CHAPTER VI

ARID FOREST RESEARCH INSTITUTE JODHPUR

Arid Forest Research Institute (AFRI), situated at Jodhpur in Rajasthan, is one of the Institutes under an autonomous council under the Ministry of Environment and Forests, Indian Council of Forestry Research and Education (ICFRE). The main objective of the Institute is to carry out research in forestry in order to develop technologies to enhance bio-productivity and to conserve biodiversity in the arid and semi-arid region of Rajasthan, Gujarat and Dadra & Nagar Havelli.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Provenance trial on Arid Zone species [AFRI-16/FGTB-3/1992-2005]

Findings: Neem : Provenance trial of Azadirachta established in 1992 using 39 seed sources showed that provenance from Palanpur (Gujarat), Jaiselmer (Rajasthan), Amrawati (Maharashtra), Jhansi (U.P.) and Gandhinagar (Gujarat) performed better than others. Palanpur provenance was found best in performance.

Rohida: The provenance trial of *Tecomella undulata* which was planted in the year 1992 with 13 seed sources from Rajasthan. Sunderpur Bir (Sikar) provenance was found superior in growth with a height of 3.81 m followed by Nagaur 3.55 m and Goshala 3.39 m. The girth was maximum in case of Barmer (Chotan) 30.73 cms followed by Nagaur 29.13 cms and Bhinslana 29.00 cms.

Shisham: Provenance trial for *Dalbergia sissoo* was laid out in August, 1995 from the seeds sent by FRI, Dehradun. During the year 2005 best performance has been recorded for height in Etawah 8.07 m followed by Pilibhit 7.81 m, Allahabad 7.35 m, Pratapgarh 6.14 m and Kasganj 6.13 m. In case of girth, Pilibhit has shown the best result with 77.00 cms followed by Lalitpur 46.99 cms, Allahabad 45.30 cms and Pratapgarh 45.00 cms.

Project 2: International Neem Network Provenance trial [AFRI-17/FGTB-2/1995-2005]

Findings: The International provenance trial on Neem was initiated by the FAO Neem Network and the seeds were exchanged between the participating countries during 1995. The field trials carried out during the July – August, 1996 at Jodhpur, Jaipur, Palanpur, Jabalpur, and Coimbatore, with 18 provenances including the control one. At present the trial is continuing only at Jodhpur, Jaipur and Coimbatore. The provenance which performed better in terms of height and girth are Ramanaguda (IND), Sagar (IND) and Jodhpur (IND) in trial-I and Sunyani (GHA), Myne (MYN) and Multan (PAK) in trial-II.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Studies on the role of trees in reclamation of waterlogged area and their impact on soil [AFRI-29/FEDD-6/2002-2006]

Status: An experiment was conducted in the year 2002 to screen suitable plants for waterlogged area in Indira Gandhi Nahar Priyojna (IGNP). Seedlings of 8 species, viz. *Eucalyptus camaldulensis*, *E. fastigata, E. grandis, E. rudis, E. saligna, Casuarina cunninghamiana, C. glauca*

and *Corymbia tesselaris* were planted on raised bunds. Observation on growth and survival was recorded periodically. Among the species planted better growth was recorded in *E. camaldulensis* and *E. rudis*. Though survival was very high in *Casuarina cunninghamiana* and *C. glauca* but due to high biotic pressure the species could not put up best growth.

Project 2: Litter dynamics and soil changes during stand development in plantation forest [AFRI-30/FEDD-5/2002-2006]

Status: An experiment was laid out in the year 2002 to study litter dynamics and soil changes at various stages of plantation in Indira Gandhi Nahar Pariyojna (IGNP). Four age groups and six species were selected for the study. 76 litter plots of 10 m x 10 m area were laid in plantations of *Eucalyptus camaldulensis, Acacia nilotica, A. tortilis, Tecomella undulata, Prosopis cineraria* and *Dalbergia sissoo* at Nachna, Sada and Ramgarh area along IGNP. Tree height and girth at breast height (GBH) were recorded for trees inside the plot. Monthly litter collection for study is continued. Litters are separated into different components and dry weight is recorded. Annual litter production (kg/ha) from different trees in IGNP area indicated highest accumulation under *E. camaldulensis* followed by *Dalbergia sissoo*.

Project 3: Identification and screening of some suitable nitrogen fixing species of dry region for their utilization in improvement of soil fertility and biomass [AFRI-41/FEDD–6 /2003-2007]

Status: Out of 10 species tested *Rhynchosia minima, Mimosa hamata, Mucuna pruriense* and *Crotolaria burhia* species indicated better soil status and therefore selected for multiplication and testing in the field for further investigation.

Project 4: Screening different phenotypes of *Dalbergia sissoo* and *Acacia nilotica* for their tolerance to salinity and sodicity [AFRI-42/ FEDD-7/2003-2007]

Status: Highest survival (30%) and growth in height (16.12 cm) of *Acacia nilotica* was recorded in phenotype collected from *Harethar* and *Lakhani*. The survival and growth of *Dalbergia sissoo* phenotype was very poor because of high salinity level. Salinity of experimental site was in the range of 8.80 – 10.88 dSm^{-1}. Soil pH and organic carbon were 7.66 – 8.86 and 0.23-0.28%, respectively.

Project 5: Provenance trials on *Acacia nilotica* and *Ailanthus excelsa* [AFRI-18/ FGTB-3/ WB/1995-2005]

Status: *Acacia nilotica*: Provenance trial was laid out in the year 1992 with 28 provenances collected from different states of India. The trial has been affected by the prolonged drought conditions in the state. The data on growth parameters have been recorded and best performing provenances for height are Shivpuri 3.26 m followed by Manikpur 3.20 m, Gurgaon 3.17 m, Hastinapur 3.13 m and Haldwani 3.13 m. The best performing provenances for girth are Makdampur 30.33 cms followed by Parlekhmundi 29.42 cms, Shivpuri 29.17 cms, Gurgaon 29.05 cms and Jhabua 28.32 cms.

Provenance trial of *Acacia nilotica*

Ailanthus excelsa: Provenance trial was laid out using seeds collected from 13 different seed sources. The provenance trial was laid out at two different sites at Jaipur and Jodhpur. This trial has been affected by the prolonged drought and low humidity conditions prevailing in the state. The data collected during this year showed that the Varanasi (3.95 m) was the best followed by Sonbhadra (3.59 m), Kazipeth (3.50 m), Mirzapur (3.41 m) and Pinjore (3.40 m). The best performing provenances for girth are; Sonbhadra 53.2 cms followed by Kazipeth 52.59 cms, Mirzapur 47.07 cms, Pinjore 46.62 cms and Varanasi 44.54 cms. The best performing provenances in terms of height at Jaipur are Bikaner (4.78 m), Jaipur (4.75 m), Varanasi (4.70 m) and Pinjore (4.48 m).

Project 6: Multilocational trials of Eucalyptus and Dalbergia clones [AFRI-31/ FGTB-7/2002-2006]

Status: A multilocational trial of *E. camaldulensis* and *D. sissoo* clones was established in August, 2003 at four different locations, viz. Dessa, Kheralu, Gandginagar and Rajpipala in Gujarat State. The objective of these trials was to evaluate and select superior clones of *D. sissoo* and *E. camaldulensis* on the basis of their growth performances.

A total of 30 clones of *D. sissoo* and 35 of *E. camaldulensis* were used for establishing multilocational clonal trials.

Project 7: Micropropagation of an important medicinal plant of the arid and semi-arid regions – Commiphora [AFRI-32/FGTB-8/ 2002-2006]

Status: Work on callus induction, multiplication and somatic embryogenesis was in progress.

Project 8: Genetic improvement of *Tecomella undulata* [AFRI- 33/FGTB-9/ 2002-2005]

Status: Based on survey conducted for availability of Candidate Plus Trees (CPTs) in different areas, 30 CPTs in the irrigated tract of IGNP canal area from the plantation raised in 1987 and 35 CPTs in the unirrigated areas in the farmers field were selected. The data has been recorded for the total height, clear bole, d,b,h, and the colour of the flower. The tree bears yellow, deep red and orange colour of flowers.

Project 9: Screening of high oil and Azadirachtin in Neem [AFRI-34/FGTB-10/ 2002-2005]

Status: Twelve hectares of progeny trials of summer and winter flowering CPTs were carried out at AFRI, Jodhpur and high Azadirachtin and high oil containing CPTs at Govindpura, Jaipur are being maintained.

Project 10: Identification of mortality factors of *Prosopis cineraria* and development of suitable management strategies [AFRI/2001-2005]

Status: It has been examined that the mortality problem primarily arose due to cumulative effects of indiscriminate and successive lopping followed by a secondary infestation of three species of root and shoot borers viz., *Aeolesthes holoserecea* Feb, *Derolus iranensis* (discicollis) Gahan and *Hypoeschrus indicus* Gahan. The affected samples reveal the presence of three highly infective species of fungi imperfectii group viz., *Alternaria* sp., *Phoma* sp., and *Botryodiploidia* sp., which cause the dieback disease in mature trees of Khejri as a result of which the tree starts drying from the top. Among other contributory factors to the problem are : continuous depletion of water table in Rajasthan owing to increasing number of tube-wells, low rain fall, change in soil property and agricultural practices and over maturity of trees.

A field experimental trial for the management of Khejri mortality has been laid out at Basuwa in Sikar district during January, 2004 in order to test the relative efficacy of different treatments for the management of infected Khejri trees. The experiment was laid out in Randomized Block Design (RBD) with seven treatments. The treatments were taken with different combinations of fungicides, insecticides and growth regulators. The lopped branches were pasted with AFRI paste (a modified chaubattia paste). The diseased samples were analysed in the laboratory and a *Colletotrichum* sp. was isolated and identified.

The most effective root treatment comprises Chloropyriphos 20 EC (300 ml) + Bavistin (300 gm) + Leader (400 ml) in 200 lt of water whereas the potential shoot treatment contains linseed oil (2 lit) + copper carbonate (1 kg) + red lead (1 kg) + Monocrotophos (2 ml).

Project 11: Studies on improving tree productivity of *P. cineraria* through VAM/ Biofertilizers [AFRI-36/Silvi-8/2002-06]

Status: VAM population studies showed that maximum number of propagules were isolated from agro forestry plantation of *P. cineraria* at Sikar and minimum from Churu. Work is in progress.

Project 12: Ethnomedical property of phyto-pathogenic fungi: screening and isolation of therapeutic products [36A/AFRI/FPD/2003-2006]

Status: Fomes species, *Aspergillus ochraceous*, *A. niger* and *A. flavus* were screened for antimicrobial activity study. These pathogenic fungi were isolated from infected trees of *Prosopis cineraria*. The results showed inhibitory action against *Fusarium* sp. The shaked culture of the *Aspergillus flavus* showed two compounds with inhibitory activity against pathogenic fungi. Further analysis is in progress.

Project 13: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI-35/ Sil-7/2002-2007]

Status: Seeds of *Dalbergia sissoo* and *Ailanthus excelsa* collected during the last year were stored at various moisture and temperature levels and were tested for moisture and germinability. It was observed that the variability of both types of seeds reduced significantly. Neem seeds collected and tested showed that physiologically mature green, green yellow and yellow fruits showed >90% germination. During storage, green yellow seeds performed better. Seeds of *Prosopis cineraria* collected by SFD, Rajasthan from four Agro-Climatic Regions (ACRs) are under seed testing. 100 seeds weight varied from 3.87 to 4.42 g while variation in germination % was from 73% to 91%. Black coloured seed of *Commiphora wightii* gave 45% germination while white coloured showed only 5% germination.

Project 14: Market survey on selected species in selected markets [AFRI-24/ FRME-1/1994]

Status: The data regarding prices of various forest products, viz. timber and fuelwood. Bamboo were collected from the markets of Jaipur and Ahmedabad on quarterly basis.

Project 15: Stand dynamics of some important tree species of Gujarat [AFRI-25/ FRME-2/2001-2006]

Status: Annual measurements were carried out in 36 sample plots of *E.* hybrid and 22 of *Acacia nilotica* laid out in Gujarat State. Data processing and plot computations have been completed which include information on stems/ha, BA/ha,

Dominant height, average height and quadratic mean diameter of the trees in the plots, volume/ha etc. The MAI in respect of total wood volume (ob), for *E.* hybrid and *A. nilotica*, ranged from 0.77 to 32.14 m^3/ha/year and 0.60 to 10.71 m^3/ha/year, respectively, depending upon age, density and site. The dominant heights in the stands varied from 5.8 m to 34.1m for *E.* hybrid and from 4.6 m to 21.1 m for *A. nilotica* depending upon site quality and age. Annual height and diameter increments and form factor for the stands have also been calculated. Preliminary total wood volume equations (over-bark and under-bark) were developed for both the species using combined variable model for estimating total volume yield in the stands. Finally total wood and merchantable volume equations for *A. nilotica* was constructed and validated.

Project 16: Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project [AFRI-6/FRME-4/1997-2003]

Status: A total of seven experimental trials exist at the salt affected area of Gangani in Jodhpur district laid out in different years (from 1997 to 2003) out of which Experiment 1 and 4 were concluded in 2003. Experiment 2, 3 and 6 were concluded in the year 2004-2005.

Experiment 2: *Salvadora persica* is a preferential halophyte, evergreen multipurpose tree, however, its slow growing nature resists its cultivation. An experiment was initiated on saline alkali sandy loam soil with eight treatments comprising of four levels of nitrogen (0, 9, 18 and 27 g of N) and two levels of gypsum (0 and @ 100% soil GR) application in a randomised block design. Results of sixth year of plant growth and biomass yield indicate that despite deficient rainfall conditions survival from 85.2 to 66.7%, was recorded in different treatments. Treatments positively influenced the growth and application of nitrogen in combination with gypsum gave better results as compared to application of nitrogen only. T_6 (gypsum + 9 g N) was the best treatment attaining 207 cm of height and 212 cm of crown diameter, which was 38% and 24% more than the untreated plants. Crescent shaped drainage trenches for individual plants helped in plant establishment and growth as it served the dual purpose of leaching of salts and water harvesting as well. The site has shown substantial improvement in soil status (reduction in soil pH and electrical conductivity and improvement in percent organic carbon content) during the study period. Growth of *S. persica* promoted the natural regeneration, dominated by halophytes, the number of plant species increased gradually. *S. persica* has the potential to make the barren salt affected area productive.

Experiment 3: *Acacia ampliceps* was planted with and without gypsum in September, 1998 on highly degraded soil. Species suffered with some casualties (more on shallow soil area) due to deficient rainfall. The overall percent survival was found as 55.4 (-5%) for control and 65 (-6%) for gypsum treated trees on deeper soil as compared to 45 (-13%) for control and 35.2 (-26 %) for gypsum treated trees on shallow soil area. *Acacia ampliceps* performs very well on deep saline-alkali soils (soil depth 60 cm to 75 cm minimum).

Experiment 5: An experimental trial of *Acacia amnicola* was laid out in August, 2000 with three planting treatments (double ridge mound S_1, elevated slope planting S_2 and simple bund planting S_3) with full gypsum requirement G_1 and control G_0. Treatment combinations were $T_1 = S_1G_0$, $T_2 = S_2G_0$, $T_3 = S_3G_0$, $T_4 = S_1G_1$, $T_5 = S_2G_1$, $T_6 = S_3G_1$. In spite of severe drought survival was maintained at 48 months of age which survival varied from 80.6% to 61.4% in different

treatments. Gypsum application positively influenced the dry biomass yield, ranging from 4% in DRM, 19% in Bund and 42 % on SRM. Cut biomass estimation in *A. amnicola* trial was determined and data analysis is under progress. Complete flowering and seed setting was observed in *A. amnicola*. Percent protein content was estimated in dried leaf (13.6–15.8%) and branch (8.1–10.8%) of various treatments.

Experiment 6: Trial was laid with three salt tolerant species namely, *Atriplex lentiformis*, *A. stocksii* and *Sueda nudiflora* and three planting techniques. *Sueda nudiflora* adapted well to the dry land stress and salt conditions. It was the best species recording nearly 100% survival, attaining maximum growth and biomass in all the three planting treatments (Double Ridge Mound (DRM), Circular Dished Mound (CDM) and control) followed by *Atriplex lentiformis*. *Atriplex stocksii* was poorest performer.

Experiment 7: A trial with two tree species, *Acacia colei* and *Azadirachta indica* was laid with three treatments of planting in August, 2001. No change in survival (from 24-36 months) was recorded and good survival was maintained in DRM (69.0%) followed by CDM structure (46%) and control (23.8%).

Experiment 8: A new experimental trial was laid in August 2003 with two fodder species namely *Ziziphus mauritiana* (Ber) and *Colophospermum mopane*. The trial was laid with two levels of gypsum (0 and 100% soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form of urea) on two modes of planting (control and circular dished mound). *C. mopane* registered 95% survival on CDM and 90% in control after one year of planting, while it was 81 and 72% for *Z. mauritiana*. Growth data recorded at 18 months showed that Ber recorded better overall average height (61 cm to 39 cm) while crown diameter was more for *C. mopane* (52 cm to 47.5 cm). In case of Ber, 10 and 16% more height and crown diameter was recorded on CDM as compared to control, while for mopane no difference in height and 10% more crown diameter was recorded. Nitrogen application increased both height and crown diameter (16%) for Ber. In case of mopane influence was on crown diameter only (15%).

Project 17: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time [AFRI-15/NWFP-4/2002-2005]

Status: The yield of petroleum ether and methanol extractives of flowers of *Calotropis procera* collected in three seasons viz., monsoon, winter and summer was determined. It was found that the yield was highest in monsoon and lowest in summer season. The yield of fractionated extracts of methanol extract showed that in case of petroleum ether, benzene and chloroform fractions, the yield was higher and in case of acetone and methanol fractions the yield was lower in monsoon season as compared to winter season. In case of ethyl acetate fraction, the yield was almost the same.

Project 18: Studies on post harvest technologies on non-traditional, under-exploited locally available timber species for suitability to handicraft and other small scale Industries [AFRI-37/NWFP-5/2002-2006]

Status: Wood logs of *Acacia tortilis* (Israili babool), *Prosopis cineraria* (Khejri) and *Prosopis juliflora* (Vilayathi babool) have been taken from experimental fields of AFRI. The logs have been sawn and treated with preservatives, 2% CCA and 2% chloropyriphos solution under pressure

of 80 psi. Moisture has been brought down to 10-12% in kiln seasoning chamber and further seasoned under natural condition. The plantation-grown wood exhibiting better shelf life compared to control. Value-added products like sofa set and utility boxes have been made out of treated wood.

Small handicraft items like pen/pencil stand have been made from treated and seasoned wood of *Acacia tortilis*, *Prosopis cineraria* and *P. juliflora* for display in fairs/ exhibitions to popularise the utilisation of lesser-known species with value addition.

Furniture from treated wood

Furniture were made from preservative treated (CCA and Chloropyriphos) under pressure treatment plant and seasoned wood of all the three plantation of lesser known timber species viz. *A. tortilis*, *P. juliflora* and *P. cineraria*.

Project 19: Survey of sandal population in Rajasthan and Gujarat states and evaluation of heartwood content and oil content [AFRI-44/NWFP-6/ 2003-2007]

Status: The oil content in sandal wood trees of Rajasthan varied from 0.9 to 3.0 %. The heartwood content was found better in naturally grown trees than trees grown on agricultural/ farmlands.

Project 20: Transfer of technology on forestry through training and demonstration [AFRI-38/SF-1/2002-2006]

Status: An Extension and Interpretation Centre has been established which was inaugurated by the DG, ICFRE on 04.07.2004 during his visit to the institute.

Project 21: Identification of key indicators and suitable strategies for sustainable Joint Forest Management in Gujarat and Rajasthan [AFRI-39/JFM-1/2002-2006]

Status: Survey works on collection of information pertaining to socio-economic status and present status of Joint Forest Management committee is in progress. So far, 125 JFM village committees (85 Rajasthan and 40 Gujarat) have been covered and the sampling survey have been completed. The committee members and villagers were interviewed and information regarding JFM Committees was collected.

Project 22: Development of suitable multi-tier farm-forestry models in IGNP command area [AFRI-39/JFM-1/2002-2006]

Status: Site at 155 RD Charanwala branch in IGNP area has been finalized. Seedling of silviculturally important species were raised at AFRI Model Nursery. Further actions will be taken after chalking out the details with Rajasthan Forest Department.

Project 23: Standardization of nursery practices in respect of selected species suitable for arid and semi-arid region [AFRI-33/ Silvi-5/DRDA/2002-2006]

Status: Planting stock required by various research divisions for undertaking different experimental trials during the year have been raised and supplied.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

Nil.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Development of silvipasture model for *Maru Gaucher Project* suitable for arid and semi-arid region of Rajasthan [AFRI-45/ Silvi-9/MGP/ 2003-2006]

Status: Technical guidance to two gram panchayats for execution of silvi-pasture rehabilitation of oran/gauchar being undertaken by them under the centrally sponsored 'Maru Gauchar Yojna' on an area of 16 ha. at each of the two villages was provided.

Project 2: Development of suitable models for urban aesthetic forestry suitable for arid and semi-arid region of Rajasthan [AFRI-28/Silvi-4/UIT/ 2001-2006]

Status: Experimental avenue plantation raised during the year 2001-02, 2002-03 and 2003-04 have been maintained during the year.

Project 3: Raising of arboretum cum botanical garden for native flora of Rajasthan [AFRI-34/Silvi-6/2002-2006]

Status: Plants belonging to 82 native tree species of Rajasthan have been maintained and an improved shade house with underground water tank was constructed.

Project 4: Survey and silvicultural management practices for commercially exploitable medicinal plants of arid and semi-arid areas of Rajasthan [AFRI-35/Silvi 8/MPB/ 2002-2005]

Status: Over 210 species of medicinal plants are being traded in 18 districts of Rajasthan. *Emblica officinalis* has maximum demand followed by *Cassia angustifolia*. Total quantity of medicinal plants traded in Rajasthan is more than 7,30, 000 kg. Jaipur tops among the surveyed districts with 40% trading of medicinal plants followed by Jodhpur (22%), Ajmer (16%), Udaipur (10%) and Chittorgarh (4%). Other districts amount 8% of trade. Germplasm bank has been established with 150 medicinal plants. Field trials/cultivation trials on *Commiphora wightii* (Guggal), *Aloe vera* (Guarpatha), *Catharanthus roseus* (Sada Bahar), *Withania somnifera* (Aswagandha), *Ocimum sanctum* (Tulsi) and *Asparagus racemosus* (Shatavari) are in progress.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Ecological and environmental assessment in the on-shore area of RJ-ON-90/2 block, Rajasthan

Status: Literature on floral diversity, faunal diversity, nesting place and migration paths of wildlife were collected from various sources. Field visits were carried out and interactions were made with the villagers and staff of forest department. Based on the literature survey and people interactions, a preliminary report was prepared.

Project 2: Study of characteristic features pertaining to bio-drainage potential of some selected tree species

Status: The project has been initiated at three sites.

Project 3: Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems

Status: The training programme for the Panchyat Raj Institutions (PRI) functionaries i.e Village Sarpanch, Up-Sarpanch, Panch, BDO's, Gram Sevaks, Gram Sabha members and farmers etc. of the 10 Desert districts, in two phases has been prepared. The project period is over two years.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Rajasthan	2*	24	3
Gujarat	-	3	-
Common to both Rajasthan and Gujarat	-	6	-

* Project concluded during 2003-2004 but report submitted by PI during 2004-2005.

TECHNOLOGY ASSESSED AND TRANSFERRED

1. Preparation of AFRI paste and its application to the affected Khejri trees has been demonstrated through training programmes of the farmers and through imparting training to the agricultural officers.
2. Indigenous and exotic species, *Atriplex lentiformis* and *Acacia amliceps* were screened for afforestation technology on salt affected lands. Seeds of the species and afforestation technology were supplied to State Forest Department of Gujarat and Rajasthan.
3. VAM production facility was developed at TRC, Gandhinagar, State Forest Department, Gujarat. Demonstration for preparation of VAM inoculum containing five different combinations of species of VAM fungi, viz. *Glomus fasciculatum*, *G. microcarpum* and *G. aggregatum* including consortium inoculum was given to the field officers.

EDUCATION AND TRAINING

Attended

International

1. Dr. Tarun Kant has been awarded one year Post Doctoral Fellowship from 16th August, 2004 to 15th August, 2005 under Biotechnology Overseas associateship 2003-2004, Govt. of India, Dept. of Biotechnology at the Department of Plant Sciences, University of Cambridge, U.K.
2. Shri N. Ravi, R.O. attended Third Country Training Programme on genetic conservation of indigenous species for

breeding purposes at Yogyakarta, Indonesia from 6th to 19th March, 2005.

Organised

1. Organized 10 nos. of 3 days training programme on Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems from 23rd August, to 6th October, 2004 for the PRI functionaries i.e Village Sarpanch, Up-Sarpanch, Panch, BDO's, Gram Sevaks, Gram Sabha members and farmers etc. of the 10 Desert districts in Phase-I at AFRI in 10 batches of 40 each of PRI functionaries and forest field staff in 4:1 ratio. In total 437 participants comprising of 269 PI Functionaries, 1 BDO, 89 Gram Sevak and 79 Forest officials including 8 womens attended the training programme.
2. As a multidisciplinary approach of watershed management, inputs on nursery and plantation techniques, biofertilzers, agroforestry models, moisture and soil conservation techniques, horticulture, on animal husbandry, pasture management were given by the resource persons from both within the institute and outside.
3. Three students each from three Universities imparted one month training in tissue culture and biotechnology.

LINKAGES AND COLLABORATION

National

1. National Bureau of Plant Genetic Resources, New Delhi
2. Tata Energy Research Institute, New Delhi
3. Central Arid Zone Research Institute, Jodhpur
4. National Botanical Research Institute, Lucknow
5. Rajasthan Forest Department
6. Gujarat Forest Department
7. Ayurvedic units

International

1. Asia Pacific Association of Forestry Research Institutions (APAFRI), Malaysia.
2. Centre for International Forestry Research (CIFOR), Indonesia.
3. International Union of Forest Research Organizations (IUFRO).
4. The Guangdong Forest Research Institute, Longdong, Guangzhdou, P.R. China.

PUBLICATIONS

Chapters in books

1. Srivastava, K.K. and Tripathi, Y.C. (2004). Potential of phytochemical in controlling pathogenic mycobionts. In: D. Reddy, B.P. Dabral, Vinai Singh and K.K. Sood (eds.). *Forest conservation and Management in challenges of the millennium*. pp. 594-612.
2. Srivastava, K.K.; Ahmed, S.I. and Thangamani, D. (2004). Biostresses on arid and semi-arid tree plantations and their possible management strategies. In the Dr. K. Bagchee Memorial Book on Forest Pathology to be published by Forest Pathology Division, FRI, Dehradun.
3. Tomar, U.K.; Sharma, N.K.; Parveen and Emmanuel, C.J.S.K. (2003). Literature review on clonal propagation of important arid zone species. In: B.B.S. Kapoor (ed) *Advances in Resource Management,* Madhu Publication, Bikaner, pp. 70-98.

Research Papers in Scientific Journals

International

1. Chaudhuri, K.K.; Singh, G. and Bala, N. (2004). Traditional knowledge and technological innovations for productivity enhancement of degraded land of arid region. *Journal of Arid Land Studies*, 14(S): 221-224.

2. Meena, R.L. and Singh, G. (2004). Integrated Ecosystem Approach for Management of Degraded arid and semi-arid areas of north-western India. *Journal of Arid Land Studies,* 14(S): 211-214.

3. Singh, G. (2004). Growth, biomass production and soil water dynamics in relation to habitat and surface vegetation in hot arid region of Indian desert. *Arid Land Research and Management,* 17(2): 1-17.

4. Singh, G. (2004). Influence of soil moisture and nutrient gradient on growth and biomass production of *Calligonum polygonoides* in Indian desert affected by surface vegetation. *J. Arid Environment*, 56(3): 541-558.

5. Singh, G.; Bala, N.; Mutha, Sarita; Rathod, T.R. and Limba, N.K. (2004). Biomass production of *Tecomella undulata* agroforestry in arid India. *Biological Agriculture & Horticulture,* 22(2): 205-216.

6. Singh, G.; Mutha, Sarita; Bala, N.; Rathod, T.R.; Bohra, N.K. and Kacchawaha, G.R. (2005). Growth and productivity of *Tecomella undulata* based on an agroforestry system in Indian desert. *Forests, Trees and Livelihood,* 15(1):89-102.

7. Tewari, V.P. (2004). Desertification and its control through afforestation activities to increase productivity. *Journal of Arid Land Studies,* 14 (S): 57-60.

8. Tewari, V.P. (2004). Stem number development and potential stand density in the unthinned even aged *Azadirachta indica* plantations in the Gujarat State of India *International Forestry Review,* 6(1): 51-55.

9. Thangamani, D.; Ghosh, M.; Thapliyal, M.; Yasodha, R. and Gurumurthi, K. (2004). Purification of antifungal protein against blishter bark pathogen of *Casuarina equisetifolia*. *Acta Botanioca Croatica,* 63(2): 75-82.

10. Thangamani, D.; Ghosh, M.; Thapliyal, M.; Yasodha, R.; Gurumurthi, K. (2004.) Isolation of *Andrographis paniculata* leaf protein with antifungal property. *Acta phyto pathologica et Entomologica Hungarica,* 39(4): 377-381.

11. Tewari, V.P. and Arya, Ranjana (2005). Degradation of arid rangelands in Thar Desert, India: A review, *Arid Land Research and Management,* 19(1): 1-12.

National

1. Ahmed, S.I. and Kumar, Shivesh (2004). Seasonal fluctuations in the population of *Eurytoma settitibia* Gahan (Eurytomotidae: Hymenoptera), a potential stem gall chalcid of Khejri (*Prosopis cineraria* Linn) in Rajasthan. *Indian Forester,* 130 (8): 885-892.

2. Bala, N.; Kumar, Pramod; Kurdaram and Singh, G. (2004). Reclamation of saline waterlogged area through community participation. *Wasteland News*, XIX (4): 33-36.

3. Kant, Tarun and Emmanuel, C.J.S.K. (2004) Tree Biotechnology and Environmental Concerns, *J. Plant Biotechnology,* 6(1): 1-7.

4. Kumar, Pramod; Bala, N.; Singh, G.; Mutha, S.; Limba, N.K. and Bohra, N.K. (2004). Socio-economic conditions with special reference to common access resources: A case study from Gujarat and Rajasthan. *Indian Forester,* 130(9): 981-990.

5. Rathore, Mala and Meena, Rajendra (2004). Nutritional evaluation of famine foods of Rajasthan, *Indian Forester,* 130(3): 304-312.

6. Sharma, Meeta and Ahmed, S.I. (2004). *Beauveria bassiana*. Vuillemin, a potential entomogenous fungal pathogen isolated from marwar Teak defoliator, *Patialus tecomella*. Pajni, Kumar and Rose (Coleoptera: Curculionidae). *Indian Forester,* 130(9): 1060-1064.

7. Singh, G.; Rathod, T.R. and Chouhan, Sahadeo (2004). Growth, biomass production and the associated changes in soil properties in *Acacia tortilis* plantation in relation to stand density in Indian arid zone. *Indian Forester,* 130: 605-614.

Scientific Reports

1. Concluding report on Agroforestry project entitled "Agroforestry research for sustainable production in arid and semi-arid regions of Rajasthan."

2. S.I. Ahmed and K.K. Srivastava (2003). A report on the scientific approach to study the causes of mortality of *Prosopis cineraria* (L.) Druce (Khejri) in Western Rajasthan, MoEF, Govt. of India.

3. G. Singh (2004). A report on floral and faunal diversity for the parts of Jalore and Barmer district under the project 'Ecological and environmental assessment in the Onshore area of RJ-ON-90/2 block.

Proceeding

Proceeding of International Conference on "Multipurpose Tree in the Tropic : Assessment, Growth and Management" Abstract of paper from 22nd to 25th November, 2004 at Arid Forest Research Institute, Jodhpur, Rajasthan.

Scientific Brochures

Azadirachta indica A. Juss. APFORGEN Priority Information Sheet by V.P. Tewari and D.K. Mishra. Published by the APFORGEN Secretariat, Forest Research Institute, Malaysia (FRIM), Kepong, 52109, Kuala Lumpur, Malaysia.

CONSULTANCY

Ministry of Rural Development, Department of Land Resources, Government of India and Department of Rural Development, Land development cell, Government of Rajasthan assigned the evaluation work of Ecological and environmental assessment in the Onshore area of RJ-ON-90/2 block, Rajasthan.

CONFERENCE/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organised

1. IUFRO International Conference on "Multipurpose Trees in the Tropics: Assessment, Growth and Management" from 22nd to 25th November, 2004 was organized. 32 foreign and 170 Indian delegates participated in the conference. The conference was inaugurated by the Hon'ble Minister of State for Environment & Forests, Govt. of India, Shri Namo Narain Meena and the function was presided over by Dr. Sim Heok-Choh, Executive Director,

APAFRI. Prof. Christoph Kleinn, IUFRO representative, delivered the keynote address. Shri R.P.S. Katwal, DG, ICFRE delivered the welcome address.

Inauguration of International Conference on Multipurpose Trees in the Tropic at AFRI, Jodhpur

IUFRO International Conference on MPTS

2. An interactive meeting was organized at Arid Forest Research Institute, on 20th August, 2004 to establish liaison with various end users and possible collaborators for smooth implementation of the research project. Eighteen (18) delegates representing different departments, NGOs and farmers and 25 Scientists/Officers from the institute participated and discussed on the abovementioned points in the meeting.

3. Research Advisory Group (RAG) meeting was organized from 15th and 16th February, 2005. The twenty eight on-going research projects were presented before the RAG members for necessary recommendations and five new projects were presented for their prioritization.

Participation

1. Dr. R.L. Srivastava, IFS, Director has participated and chaired a session in National symposium on "*Conversing Space Technologies for National Development*" at Jaipur from 3rd to 5th November, 2004.

2. Dr. R.L. Srivastava, IFS, Director has participated and chaired one session in National seminar on *"Recent advances in analytical chemistry"* at JNV, Jodhpur from 29th November to 1st December, 2004.

3. Shri R.L. Meena, IFS, GC(R) has attended Regional Workshop on "*Emerging trends and issues in forestry*" at Gandhinagar, Gujarat from 4th and 5th November, 2004 and made presentation on *"Thar Biodiversity: its traditional and technological conservations efforts"*.

4. Dr. G. Singh attended 'National Seminar on Recent Advances in analytical Chemistry' held at Jai Narain Vyas University, Jodhpur from 29th November to 1st December, 2004

and presented paper on "*Changes in soil properties as a result of irrigation with effluent of varying chemistry and impact on tree seedlings*".

5. Dr. R.L. Srivastava, IFS, Director AFRI and Shri R.L. Meena, IFS, CF attended workshop on "Rehabilitation of mined land: Protection of environment and helping livelihood" organized at Hotel Taj Hari from 18th and 19th June, 2004.

6. Dr. R.L. Srivastava, Director participated in 'Paryavaran Padyatra 2004' from Parsusram Mahadev to Rajpura nursery (Pali) organized by Rajasthan Forest Department.

7. Shri R.L. Meena, CF and Shri Arvind Apte, DCF attended '*Khejdli Shahid Mela*' at Khejarli and joined 'Paryavaran Padyatra 2004' organized by Rajasthan Forest Department from Jaswantpura to Sundhamata (Jalore).

8. Dr. R.L. Srivastava, Director, Shri K.K. Chaudhuri and Dr. D.K. Mishra, participated in the Brain Storming session on "Herbs for the health of armed forces in desert area" at Defence Lab., Jodhpur on 13th August, 2004.

9. Dr. R.L. Srivastava, IFS, Director, attended chaired the technical session during the workshop on "Integrative Approaches for Assessing Extent and Cause of Degradation in Arid Community Rangelands" organized at CAZRI on 26th May, 2004.

10. Dr. R.L. Srivastava, IFS, Director, attended National workshop on "Famine and water conservation-myths and realties" from 8th to 10th June, 2004.

11. Dr. R.L. Srivastava, IFS, Director, attended "2nd Global summit on medicinal plants" from 25th to 29th October, 2004 at New Delhi.

12. Dr. G. Singh, Scientist-E attended one day workshop on "Persistent organic pollutants at Vadodara" (Gujarat) on 19th May, 2004.

13. Smt. Sangeeta Tripathi, RA-I and Shri R.K. Gupta, RA I attended workshop on Training module of Integrated Watershed management Programme at IGPR&GVS, Jaipur from 15th to 17th April, 2004.

Extension Publications

1. "AFRI Darpan"- Quarterly Newsletter for the period from April to June' 2004. Also updated the AFRI Brochure which constituted a part of reading materials for the delegates of International Conference on Multi Purpose Tree species-Assessment, Growth and Management held at AFRI from 22nd to 25th November, 2004.

2. Updated the AFRI Brochure in Hindi, depicting the research findings and technology developed by the institute.

3. Study Material for the training programme - Shri Balbir Singh, Head, AF&E Div., Smt. Sangeeta Tripathi and Shri R.K. Gupta.

4. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Cassia angustifolia* Vahl.: A green gold for arid areas. Extension brochure.

5. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Chlorophytum borivilianum* S. and Fernandes.: Tuberous power for healthy life. Extension brochure.

6. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Emblica officinalis* Gartn.: The store house of vitamin C. Extension brochure.

7. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Commiphora wightii* Arn.: A shining tree of golden gum. Extension brochure.

8. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Ashwagandha, *Withania somnifera* Linn (Dunal): Winter Cherry.

9. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Giloe, *Tinospora cordifolia* (Wild). Miers: The Climber of Longevity.

10. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Sarpgandha, *Rauwolfia serpentina* Benth. Ex. Kurz: Bitter root to better high blood pressure.

11. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Isabgol, *Plantago ovata* (Forsk). Natural defence to digestive disorders.

12. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Bhui Amla, *Phyllanthus amarus* Schum & Thonn: The wonder herb.

13. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Tulsi, *Ocimum santum* Linn: The sacred plant.

14. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Ratanjot, *Jatropha curcas* L: The bio-diesel plant.

15. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Mulhatti, *Glycyrrhiza glabra* Linn: Sweet Root sweeter than sugar.

16. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Shatavari, *Asparagus racemosus* Willd.

17. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Kalmegh, *Andrographis paniculata* (Wall) Ness. The King of bitters.

18. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Guar Patha, *Aloe vera* (Linn.) Burm.f. Lily of the Desert.

AWARDS

1. Dr. G. Singh, Scientist-E and Shri N. Bala, Scientist-C were awarded S.K. Seth Prize for best paper in Environment and Ecology in *Indian Forester,* 2002.

2. Dr. G. Singh, Scientist-E was conferred ICFRE AWARD for excellence in Forestry Research for the year 2003-2004.

DISTINGUISHED VISITORS

1. Shri Namo Narayan Meena, MOS (E&F), Govt. of India on 23rd November, 2004.

2. Dr. Sim Heok-Choh, Executive Director, APAFRI, Malaysia; Dr. Markku Kanninen, Director, Environmental Services and Sustainable Use of Forests Program, CIFOR and 30 other foreign scientists from 22nd to 25th November, 2004.