Forestry Training Academy, Haldwani | 11.03.2022 | 50 |
| 26. | A group of M.Sc. Zoology Students from JNV University, Jodhpur with faculty member Dr. S.L. Nama and Dr. R.P. Saran | 11.03.2022 | 42 |
| 27. | A group of FRO Trainees (Batch 2021–2022) from Tamil Nadu Forest Academy, Tamil Nadu withfaculty member Sh. Thiru K Manoj | 29.03.2022 | 46 |

## Weekly activity under Azadi Ka Amrit Mahotsav (2021-2022)

- On 09$^{th}$September, 2021, a lecture on topic “Value addition of NTFPs –from sustainable livelihood generation for rural India to vocal for local” by Smt. Sangeeta Tripathi, CTO was organized.
- On 6$^{th}$October, 2021, an Iconic Week (4–10$^{th}$ October, 2021) of Awareness Program to Avoid use of Single Use Plastic was organized.
- On 21$^{st}$October, 2021, under Bharat ka Amrut Mahotsav Week (16–21$^{st}$October, 2021) a programme was organized. A lecture on "Carbon Sequestration and Rajasthan Forest" was delivered by the Chief Speaker Dr G. Singh (Scientist G).
- On 26$^{th}$ November, 2021, “Constitution Day” was celebrated.
- During 19–25$^{th}$November, 2021, in pursuance of the celebration of Communal Harmony Week institute, a lecture was organized on the topic "Role of Communal Harmony and National Integration in the development of the country".
- On 17$^{th}$ December, 2021, as a part of celebrating “Rivers of India”, a lecture on “Luni & other main rivers of Rajasthan”was delivered by Dr. G. Singh (ScientistG)
- On 17$^{th}$ December, 2021, winner securing 1$^{st}$, 2$^{nd}$ and 3$^{rd}$positionsin a poster competition on theme “Save the Rivers” were honoured by providing certificates.
- During 20–26$^{th}$December, 2021, “Good Governace Week” was celebrated.

- On 27th December, 2021, two seminars were organized. One lecture on "Potential of Sandalwood Cultivation in Arid and Semi arid region" was delivered by Dr. M.T. Hegde (ScientistF)andthe second lecture was delivered by Dr. Sangeeta Singh (ScientistE) topic on "Managing Disease of Forestry species".
- On 07th January, 2022, a lecture was delivered by Dr. Bilas Singh (CTO) on the topic "Benefits of Agro forestry in Rajasthan".
- On 10th February, 2022, a lecture was delivered by Dr. Tarun Kant (ScientistF, GC(R)and Head GTI Division) on the topic "Gene-Mining from Trees using Gene Co-expression Networks and Comparative Genomics for Abiotic Stress Tolerance"
- On 8th March, 2022, International Women's Day was celebrated. Dr. Sangeeta Lunkar, Director, Kamala Nehru College, Jodhpur planted a tree of Amaltash in AFRI Campus.
- On 21st March, 2022, World Forestry Day was celebrated with the theme "Restoration of Degraded Lands through Forestry Interventions".

## 4.3.1 Clones/Varieties released (species-wise)

**1. Clones of *Dalbergia sissoo***

In the Variety Releasing Committee (VRC) of ICFRE held on 18thNovember, 2021, three clones (AFRI-DS-1, AFRI-DS-2 and AFRI-DS-4) of *Dalbergia sissoo* developed by AFRI were released for commercial cultivation in semi-arid agro-ecological belt in Gujarat (North, Middle and Upper Southern Gujarat). The certificates for the clones were distributed by DGF&SS. Gujarat Forest Department and AFRI will jointly take up the multiplication of clones and ensure distribution to stakeholders.

These clones are fast-growing and are expected to give at least 60–75% better timber yield compared to unimproved planting stocks. By planting these clones, the farmers may get an additional income of Rs. 50,000 per year compared to planting unimproved planting stocks. These clones can be harvested in a 20–25 year growing period and are fairly tolerant to diseases and insect pests.

## 4.3.2 Packages of practices developed (species-wise)

**1. Application of *Rhizobium* isolates (PC 49, PC 54 and PC 69) with (*Bacillus* B1) for quality planting material of Khejri**

**2. Package of Practices developed and extended to stakeholders**

| S. No. | Year | Name of Package of Practices | Benefits | Stakeholders | Efforts for Extension | Remarks |
|---|---|---|---|---|---|---|
| 1. | 2021 In ICFRE Plan Project | Herbal gulal (*Butea monosperma*) | | 1.Bhoorki Devi Mahila SHG, Jamboori in Sirohi, (N=24°23.621'; E=072°55.151', HH375)<br><br>2.Mahadev SHG, Surpagla (Abu Road Block, Sirohi) (N=24°23.200';E=072°49.538'; 549/610 Garasia tribe) | Organized two training cum demonstration programme (3 days each) on value addition of *Butea monosperma* in February, 2021 | Nil |
| 2. | 2021 | Jam | | 1.Bhoorki Devi Mahila SHG, | Organized | Nil |

| | | | | | | |
|---|---|---|---|---|---|---|
| | In ICFRE Plan Project | (*Diospyros melanoxylon*) | | Jamboori in Sirohi, (N=24°23.621'; E=072°55.151', HH375)<br><br>2.Mahadev SHG, Surpagla (Abu Road Block, Sirohi) (N=24°23.200'; E=072°49.538'; 549/610 Garasia tribe) | two training cum demonstration programme (3 days each) on value addition of *Diospyros melanoxylon* in March, 2021 | |

## 3. **Preparation of Compost using fallen leaves of *Azadirachta indica* (Neem) and other species growing in AFRI premises, Jodhpur.**

Objective and target groups:

- To make available good quality organic compost rich of nutrients to end users (farmers, tree growers, general public and other stakeholders of the area
- Generating source of income for the Institute by making compost using fallen leaves of *Azadirachta indica* (Neem) and other species in the AFRI premises
- To undertake experiments on how to improve quality and to make compost rich of nutrients through value additions
- To prepare compost in less duration and at low cost using various techniques

**Description:**India is an agricultural country where about 70% of the population depends on agriculture. Since ancient times, farmers used to make manure in their fields from natural waste such as leaves, animal faeces and other vegetable waste, which contained all the nutrients needed for the growth of plants andcrops and sufficient amount of micro-organisms distributing organic matter in the soil. With the use of such manure, the soil of the fields always remained fertile and the crop was produced for a long time. But the greed for more production gradually encouraged the use of chemical fertilizers. As a result, the fertile land of the fields started deteriorating and due to continuous use of chemical fertilizers, animals, birds, other organisms and human life started to suffer. But gradually the losses due to chemical fertilizers and adverse effects on health forced people to adopt compost.

Commonly known as garbage manure is obtained from the decomposition of organic matter. To make it, the leaves of trees and plants, the crop residues, rotten green waste, cow dung and faeces and urine of human and animals are used. There are several methods of making it, in which these organic substances are left for a few weeks or months so that they are decomposed. During above process, the organic matter is decomposed by micro-organism in a favourable amount of air, humidity, temperature and nitrogen. Nutrients are separated from organic matter during this process and whole organic matter is converted into brown or black-brown compost after three- four months.

**Preparation of compost in AFRI campus**

More than 3000 trees of *Azadirachta indica* (Neem) & other species are growing in residential campuses & various other experimental fields of the Institute. Tons of leaves fall from these trees every year. Generally, a neem tree of 20 to 25 years old sheds about 10 to 15 kg of dry leaves in a year. Earlier, the leaves were not being used for any purpose and thousands of rupees were being

spent on removing them from campus and cleaning the premises. A plan was prepared in the year 2019 to make compost from fallen leaves of Neem trees. It was embodied so as to generate income for the Institution and the expenditure incurred on it for removing & cleaning could also be saved. Two types of methods were adopted by the Institute to prepare compost. There are: (a) Pit Method (b) Raipur Method (Heap structure).

**Pit Method:**For making compost twelve pits of average size of 24×8×5 ft were dug. Nine tractor trolleys (one tractor trolley equivalent to 100 cft or 346 kg) neem leaves were put in a pit. After laying one feet of neem leaves, a layer of FYM half inch thick was laid. Layers of leaves & FYM were repeated till the pit was filled completely. About 50 cft of FYM was used in a pit. Watering was done in the pit to maintain 20–30 % moisture level. Top most layer of the pit was covered with a mixture of equally proportionate soil and FYM so that required level of heat (about 60 degree Celsius) could be generated for the fast process of decomposition. Whole material was turned after two months with the help of JCB to keep the pile's temperature maintained. After four months compost was ready.

**Raipur Method (Heap structure):** In this method, heap structure is prepared on the surface laying tree and plant leaves, green waste, crop residue, kitchen green waste, vegetables and other vegetative materials. Structure of heap may vary according to availability of space. However, heap size 20×8×5 ft is ideal for making compost through this method.

Some heap structures of size 20×8×5 ft are prepared in AFRI main campus to make compost through Raipur method. To prepare heap structure, a 6 inch thick layer of neem leaves dipped in a solution of water & 5% FYM laid first on the surface then a layer of half to 1 inch of soil was laid. Same layers were repeated till the heap attained height of 5 ft. Whole structure was coated with a proportionate mixture of soil and manure. After three four days, 6–7 inch deep holes are made at the distance of 8–9 inch from each other on the top of the heap with a cylindrical tin box of diameter of 6 inch so that aeration could be made available to organic matter for fast decomposition. The holes are also used for pouring water in the heap in order to maintain desired moisture level. Compost is prepared in four–five months using above method.

**Achievement**: Compost so prepared is made available in the nursery different pickings for sale. Farmers, tree growers, general public& other stakeholders of the area are demanding for more quantity of compost prepared by this Institute as it has good quality & rich of nutrients such as Nitrogen, phosphorus and potash (NPK). Due to value addition through application of *Trichoderma*, PSV & AM fungi, its quality of compost is improved. Presently, Institute is preparing compost of mixed leaves of different trees and plants in addition to neem leaves compost. In near future, Institute is planning to undertake experiments on how to improve quality of compost through value additions and creation of new structures and development of new techniques.

(a) Since no other government body or private agency is preparing compost using leaves of trees of neem and other species in this region, therefore, people of this area are demanding compost prepared in the Institute because of its good quality and purity. Institute has earned a handsome amount after selling it on the price of Rs. 30 per kg. Compost prepared through both the methods are having high quality and good for growing trees & crops as per the feedback received from users like forest departments, city public & farmers. Value addition of compost through of *Trichoderma*, PSV & AM fungi has shown increase in quality of compost.

(b) The expenditure of lakhs of rupees incurred on cleaning, i.e. removing of fallen leaves from various AFRI premises (surroundings of office buildings, residential colony, experimental fields etc.), have been saved.

(c) Earlier Institute was purchasing vermi- and other compost from private organizations/agencies and a large amount was spent on the purchase of the same for the use in Institute's nursery, for the maintenance of plants, lawns, hedges and other plantations in AFRI main and 729 campuses, experimental fields for various research projects. Lakhs of rupees were being spent on all these purposes. Now Institute has saved all above expenditures.

(d) Compost prepared by the Institute has all the required nutrients and fungal resistant property, therefore, it is giving good response in the fields and people are continuously demanding it in more quantity.


**Figure 10:** Production of Neem compost by collecting fallen leaves and its disbursement to end users (A–D).

## 4.3.3 Products developed

**1. Products – details of products and efforts made for their extension and commercialization**

| S. No. | Year | Name of Product | Details of Product | Target Groups | Efforts for Extension/ commercialization | Revenue Earned ( Rs. In Lakh) |
|---|---|---|---|---|---|---|
| 1. | 2021 | Herbal gulal | -- | 1.Bhoorki Devi Mahila | Organized two | Nil |

| | | | | | | |
|---|---|---|---|---|---|---|
| | In ICFRE Plan Project | (*Butea monosperma*) | | SHG, Jamboori in Sirohi, (N=24°23.621'; E =072°55.151', HH375)<br><br>2.Mahadev SHG, Surpagla (Abu Road Block, Sirohi) (N=24°23.200';E= 072°49.538'; 549/610 Garasia tribe) | training cum demonstration programme (3 days each) on value addition of *Butea monosperma* in February, 2021 | |
| 2. | 2021 In ICFRE Plan Project | Jam (*Diospyros melanoxylon*) | Shelf life: Six Months | 1.Bhoorki Devi Mahila SHG, Jamboori in Sirohi, (N=24°23.621'; E=072°55.151', HH375)<br><br>2.Mahadev SHG, Surpagla (Abu Road Block, Sirohi) (N=24°23.200';E=072°49.538'; 549/610 Garasia tribe) | Organized two training cum demonstration programme (3 days each) on value addition of *Diospyros melanoxylon* in March, 2021 | Nil |

## 4.3.4 QPM produced and supplied to stakeholders (species-wise)

Forest plantations established in the arid zones should provide an array of products and services. While the tree and shrub species and techniques chosen must ensure soil and water conservation and provide shade and shelter, they also should yield the immediate requirements for fuel, fodder, and generally, multiple uses, whenever possible such kind of species are produced in AFRI nursery and supplied to stakeholders.

Various species, like *Azadirachta indica, Prosopis cineraria, Tecomella undulata, Acacia senegal, Salvadora persica, Salvadora oleoides, Cordia myxa, Cordia gharaf, Pongamia pinnata, Holoptelea integrifolia, Zizyphus* sp., *Moringa oleifera, Acacia catechu, Ailanthus excelsa, Commiphora wightii, Santalum album, Syzygium cumini, Vachellia nilotica, Dalbergia sissoo, Terminalia arjuna, Anogeissus pendula*, are produced in AFRI nursery and supplied to various stakeholders like Nagar Nigam, Agricultural university, CAZRI, BSI, NIFT, Jodhpur, IBPGR, Noida, State forest department, Haryana, NGO like DhartiAmrit Jaipur, Nagour, Sahgal Foundation Barmer and further AFRI provided nursery techniques to them.

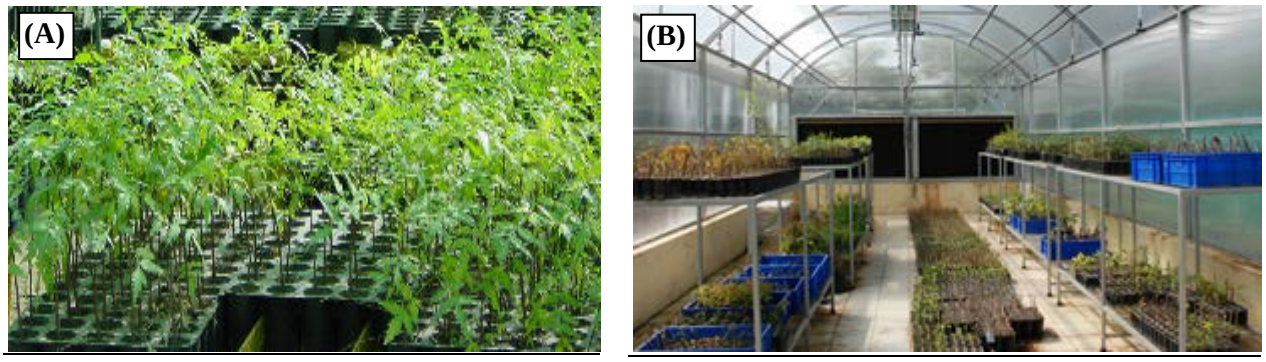


**Figure 11:** Various species for providing QPM produced at AFRI (A–B).

4.3.5 Patented technologies: Nil

4.3.6 License/Material Transfer Agreement signed: Nil

4.4 Intellectual Property: Nil

4.4.1 Patents granted/ applied for: Nil

4.4.2 Others: Nil

4.5 Research Publications: enclosed as Annexure 11

| Books | Booklets/ Brochure/ Bulletins/ Pamplets | Articles in seminars/ conference/ workshops etc | | Popular article | Research papers in Journals | | Chapters in Books/ Proceedings |
|---|---|---|---|---|---|---|---|
| | | Article | Abstracts | | Foreign | Indian | |
| 2 | 44 | - | 19 | 16 | 2 | 4 | 1 |

## 4.6 Consultancies

**1. Training of Rajasthan rural women on use of biofertilizer for crop productivity enhancement.**

Funding Agency: DSIR, Govt. of India

Budget Outlay: Rs. 8.45 Lakhs

**2. Preparation of DPR for Restoration of Degraded Land in the Aravali zone**

Funding Agency: MoEF&CC, Govt. of India

Budget Outlay: Rs. 75.20 Lakhs

## 4.7 Technical Services

4.7.1 Identification and testing services

4.7.2 Advisories given to SFDs and other stakeholders

4.7.3 Other technical services not covered elsewhere in the report

## 4.8 Activities of Rajbhasha

शुष्क वन अनुसंधान संस्थान,जोधपुर में हिन्दी सप्ताह **(14 से 20 सितंबर, 2021)** का आयोजन हुआ। दिनांक 14.09.2021 को **'हिन्दी दिवस'** पर हिन्दी सप्ताह-2021 का समारंभ हुआ। इस अवसर पर संस्थान निदेशक श्री एम.आर.बालोच, भा॰व॰से॰ ने सभागार में उपस्थित कार्मिकों को 'राजभाषा प्रतिज्ञा' दिलवाई। माननीय गृह मंत्री, भारत

सरकारके ऑडियो व वीडियो संदेश को प्रसारित किया गया। संस्थान के सहा.निदेशक (राजभाषा) ने सभी को हिन्दी सप्ताह के दौरान होने वाली प्रतियोगिताओं राजभाषा बोध, हिन्दी टिप्पण- आलेखन, हिन्दी टंकण सामान्य व सारांश(यूनिकोड समर्थित), स्वरचित कविता-पाठ की जानकारी दी। हिन्दी दिवस के दिन राजभाषा प्रतिज्ञा, माननीय गृह मंत्री के संदेश एवं हिन्दी दिवस पर संस्थान निदेशक की अपील को सभी संस्थान कार्मिकों को ई-मेल से परिचालित किया गया तथा हिन्दी लेखकों व विचारकों की सूक्तियों का सूचना पट्ट पर प्रदर्शन भी किया गया। समारंभ समारोह में अपने विचार व्यक्त करते हुए संस्थान निदेशक ने 'हिन्दी दिवस' के आयोजन पर प्रकाश डालते हुए संस्थान में राजभाषा नीति के अनुसार सरकारी कामकाज को बढ़ावा दिये जाने का आग्रह करते हुए हिंदी सप्ताह-2021 के समारंभ की औपचारिक घोषणा की तथा हिंदी प्रतियोगिताओं में बढ़-चढ़ कर भाग लेने का आह्वान किया।

हिन्दी सप्ताह-2021 का समापन समारोह दिनांक 20.09.2021 को आयोजित हुआ जिसमें मुख्य अतिथि डॉ. आईदान सिंह भाटी, हिंदी तथा मारवाड़ी के जाने माने कवि रहे। इस अवसर पर हिंदी सप्ताह के दौरान आयोजित हुई प्रतियोगिताओं के विजेताओं को मुख्य अतिथि ने सम्मानित किया।

वर्ष 2021-22 के दौरान विभागीय राजभाषा कार्यान्वयन समिति की निर्धारित 04 तिमाही बैठकें आयोजित हुई तथा 02 हिंदी कार्यशालाओं का भी आयोजन किया गया।

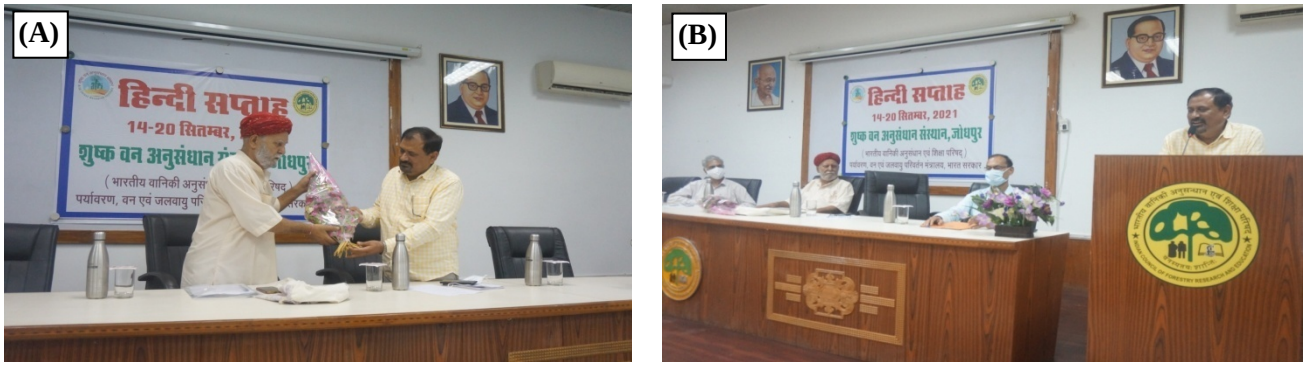


**Figure 12:** Hindi week celebration held at AFRI (A–B).

## 4.9 Awards and Honours

## 4.10 Special Activities

1. International Biodiversity Day on 22.05.2021
2. Environment Day on 05.06.2021
3. World Day to Combat Desertificationon 17.06.2021
4. Van Mahotsava Celebration on 19.07.2021
5. Rastriya Ekta Divas on 31.10.21
6. International Day of Forests on 21.03.2022
7. Vigilance awareness week on

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भारत के कालचक्र में समय-समय पर अनेक महापुरुष अवतरित हुए हैं। जिससे सभ्यता के विकास के साथ-साथ मानवता के आधार पर दोनों को एकजुट करने में सफलता प्राप्त हुई है। इन्ही में से एक भारत रत्न बाबा साहेब डॉ. भीम राव अम्बेडकर थे। उनके द्वारा संविधान निर्माण, समाज सुधर तथा अर्थशास्त्र आदि में किये गए कार्य अतुलनीय हैं। शुष्क वन अनुसन्धान संसथान (आफरी) जोधपुर में संविधान निर्माता डॉ. भीम राव अम्बेडकर की १३०वीं जयन्ती श्रद्धा पूर्वक मनाई गई। इस अवसर पर मुख्य अतिथि श्री. आई. आर. गेंवा, प्राचार्य आई. टी. आई. जोधपुर ने अपने उदभोदन में बाबा साहेब के जीवन से प्रेरणा लेने एवं संविधान वर्णित अधिकारों एवं कर्तव्यों का पालन कर एक सशक्त भारत के निर्माण करने का आह्वान किया। उन्हें दार्शनिक एवं क्रन्तिकारी बताया। इस अवसर पर आफरी निदेशक श्री. माना राम बालोच भा.व. से. अपने उदभोदन में डॉ. भीम राव अम्बेडकर साहेब के आदर्शों को यथार्थ जीवन में अपनाने की ज़रूरत बताते हुए बाबा साहेब के सपनों को साकार करने में हर एक को अपना योगदान देने की आवश्यकता प्रतिपादित की। निदेशक महोदय ने बाबा साहेब के गुरु श्री. ज्योतिबा फुले के विचारों एवं किये गए कार्यों के बारे में अवगत कराया। आफरी के वरिष्ठ वैज्ञानिक एवं संवयक (शोध) डॉ. जी. सिंह ने संविधान निर्माण, समाज सुधारक तथा अर्थशास्त्र आदि में किये गए कार्यों के बारे में अवगत कराया तथा उनके सपनों को पूरा करने के लिए दूरदृष्टि से कार्य करने तथा अपने-अपने क्षेत्र में हर व्यक्ति को योग्यता तथा सक्षमता से कार्य करने की अपील की। वरिष्ठ वैज्ञानिक डॉ. तरुण कान्त ने अम्बेडकर साहेब की तरह कर्मयोगी बनने पर बल दिया। डॉ. हेगड़े ने बाबा साहेब अम्बेडकर के जीवन से नैतिकता एवं ज्ञान के महत्व को स्वीकार करने तथा दोनों की एकता के लिए जीवन के निजी स्वार्थों का त्याग करने पर बल दिया। श्री. कैलाश गुप्ता, सहायक निदेशक, हिंदी अनुभाग ने अम्बेडकर साहेब की शिक्षा एवं उनके जीवन पर अपने विचार व्यक्त किये। श्रीमती अनीता भा.व. से. प्रभागाद्याक्षा सुविधाएं एवं सेवाएं ने बाबा साहेब की शिक्षा एवं उनके जीवन पर अपने विचार व्यक्त किये।

## Vigilance awareness week

Vigilance awareness week was celebrated from 26th October to 1st November, 2022. Several competitions were organized in which AFRI employees participated. The function was held on 1st November, 2022 and Smt. Geetika Pandey, DRM, Jodhpur was the chief-guest.

# 4.11 Extension Activities performed under CAMPA Extension

### (a) VVK at Bichhawal Nursery, Bikaner (Rajasthan)

Meetings were conducted with Rajasthan Forest officials regarding VVK works. Under Rajasthan VVK, high-tech nurseries (at Bichhwal Bikaner with its satellite facility at Mohangarh) of SFD Rajasthan were maintained during 2021-22.

### (i) Maintenance of High-Tech Nursery Bichhwal, Bikaner-

Maintenance work of high-tech nursery Bichhwal, Bikaner were undertaken,and foggers, water supply pipes and valves, etc. were procured for the high-tech nursery. Iron structure of Polyhouse was repaired and colour was done.

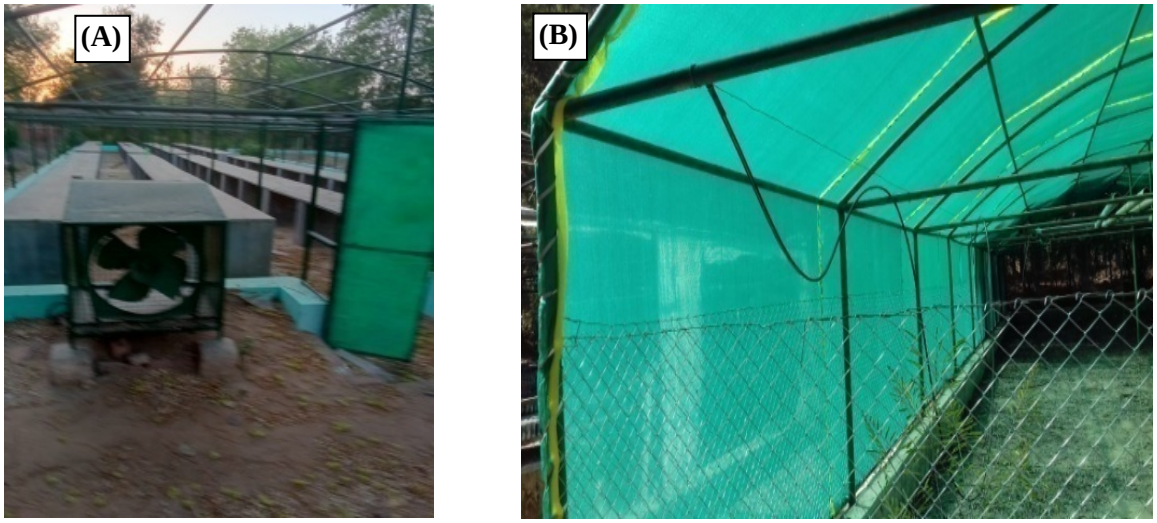


**Figure 13:** Renovated VVK Nursery at Bicchwal, Bikaner in March 2022 (A); RenovatedAgroshed house at High-Tech nursery at IGNP area, Mohangarh, Jaisalmer (B).

**(ii) Maintenance of high-tech Nursery at IGNP area, Mohangarh, Jaisalmer**

Maintenance works of Agroshed house (28 x 12 m x 2.5 m size) at high-tech nursery, IGNP area, Mohangarh, Jaisalmer werefulfilled and agroshed net and Iron mesh, etc. were procured and fixed.

**(iii) VVK Training**

A three-day training programme for farmers and field functionaries under Van Vigyan Kendra (VVK) Bikaner was organized with the help of Rajasthan Forest Department during6-8$^{th}$March, 2021 at Krishi Vigyan Kendra, Jaisalmer. A total 84 participants (31 forest staffs and 53 farmers) from various villages/ranges of Division (IGNP, Jaisalmer and Jaisalmer) attended the training. They learned about techniques of organic and compost manure farming, nursery management, raising quality plant stock and maintenance, conservation and economic benefits of agroforestry, cultivation of arid fruit tree and production, silvi-pastoral and grass production, different agro-techniques and Sustainable Development Goals (SDGs), etc. Trainees also visited and learned about technologies demonstrated on agro-forestry and animal husbandry at KVK, Jaisalmer, conservation of local tree species in Gadhisar Talab through public participation, traditional water harvesting in khadin in Huda area, high-tech nursery at IGNP area, Mohangarh and Demo village activities at 1445 RD, IGNP area, Mohangarh, Jaisalmer.

**Figure 14:** VVK Training during 6-8th March, 2022 at KVK Jaisalmer.

**(b) VVK at Chhipardi Beedi, Rajkot (Gujarat)**

**(i)**Meetings organized between AFRI official and additional PCCF (Research), and DCF (Research) & Nodal Officer (VVK) at GFRI, Gandhinagar regarding research demonstration, renovation of Hi-Tech nursery, high quality raising seedlings and training works for financial year 2021-22.

**(ii) VVK Training**

Three-day training programme for farmers and field functionaries under Van Vigyan Kendra, was with the help of Gujarat Forest Department during 27-29thOctober, 2021 at Gujarat Forest Research Institute (Gujarat). A total 39 participants (30 forest staffs and 9 farmers) attended the training. Both classroom lecturers and field visits were included in this training programme. Participants learned about natural resource management for enhancing forestry production, Tree species and agroforestry in Gujarat, Sandalwood cultivation, medicinal plant cultivation and income, forest biodiversity, MFP, employment in producing quality planting material and livelihood and agroforestry, Sustainable Development Goals (SDGs), etc. During the field visit, the participants learned about medicinal plant of Gujarat at Medicinal Garden of GMPB, Gandhinagar, the advance techniques through demonstrations of vegetative propagation of tree species, raising high quality seedlings, vermi-compost and different trial at Basan nursery, Gandhinagar.

**Figure 15:** VVK training at GFRI, Gandhinagar during October, 2021.

## (c) Kalka Mata Nursery, Udaipur

### (i) Establishment of VVK

Couple of meetings were organized between AFRI and RFD for discussion over establishment of New VVK at Udaipur in Aravali region of Rajasthan. VVK site was finalized to be established at Kalka Mata Nursery, Udaipur. An MoU was signed between AFRI and DFO (S), Udaipur on 4$^{th}$October, 2021 for the same.


**Figure 16:** Signing of MoU between AFRI and RFD for establishment of New VVK, Udaipur on4$^{th}$October, 2021.

### (ii) Establishment of high-tech nursery

Poly house (20 m × 28 m area) was constructed with all necessary equipment and facilities at Kalka Mata Nursery, Udaipur.

**Figure 17:** Newly constructed Poly house at Kalka Mata nursery at Udaipur

### (iii) VVK training

VVK training was organized on “Role of forest for soil and water conservation” for forest functionaries, VFPC members and farmers (47 trainees) at KVK Udaipur during 23–25$^{th}$March, 2022. They learned about soil water conservation techniques in forestry, effectiveness of soil water conservation devices, plantation techniques, cultivation of horticultural species, soil and water

conservation in agroforestry, medicinal plant production through soil and water conservation.During the field visit, the participants also learned about agroforestry systems, budding and grafting techniques, control of insect pest and pathogen in field at KVK Udaipur. They also visited the soil and water conservation works of forest department and at Kalka Mata nursery, Udaipur.

**Figure 18:** VVK training at KVK Udaipur in March, 2022.

**(iv) Display materials**

Photo gallery was prepared. Display materials (LED poster (40 Nos.) and photo frame (10 Nos.)) were prepared. Display stands (8 Nos.) were procured for display.

**VVK/KVK Networking:**

- An e-copy of the "Information Booklet" displaying the research related achievements and works published by AFRI, Jodhpur was sent through e-mail to Krishi Vigyan Kendras under Networking of ICAR of Rajasthan and Gujarat's Zone in the month of May, 2021.
- An e-copy of the pamphlet "Importance of good seeds, method of selection and collection" published by AFRI was sent through e-mail to Krishi Vigyan Kendras of Rajasthan and Gujarat Region in the month of June,2021.
- An e-copy of the pamphlet “Identification and Prevention of Pests and Diseases in Mehndi” published by AFRI, was sent to Krishi Vigyan Kendras of Rajasthan and Gujarat’s region through e-mail in the month of July,2021.
- E-copy of the pamphlet “Rohida: Marwar Teak (One Step towards Genetic Improvement)” published by AFRI was sent to Krishi Vigyan Kendras of Rajasthan and Gujarat Region through E-mail in the month ofAugust, 2021.
- Virtually SAC meeting of KVK Gudamalani, Barmer was attended by Dr. Bilas Singh, AFRI, Jodhpur on 3rdAugust, 2021.
- An e-copy of the leaflet "Giloy" (*Tinospora cordifolia*) - wild 'mears' published by AFRI was sent to the Krishi Vigyan Kendras of Rajasthan and Gujarat Zone, through e-mail in the month of September,2021.
- Link of e-copy of "AFRI Darpan" (Quarterly magazine - July to December, 2020,) published by AFRI was sent to Krishi Vigyan Kendras of Rajasthan and Gujarat Region via e-mail in the month of October, 2021.

- An e-copy of the leaflet published by AFRI on "Kair: *Caparis Decidua*" was sent to the Krishi Vigyan Kendras of Rajasthan and Gujarat Region through e-mail in the month of November, 2021.
- E-copy of the leaflet, published by AFRI on "Ayurvedic Medicine for Boons: Ashwagandha (*Withaniasomnifera*, Dunal)" was sent to Krishi Vigyan Kendras of Rajasthan and Gujarat Region via mail in the month of January,2022.
- In collaboration with KVK, Jaisalmer (Raj.), 3-day training programme was organized at VVK, Bikaner during 06–08$^{th}$March,2022.
- In collaboration with KVK, Udaipur(Raj.), 3-day training programme was organizedat VVK, Udaipur during 23–25$^{th}$March,2022.

# 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 24×7 internet connectivity was provided to the users. Several video conferencing sessions were organized during the year. For ensuring continuous internet connectivity, The Hindi and English website of the institute were 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. Two new computers with UPS were procured. Two new and updated Aadhar-Enabled Biometric Attendance System (AEBAS) terminals were procured and installed after the biometrics based attendance was once again started after being suspended due to COVID-19 restrictions. CCTV surveillance system is being maintained at the institute. The online portal for Group-C recruitments for various posts at AFRI developed with the help of RISL, a Government of Rajasthan was utilized for management of candidates' data during written exams. 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 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 pursuing 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 are 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 NGOs. Research problems highlighted during discussions are taken under project formulations by 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 village, 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. Seven new projects (Six projects to be funded by ICFRE and one for recommended to get external funding) were approved for initiation in the next financial year by RPC held in February, 2022. 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 Mahotsava. 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

As mentioned in Annexure 7.

#### 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 in Annexure 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.

## 5.3Welfare measures for the SC / ST/ backward / minority communities

| S. No. | Name of officer & Post | Liaison Officer |
|---|---|---|
| **1.** | Sh. Deepak Kumar, Scientist B | Liaison Officer for SC |
| **2.** | Sh. S.L. Meena, ACTO | Liaison Officer for ST |
| **3.** | Ms. Kusum Lata Parihar, STO | Liaison Officer for OBC |

## 5.4 Welfare measures for women

Members of women cell meet once in a quarter and discuss rules and guideline concerning women employee at workplace. Women's day was celebrated at AFRI on 8th March 2022. All women employee attended this programme. A talk was delivered regarding women cell and its aims. Rights of women employee at workplace were explained. Women field workers were also honoured on this occasion.


**Figure 19:** Celebration held at AFRI on the occasion of Women's day (A–D).

## 5.5 HR News

**अवधि अप्रैल, 2021 से अप्रैल,2022 तक**

**स्थानान्तरण/कार्य–मुक्त/सेवानिवृत्त**

1. श्री रमेश कुमार मालपानी, उपवन संरक्षक कोदिनांक 10.04.2021 कोकार्यमुक्तकियागया।
2. डॉ. आई.डी.आर्य, वैज्ञानिक–जीअधिवर्षिताआयुपरदिनांक 30.04.2021 कोसेवानिवृत्तहुए।
3. डॉ. सरिताआर्य, वैज्ञानिक–जी दिनांक 30.04.2021 कोस्वैच्छिकसेवानिवृत्त(VRS) हुए।
4. श्रीमतीअनुराधा भाटी, लाईब्रेरियन अधिवर्षिताआयुपरदिनांक 30.06.2021 कोसेवानिवृत्तहुए।
5. डॉ. जी.सिंह, वैज्ञानिक–जीअधिवर्षिताआयुपरदिनांक 31.12.2021 कोसेवानिवृत्तहुए।
6. श्री ए.दुरई, मुख्य तकनीकीअधिकारीअधिवर्षिताआयुपरदिनांक 31.12.2021 कोसेवानिवृत्तहुए।
7. श्रीकिंगशुकमोदक, वैज्ञानिक–बी का आर.एफ.आर.आई. जोरहाटस्थानान्तरणपरदिनांक 31.3.2022 कोकार्यमुक्तकियागया ।

**नवनियुक्त/कार्यभारग्रहण**

1. श्रीमती अनिता, ने संस्थानमें उप वनसंरक्षक पद परदिनांक 06.04.2021 कोकार्यभारग्रहणकिया।

**पदोन्नति**

1. कुमारी शुभीकुल श्रेष्ठ, तकनीशियनकोतकनीकीसेवा नियम–2013 के अंतर्गतअसेस्मेंटप्रमोशन(Assessment Promotion)परदिनांक 05.04.2021 से वरिष्ठतकनीशियन के पद परपदोन्नतकियागया।

1. श्रीमानारामबालोच, भा.व.से., निदेशक, आफरीकोदिनांक 01.07.2021 APCCF सेPCCF पद परपदोन्नतकियागया ।
2. श्री अमीन उल्लाह खान, वरिष्ठ तकनीकी अधिकारी कोदिनांक 09.03.2021 से सहायक मुख्य तकनीकीअधिकारी के पद परपदोन्नतकियागया ।
3. श्री जय प्रकाशदाधीच, तकनीकीअधिकारीकोदिनांक 09.03.2021 से वरिष्ठतकनीकीअधिकारी के पद परपदोन्नतकियागया ।
4. श्रीअनिल शर्मा, तकनीकीअधिकारीकोदिनांक 14.11.2021 से वरिष्ठतकनीकीअधिकारी के पद परपदोन्नतकियागया ।
5. श्रीचरण सिंह सोंलकी, प्रवर श्रेणी लिपिककोदिनांक 30.12.2021 से सहायक के पद परपदोन्नतकियागया।
6. श्रीमती भावना शर्मा, वैज्ञानिक–डी का`दिनांक 01.01.2022 से वैज्ञानिक–ई के पद परपदोन्नत किया गया ।
7. श्रीमती रश्मि, वैज्ञानिक–ई 28.3.2022 को lien अवधि समाप्ति पर SVBPUA&T, Meerut में absorb हो गई ।

**देहावसान**

1. श्री दिनेश परमार
2. डॉ. हेमन्तकुमार शर्मा, मुख्य तकनीकीअधिकारी की दिनांक 14.05. 2021कोआकस्मिकमृत्युहोगई।

# Annexure 1-11 (total 12nos.)

## Annexure1 :Information on RTI

| RTI Applications/ Requests | No. of applications received as transfer from other P/As u/s 6(3) | Received during the month (including cases transferred to other Public Authority) | Number of cases transferred to other Public Authorities u/s6(3) | Decisions where requests/ Appeals rejected | Decisions where requests/ Appeals accepted |
|---|---|---|---|---|---|
| 1st Quarter | 00 | 10 | 00 | 00 | 10 |
| 2nd Quarter | 03 | 15 | 00 | 00 | 18 |
| 3rd Quarter | 02 | 13 | 00 | 00 | 15 |
| 4th Quarter | 04 | 25 | 02 | 00 | 28 |
| Total | **09** | **63** | **02** | **00** | **71** |
| **RTI First Appeals** | | | | | |
| 1st Quarter | 00 | 00 | 00 | 00 | 00 |
| 2nd Quarter | 00 | 00 | 00 | 00 | 00 |
| 3rd Quarter | 00 | 02 | 00 | 00 | 01 |
| 4th Quarter | 00 | 03 | 00 | 01 | 02 |
| **Total** | **00** | **05** | **00** | **01** | **03** |

## Annexure 2: Information on Vigilance Cases

| Information on the vigilance cases | | | | | | |
|---|---|---|---|---|---|---|
| S.No. | Vigilance cases carried forward from previous years | Vigilance cases initiated in the year | Vigilance cases disposed | Vigilance cases pending | Nature of such cases | Remarks, if any |
| | NIL | | | | | |

## Annexure 3: Information on Audit Objections

| S. No. | Audit objections carried forward from previous years | Audit objections initiated in the year | Audit objections disposed | Audit objections pending | Nature of Audit objections | Remarks, if any |
|---|---|---|---|---|---|---|
| 1. | Nil | Audit Memo No. AFRI/CA/2021-22/2 | Disposed | Nil | Harp copy of Annual Report of AFRI for last 8 years | - |
| 2. | Nil | Audit Memo No. AFRI/CA/2021-22/3 | Disposed | Nil | Organizational set-up of AFRI, objectives/functions and work, RAG Meeting etc. | - |
| 3. | Nil | Audit Memo No. AFRI/CA/2021-22/8 | Disposed | Nil | Details on Parliamentary Questions | - |
| 4. | Nil | Audit Memo No. AFRI/CA/2021-22/10 | Disposed | Nil | Research Projects | - |
| 5. | Nil | Audit Memo No. AFRI/CA/2021-22/11 | | | Overview of AFRI | - |
| 6. | Nil | Audit Memo No. AFRI/CA/2021-22/15 | Disposed | Nil | Details of In-house and Sponsored Projects | - |
| 7. | Nil | Audit Memo No. AFRI/CA/2021-22/28 | Disposed | Nil | Year wise project details | - |
| 8. | Nil | Audit Memo No. AFRI/CA/2021-22/20 | Disposed | Nil | Information on Symposia/Seminars/ Workshops/ Exhibition/ Training Programme/ Annual day etc. | - |
| 9. | Nil | Audit Memo No. AFRI/CA/2021-22/26 | Disposed | Nil | Details MoUs signed during last eight years | - |

## Annexure 4 :Email and postal addresses

**Director**

**Arid Forest Research Institute**

P.O. Krishi Upaz Mandi, New Pali Road, Jodhpur, 342005,

Email: dir_afri@icfre.org, groupco_afri@icfre.org

Phone: 0291-2742549,2729104, FAX: 0291-2722764

## Annexure 5: List of abbreviations

| | |
|---|---|
| AF&ED | Agroforestry and Extension Division |
| AFRI | Arid Forest Research Institute |
| AM | Arbuscular 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 Ribonucleic 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 | Government 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 Biotechnology & Nanotechnology |
| IBA | Indole Butyric Acid |
| ICAR | Indian Council of Agriculture Research |
| ICRAF | International Council for Research on Agroforestry |
| IES | Indian Engineers Service |

| | |
|---|---|
| IFFCO | Indian Farmers Fertilizer 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 | Phosphorus 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 |

## Annexure 6: Details of trainings organized (HRD Trainings)

| Sr. | Topic | Duration | | Participants | | Overall feedback of participants |
|---|---|---|---|---|---|---|
| | | Days | Date | Category | Number | |
| | Nil | | | | | |

## Annexure 6(A):Details of trainings organized (Extn. Trainings)

| S. No. | Topic | Duration and Period | | Participants | | Overall feedback of participants |
|---|---|---|---|---|---|---|
| | | Days | Date | Category | Number | |
| a. Training under VVK | | | | | | |
| 1. | Training on Agroforestry and Nursery Management Training at VVK Bikaner | 03 | 06.03.2021–08.03.2021 | farmers and field functionaries | 84<br>31 forest staffs and 53 farmers | |
| 2. | Training on Agroforestry at VVK at ChhipardiBeedi, Rajkot (Gujarat) | 03 | 27.10.2021–29.10.2021 | Forest staff and Farmers | 39<br>(30 forest staffs and 9 farmers) | |
| 3. | Training on 'Role of forest for soil and water conservation' at KVK Udaipur | 03 | 23.03.2022–25.03.2022 | VFPC members/ Farmers/ Forest field workers | 47 trainees | |
| b. Training under DV | | | | | | |
| | Nil | | | | | |
| c. Training under GSDP | | | | | | |
| | Nil | | | | | |
| d. Other Trainings (except HRD Training) | | | | | | |
| 01. | जैवउर्वरककेप्रकार , बनानेकीविधियाँ , उपयोगिताएवंमूल्यवर्धन | 01 | 15.03.2022 | Farmers and SFD Officers | 43 | |

Category: Students, farmers, ladies, officers from SFDs, Members of JFMCs etc.

## Annexure 7: Details of participation in workshops etc.

| S. No. | Topic | Duration | | Participants from the Institute | |
|---|---|---|---|---|---|
| | | Days | Date | Category | Number |
| 1. | Webinar on Advancements in Teak cultivation: Genetic Resources & Technologies hosted by IFGTB, Coimbatore | 01 | 16.07.2021 | Scientist | 03 |
| 2. | Training on Introduction to Remote Sensing, GIS and GNSS in forestry by Remote sensing Institute, Dehradun | 05 | 02.08.2021–06.08.2021 | Scientist | 02 |
| 3. | National Stakeholder's Consultation Workshop on Evaluation of the Working/Effectiveness of Forestry Extension System through the Van Vigyan Kendras and Recommendation for its Strengthening. | 01 | 26.08.2021 | Scientist | 01 |

| | | | | | |
|---|---|---|---|---|---|
| 4. | National Consultation workshop for the stakeholders on 'Development of Roadmap for Institutional and Policy Mainstreaming of Sustainable Land and ecosystem Management (SLEM) in India. | 01 | 27.08.2021 | Scientist | 01 |
| 5. | Workshop on Application and limitation of Forest Biotechnology in Propagation, Improvement & Conservation | 01 | 03.09.2021 | Scientist | 01 |
| 6. | IUFRO World Day-Digital Forest Service Forum 2021 Webinar | 01 | 29.09.2021 | Scientist | 01 |
| 7. | Efficiency of arbitrary and semi-arbitrary markers for assessing genetic diversity in natural populations of *Tecomella undulata* – An important timber yielding tree species of Rajasthan.In Souvenir cum Abstracts/Proceedings: 3rd International conference on Global Initiatives in Agricultural Forestry and Environmental Technology Development Society (AETDS). | 02 | 17.10.2021–18.10.2021 | Dr. Desha Meena (Scientist C) and Dr. Tarun Kant (Scientist F) | 02 |
| 8. | Bioremediation of soil persistent pesticides by microbes: A novel approach for pesticide waste management. In Souvenir cum Abstracts/Proceedings: 3rd International Conference on "Global Initiative in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)" | 02 | 17.10.2021–18.10.2021 | Dr. Shiwani Bhatnagar (Scientist D) and Dr. Desha Meena (Scientist C) | 02 |
| 9. | "Co-expression Network Based Mining of 140 Cross-talking Salinity-implicated Genes from Trees" in 44th All India Botanical Conference of the Indian Botanical Society organized by Department of Botany, JNV University, Jodhpur | 01 | 19.10.2021 | Dr. Tarun Kant (ScientistF) | 01 |
| 10. | Capacity building workshop for state forest department for developing state REDD+ action | 02 | 21.10.2021–22.10.2021 | Sh.S.N.Murthy (Scientist B),Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B) | 03 |
| 11. | Online training in the "Economic valuation of forest" | 08 | 22.10.2021–29.10.2021 | Sh.S.N.Murthy (Scientist B) | 01 |
| 12. | National Conference on Clonal Forestry in Eco-restoration(NCCFER-2021) held at FRCER, Prayagraj | 02 | 10.11.2021–11.11.2021 | Dr. Tarun Kant (Scientist F), Dr. Desha Meena (Scientist C), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor | 04 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | (Scientist B) | |
| 14. | ICFRE-IUFRO International Workshop on Forest and Landscape Restoration; session IV: FLR- Financing and Building Capacities. | 01 | 12.11.2021 | Dr. Tarun Kant (Scientist F) | 01 |
| 15. | Online training in the “Cultivation,processing techniques and management of NWFPs including medicinal plants” | 05 | 22.11.2021–26.11.2021 | Sh.S.N.Murthy (Scientist B) | 01 |
| 16. | Online training in the “Ecological Niche modeling” | 05 | 06.12.2021–10.12.2021 | Sh.S.N.Murthy (Scientist B) | 01 |
| 17. | Webinar on Nursery Techniques, cultivation and Management of Sandalwood | 01 | 10.12.2021 | Dr. M. T Hegde (Scientist F) | 01 |
| 18. | Regional Research Conference on Vocal for local: Sustainable development of Non-Timber Forest Products for livelihood generation organized by TFRI, Jabalpur | 01 | 13.12.2021 | Scientist, CTO | 02 |
| 19. | Training on "Forest Policy, Laws and Environmental Law" | 05 | 13.12.2021–17.12.2021 | Sh.S.N.Murthy (Scientist B), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B), | 03 |
| 19. | Online training on "Forest Policy, Laws and Environmental Law" | 05 | 13.12.2021–17.12.2021 | Sh.S.N.Murthy (Scientist B), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B) | 03 |
| 20. | National Conference on “Value addition and marketing of NTFPs”, Organized by TFRI, Jabalpur. | 01 | 16.12.2021 | Dr. Shiwani Bhatnagar (Scientist D), Dr. Desha Meena (Scientist C), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B), Ms. Swati Prasad, Ms. Aastha Sharma | 06 |
| 21. | Webinar on Guidelines and procedures for Clone/Variety Release in Forestry Species | 01 | 06.01.2022 | Dr. M. T Hegde (Scientist F) | 01 |
| 22. | DST sponsored online Training Program on “Natural Resource and Environment | 02 | 17.01.2022–21/01/2022 | Dr. Aditi Tailor | 02 |

| | | | | | |
|---|---|---|---|---|---|
| | Management" organized by IIFM, Bhopal | | | (Scientist B), Sh. Tanmaya Kumar Bhoi (Scientist B) | |
| 23. | Online training in the "High-tech forest nurseries for officials of Sri Lanka forest department" | 04 | 18.01.2022–21.01.2022 | Sh.S.N.Murthy (ScientistB) | 01 |
| 24. | Online training in the "Resource management and value addition of NTFPs" | 01 | 28.01.2022 | Sh.S.N.Murthy (ScientistB) | 01 |
| 25. | Interactive session and field visit to AFRI during meeting of NABARD officials | 01 | 14.02.2022 | Sh.S.N.Murthy (ScientistB) | 01 |
| 26. | DST-sponsored online Training Program on "Community Resourced Management" organized by IIFM, Bhopal between 21/02/2022 and 25/02/2022 | 05 | 21.02.2022–25.02.2022 | Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B) | 02 |
| 27. | One day PGR awareness programme under SCSP Scheme for SC community of Balesar tehsil of Jodhpur district of Rajasthan at ICAR-NBPGR,Regional station,Jodhpur | 01 | 28.02.2022 | Sh.S.N.Murthy (ScientistB) | 01 |
| 28. | Advances in smart agriculture & biodiversity conservation for sustainable development | 02 | 04.03.2022–05.03.2022 | Dr. N.K.Bohra (ScientistC) | 01 |
| 29. | One Week Compulsory Training Course for IFS Officers organized by AMITY University Noida through online mode on "The flourishing forest based handicraft industry of Western India – status, challenges and prospects". | 01 | 08.3.2022 | Dr. Tarun Kant (ScientistF) | 01 |
| 30. | One week HRD training for the ICFRE Scientists on "Wood Seasoning, Preservation and Composite Wood" at IWST, Bengaluru | 05 | 07.03.2022–11.03.2022 | Dr. M. T Hegde (Scientist F), Dr. N.K. Bohra(Scientist C), Sh.S.N.Murthy (ScientistB) | 03 |
| 31. | Advanced training in molecular biology techniques and its application organized by TFRI | 05 | 21.03.2022–25.03.2022 | Dr. Pooja Sharma (Scientist B), Dr. Anjali Joshi (Scientist B) and Dr. Aditi Tailor (Scientist B), Sh. Deepak Kumar (Scientist B) | 04 |
| 32. | Role of wood science and technology in sustainable development of handicraft sector | 30 | 29.3.2022 | Scientists/Officers/ | 30 |

| | | | | | |
|---|---|---|---|---|---|
| | status and future prospects delivered by Sh. Ravi Veer Choudhary, Asst. Director, Handicraft, Ministry of textile GOI | | | Technical Staff | |
| 33. | Online meeting held for discussions on draft working plan of Rajsamand district, Rajasthan | 01 | 29.03.2022 | Scientist | 01 |

Category: Scientists, TOs, Forest Officers, etc .

## Annexure 8: Details of Workshops/symposia etc. organized

| S. No. | Topic | Duration | | Participants | | Overall feedback of participants |
|---|---|---|---|---|---|---|
| | | Days | Date | Category | Number | |
| 1. | "Restoring degraded lands from forestry interventions"as a part of lecture series under celebrations of Azadi Ka Amrit Mahotsav | 01 | 21.03.2022 | Officials, Scientists, Technical Staff of AFRI | 80 | |
| 2. | "Gene Mining from trees using gene co-expression networks and comparative genomics for abiotic stress tolerance" as a part of lecture series under "Azadi ka Amrit Mahotsava" | 01 | 10.02.2022 | Scientist of AFRI | 30 | |

Category: Students, farmers, ladies, officers from SFDs, Members of JFMCs etc.

## Annexure 9: Details of Awareness/Demonstration programmes organized

| S. No. | Topic | Duration | | Participants | | Overall feedback of participants |
|---|---|---|---|---|---|---|
| | | Days | Date | Category | Number | |
| 1. | Research activities demonstration to M.Sc. Zoology students | 01 | 11.03.2022 | M.Sc. Students | 40 | |
| 2. | Forestry Research and Awareness demonstration programme | 01 | 09.03.2022 | Students from Govt. Sr. Sec. School, Lohawat | 55 | |
| 3. | Different Aspects of Forestry Research and Awareness Programme. | 01 | 28.02.2022 | Students of B.Sc. from NakodaPashvnath Jain Mahavidhyalay | 120 | |
| 4. | World day to combat Desertification and Drought (WDCDD) | 01 | 17.06.2021 | Scientists, Researchers, Farmers and staff of AFRI | 50 | |
| 5. | World Environment Day | 01 | 05.06.2021 | Scientists, Researchers from | 30 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | abroad, Staff of AFRI | | |
| 6. | International Day for Biological Diversity 2021 with the theme – We Are Part of Solution | 01 | 22.05.2021 | Retd. Professor, Scientists, Researchers and staff of AFRI | 30 | |

Category = Students, farmers, ladies, officers from SFDs, Members of JFMCs etc.

## Annexure 10:Details on License/ Material Transfer agreements

| S. No. | Name of Technology/ package of practices | Name of species | Name of the party | Revenue details including revenue generated and mode of payment, if any |
|---|---|---|---|---|
| | Nil | | | |

## Annexure 11: List of publications

Please prepare the list in the following order:

### Books

1. **AFRI Darpan,** June – December, 2020
2. **AFRI Darpan,** January – December, 2021

### Booklets/Brochures/Bulletins/ Pamphlets etc.

**Poster**

1. 40 LED Backlit Posters for Display

**Pamphlet**

1. Biodiversity Conservation, Climate Resilience and Human Health
2. Importance of good seeds, method of selection and collection
3. Identification and Prevention of Pests and Diseases in Mehndi
4. Rohida: Marwar Teak (One Step towards Genetic Improvement)

### Article in Seminars/Conferences/Workshops etc.

### Abstracts

1. Iqbal A., Dave N. and Kant T. 2021. *Agrobacterium*-mediated genetic transformation of *Azadirachta indica* A. Juss. (Neem) using leaf derived callus. In: Abstract Volume of 42nd Annual Meeting of Plant Tissue Culture Association (India) and International Symposium On Advances In Plant Biotechnology And Genome Editing-2021 (APBGE-2021), 8–10th April, 2021. Poster awarded 1st Prize.

2. Mehra S. and Kant T. 2021. Developing a fed-batch bioreactor prototype for the production of active cell biomass of *Commiphora wightii* (Guggul) containing guggulsterones. In: Abstract Volume of International Symposium on "Advances in Plant Biotechnology and Genome Editing" (APBGE) and 42nd Meeting of Plant Tissue Culture Association (India), 8–10thApril, 2021.

3. Bhatnagar S. and Meena D. 2021.Bioremediation of soil persistent pesticides by microbes: A novel approach for pesticide waste management. In: Proceedings of 3rd International Web Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (Theme: Food, Environmental Security and Sustainable Development) (GIAFAS-2021), 17–18th October, 2021, P.238.

4. Bhatnagar S., Sharma N., Suman R. K., Sankhla M., Khan A.U., Singh S. and Bhoi T. K. 2021.Marwar teak defoliator *Patialus tecomella* (Coleoptera: Curculionidae) infestation on *Tecomella undulata* (Sm.) Seem. (Rohida) in Rajasthan. In: Proceedings of 3rdInternationalWeb Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (Theme: Food, Environmental Security and Sustainable Development) (GIAFAS-2021), 17–18th October, 2021, P.237.

5. Bhatnagar S., Singh S., Khan A.U., Kumar B., Srivastav V. And Nirwan B. 2021. Artificial diet for laboratory rearing of *Acanthophorous serraticornis* (Olivier) Khejri root borer. In: Proceedings of 3rdInternationalWeb Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (Theme: Food, Environmental Security and Sustainable Development) (GIAFAS-2021)17–18thOctober,2021, P.237.

6. Bhoi T. K., Singh S. and Bhatnagar S. 2021. Habitat Management of Green lacewings: A Potential Biocontrol Predator in Agroforestry System. In: Proceedings of 3rdInternationalWeb Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (Theme: Food, Environmental Security and Sustainable Development) (GIAFAS-2021), 17–18thOctober, 2021, P.105.

7. Meena D. and Bhatnagar S. 2021 Trees for Remediation. In: Proceedings of 3rd International Web Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (Theme: Food, Environmental Security and Sustainable Development) (GIAFAS-2021),17–18thOctober,2021, P.137.

8. Meena D. and Kant T. 2021. Efficiency of arbitrary and semi-arbitrary markers for assessing genetic diversity in natural populations of *Tecomella undulata* – an important timber yielding tree species of Rajasthan. In: Abstract Volume of 3rd international conference on Global initiatives in Agricultural Forestry and Environmental Technology Development Society (AETDS),17–18thOctober, 2021.

9. Kant T. 2021. Co-expression Network Based Mining of 140 Cross-talking Salinity-implicated Genes from Trees. In: Abstract Volume of 44th All India Botanical Conference of the Indian Botanical Society organized by Department of Botany, JNV University, Jodhpur, 19thOctober, 2021.

10. Hegde M. 2021. Variation in Growth Traits and Wood Density among 14 Year Old *Acacia mangium* Half-sib Families Paper was Presented during 3rd IUFRO Acacia Conference Embracing Transformation for Sustainable Management of Industrial Forest Plantations (online) held in Malaysia, 26–28th October, 2021.
11. Hegde M. 2021. Evaluation of Early Growth Performance of *Acacia auriculiformis* Clones across Contrasting Sites in Southern India. Paper was presented during 3rd IUFRO Acacia Conference Embracing Transformation for Sustainable Management of Industrial Forest Plantations (online) held in Malaysia, 26–28thOctober, 2021.

12. Hegde M. 2021. Development of *Acacia auriculiformis* clones with better stem form and faster growth. In: Abstract Volume of the National Conference on Clonal Forestry in Eco-restoration(NCCFER-2021) held at FRCER, Prayagraj,10–11th November, 2021,P.59.
13. Hegde M., Durai A., Bohra N. K. and Nicodemus A.' 2021. Selection of suitable clones of *Casuarina* for planting in saline and inland areas of Gujarat based on early growth performance. In: Abstract Volume of the National Conference on Clonal Forestry in Eco-restoration (NCCFER-2021) held at FRCER, Prayagraj,10–11th November, 2021, P.60.
14. Kant T., Mehra M. and Parmar A. K. 2021. Applicability of Clonal Propagation versus Somatic Embryogenesis - A case study in *Commiphora wightii* ('Guggul'), a critically endangered medicinal plant. In: Abstract Volume of the National Conference on Clonal Forestry in Eco-restoration(NCCFER-2021) held at FRCER, Prayagraj,10–11thNovember, 2021, P.31.
15. Meena D., Joshi A. and Tailor A. 2021. Role of Macro- and Micro-propagation Techniques in Cloning of Trees. In: Abstract Volume of the National Conference on Clonal Forestry in Eco-Restoration (NCCFER-2021) held at FRCER, Prayagraj,10–11thNovember, 2021, P.48.
16. Meena D. and Kant T. 2021. Selection of candidate plus trees of *Tecomella undulata* (Rohida) – Step towards establishment of clonal orchards. National Conference on Clonal Forestry in Eco-restoration (NCCFER-2021) held at FRCER, Prayagraj,10–11th November,2021, P.85.
17. Bhatnagar S., Singh S., Khan A.U., Sharma N. and Suman R. K. 2021.Non-timber forest products (NTFPs) in context of climate change. In: Souvenier and compendium of abstracts of National Conference on value addition and marketing of NTFPs, 16th December, 2021, P.31.
18. Joshi A. and Tailor A. 2021. Utility of *Commiphora wightii* (Arn.) Bhandari and approaches for its conservation. In: Abstract volume of Conference on Value addition and marketing of NTFPs organized by TFRI, Jabalpur, 16thDecember, 2021.
19. Tailor A. 2021. Oils and biofuels: Important NTFPs of the arid regions of India. In: Abstract volume of Conference on Value addition and marketing of NTFPs organized by TFRI, Jabalpur, 16thDecember, 2021.

## Popular articles

- नरेन्द्र कुमार कडेला, एस. आर. बालोच, कुल्लोली रवि किरण निन्प्पा. २०२१. फोग (*केलिगोनम पोलीगोनोइड्स* लिन्न.) : राजस्थान का एक बहुपयोगी मरुस्थलीय पादप। अनुसन्धान ई पत्रिका, ०५ : २६-२८
- सीमा कुमार, भारतवीर जयंत, मूलचंद खत्री, विकास कुमार परमार. २०२१. विलायती बाबूल: वरदान या अभिशाप। आफरी दर्पण, ०१-०४ : ०२-०५
- एस. आर. बालोच, नरेन्द्र कुमार कडेला, रेखा राणा. २०२१. तीन पारिस्थिकी तंत्र का संगम : विरात्रा माता मंदिर चौहटन (बाड़मेर)। तरुचिन्तन ०१-०४ : ५-७
- संगीता सिंह, तन्मय कुमार भोई, अतिराज राठी, इफ्रा खान. २०२१. जैव उर्वरक और उस का महत्व। आफरी दर्पण, ०१-०४ : १०-१२

- शिवानी भटनागर, अमीन उल्लाह खान, देशा मीणा, राज कुमार, नेहा शर्मा, आस्था शर्मा. २०२१. रोहिड़ा के संतती परिक्षण (**Progeny-Trial**) में दीमक का संक्रमण एवं उसका प्रबंधन। आफरी दर्पण, ०१-०४ : १७-१८
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