150 YEARS OF CELEBRATING THE MAHATMA

सत्यमेव जयते

75 Azadi Ka Amrit Mahotsav

ANNUAL REPORT
(2020-21)

घर-घर औषधि योजना

OFFICE OF THE CHIEF CONSERVATOR OF FORESTS
(SILVICULTURE), RAJASTHAN, JAIPUR

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ANNUAL REPORT (2020-21)

OFFICE OF THE CHIEF CONSERVATOR OF FORESTS
(SILVICULTURE), RAJASTHAN, JAIPUR

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IFS
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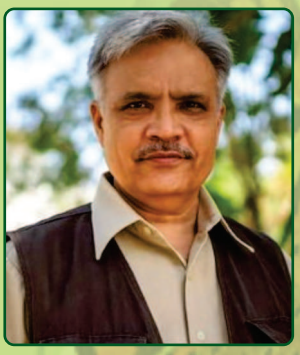
Principal Chief Conservator of Forests (HoFF),
Rajasthan
प्रधान मुख्य वन संरक्षक (वन बल प्रमुख),
राजस्थान



FOREWORD

It gives me immense pleasure in bringing out the Annual report 2020-21 of the State Silviculture unit of Rajasthan. Research and Development (R & D) plays a crucial role in development of every sector. The Silviculture division of Rajasthan Forest Department undertakes research on various aspects of applied forestry in collaboration with AFRI (ICFRE), Jodhpur to make inputs relevant to contemporary issues of society and forests.

Forest Department has conducted a number of research studies and has developed technologies which are relevant for use by different stakeholders including forest managers, researchers, farmers etc. In addition, considerable amount of information in augmentation of natural resource planning and management of state forests have been generated, published and disseminated by the unit. The present report focuses on the outcome of diverse activities for dissemination of significant expertise.

The on-going projects and other various activities taken up by the Silviculture division in the year 20-21 are being published in a concise format. I hope this document will bridge the gap between knowledge and action and facilitate transfer and dissemination of information to all stakeholders and end users. We also welcome suggestions for further improvement of this Annual Report.

I appreciate the efforts of Shri Arijit Banerjee APCCF, Shri Rajiv Chaturvedi CCF, Shri Mukesh Tiwari DCF and team for doing the vital work to support forestry.

(Dr. Deep Narayan Pandey)

Rajiv Chaturvedi
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सत्यमेव जयते

Chief Conservator of Forests
(Silviculture) Rajasthan
मुख्य वन संरक्षक
(वन वर्धन) राजस्थान

PREFACE

Silviculture Wing of the State of Rajasthan is engaged in research activities and development of new methodologies in the field of forestry for various stakeholders including forest managers, researchers, farmers etc. Progress of the various activities of Silviculture Wing during the financial year 2020-21 are being published in the form of Annual Report for the benefit of stake holders. The Annual Report formally reflects Silviculture Wing's activities up until 31 March, 2021.

This report has been compiled based on the research and other activities carried out by forestry research centers of the Silviculture Wing namely Grass Farm Research Centre, Jaipur, Govindpura Research Centre, Jaipur, World Forestry Arboretum Research Centre, Jaipur, Banki Research Centre, Udaipur, Seed Testing Laboratory, Soil & Water Testing Laboratory, Jaipur and AFRI, Jodhpur.

I wish to express my sincere thanks to Sh. Mukesh Kumar Tiwari, Deputy Conservator of Forests, for his active and timely efforts in providing the necessary inputs for preparation of said report. I also express my sincere appreciation for all team members of DCF (Research), Jaipur in bringing out this document within the stipulated time period. Suggestions for further improvement of this Annual Report are welcome.

राजीव चतुर्वेदी
Rajiv Chaturvedi

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1. INTRODUCTION

1.1 Rajasthan is the largest state of the country, having a geographic area of 3, 42,239 sq. km. which constitutes 10.41% area of the country. The State can be divided into four major physiographic regions namely the western desert with barren hills; the Aravalli hills; the level rocky/sandy plains and the south-eastern plateau. Aravalli hill range divides the state in two unequal parts. Though the entire state falls under Arid and Semi arid zone yet the area North-West of the Aravalli range comprising of 12 districts viz. Jodhpur, Jaisalmer, Barmer, Pali, Jalore, Sikar, Churu, Jhunjhunu, Nagaur, Bikaner, Hanumangarh and Ganganagar comprises the Thar Desert and is around 2/3 of the area of the state.

1.2 The State is deficient in natural forest resources. The Recorded Forest Area (RFA) in the State is 32,737 Km^2 which is 9.565% of the state's geographical area. Forest Survey of India has published the State of Forest Report, 2021. Based on interpretation of satellite data 2019-20, the forest cover in the state has been assessed to the tune of 16,654.96 Km^2 which is only 4.87 % of the Geographical Area of the State.

1.3 The estimated tree cover in the state is 8,733 km^2 which is 2.55 % of its geographical area. The forest and tree cover of the state is presented in Table 1.3.1

Table 1.3.1: Forest and Tree Cover of Rajasthan-2021

(Area in km^2)		
Category	**Area**	**% of Geographical Area**
Tree Cover	8,733	2.55
Forest Cover	16,654.96	4.87
Total Forest and Tree Cover	**25387.96**	**7.41**

Main reasons for the increase of forest cover in the State are plantations and conservation activities as well as updation in interpretation.

1.4 The State forest policy has set a goal of 20% of the geographical area to be brought under Forest Cover. This would need intensive inputs in the field of Forestry Research for enhancing productivity of forests and increasing tree cover outside forest areas.

Forestry in Rajasthan is a challenging task because of the inhospitable climatic and edaphic conditions coupled with severe biotic pressure and ever increasing demand and supply gaps in forest products. Majority of tribal and other rural communities living in and around forest areas depend on forests for their livelihood and sustenance.

1.5 Thirteen districts of the state have more than 20% of the geographical area as recorded forest. These include Alwar, Banswara, Baran, Bundi, Chittorgarh, Dholpur, Jhalawar, Karauli, Kota, Pratapgarh, Sawai Madhopur, Sirohi and Udaipur districts. In these districts primary focus of the department shall be on conservation, protection and enrichment of forests that needs to be strengthened by effective mobilization of man and material resources.

Eleven districts of the state have between 5% to 20% of the geographical area as recorded forest. These include Ajmer, Bharatpur, Bhilwara, Dausa, Dungarpur, Ganganagar, Jaipur, Jhunjhunu, Pali, Rajsamand and Sikar. Apart from conservation, protection and enrichment of forests in these districts, promotion of afforestation activities in non forest areas is required to increase trees outside forests (TOF) on wastelands under Government, community and private ownership.

Remaining nine districts namely Barmer, Bikaner, Churu, Hanumangarh, Jaisalmer, Jalore, Jodhpur, Nagaur and Tonk have less than 5 % of the geographical area as recorded forest. Hence vegetal cover need to be enhanced by taking up Combating Desertification Programmes and promoting agro forestry for increasing the tree cover outside forest on wastelands under Government, community and private ownership.

1.6 A large area in Rajasthan has been categorized as wasteland having very poor or low productivity. There is, therefore, tremendous scope of taking up large scale plantations in the State. These wastelands need different technologies wherein concerted research inputs are essential.

Thus, there is an urgent need for taking up applied and adaptive nature of research, which aims toward the enhancing productivity and promoting sustainable utilization of forest produce. The research projects should address to promote forestry & allied research in response to the requirements of all stakeholders for quality, productivity and cost effectiveness in the implementation of the State Forest Policy, 2010.

1.7 To give direction to the Research Activities as per the requirement of the department and stakeholders, a Research Advisory Group (RAG) has been constituted way back in 2005-2006. The mandate of the RAG is to discuss the research needs of different stakeholders, prioritize and approve the proposed Research Projects on the basis of their utility and to review the ongoing research projects. Strategy of Forest Research as listed in Rajasthan State Forest Policy, 2010 is identification of problem for research and their prioritization through periodic dialogue among all stakeholders. Projects shall be prepared based on identified problems/ topics of research and shall be implemented after getting the approval of Research Advisory Group (RAG). Applied and adaptive nature of research will be given priority by the department. Collaborative research shall be encouraged with reputed forestry research institutions. The technologies and management practices developed by other national and international research organization relevant to Rajasthan will be tested and adopted.

2. RAJASTHAN STATE FOREST POLICY AND FORESTRY RESEARCH

2. Excerpts from Rajasthan State Forest Policy 2010 relevant to Forestry Research Objectives

Strengthening forestry research base for enhancing productivity of forest and promoting better utilization of forest produce

2.1 **Enhancement of Productivity**

The existing average growing stock of the state forests is around 10 cu M per ha as against 74 Cu M per ha of the country. There is enormous potential to enhance the growing stock by providing technical and proper material inputs as well as by using site specific technologies coupled with intensive management practices.

2.1.1 Tree improvement shall be given top most priority by selection of isolated candidate plus trees with superior phenotypic behavior and Seed Stands from plantations or natural forests by selected removal of inferior phenotypic trees. It should be ensured to collect seeds, vegetative cuttings and propagules for macro or micro propagation in the state in future.

2.1.2 Seedling Seed Orchards or Clonal Seed Orchards shall be set up in different regions as far as possible. State Silviculture Wing shall ensure to provide certified seeds of various species. Genotypically superior trees will be identified after multi-locational provenance trials followed by progeny trials.

2.1.3 Modern hi tech nurseries with temperature and humidity controlled Mist Chambers and

Net Houses will be used to produce planting stock by using root trainers and manipulated medium.

2.1.4 Quality Planting Material (QPM) shall only be used in raising plantations everywhere irrespective of initial cost increase. Bio fertilizer like *Rhizobium* and *Mycorrhyza* shall be used for boosting up the growth.

2.2 Research

The state will promote forestry and allied research to be responsive to the requirements of the stakeholders for quality, productivity and cost effectiveness in the implementation of the Forest Policy.

2.2.1 Identification of problems for research and their prioritization through periodic dialogue among all stakeholders like managers, NGO's, industries and even villagers before getting them approved by Research Advisory Groups comprising of forest officials, scientists from Research Organizations and representatives of Stakeholders.

2.2.2 Applied and adaptive nature of Research will be given priority by the department. The technologies and management practices developed by other national and international research organizations relevant to Rajasthan will be tested and adopted.

2.2.3 The department will make use of the expertise available in various research institutions and departments to undertake Forestry Research projects. Collaborative research shall be encouraged with reputed forestry research institutions.

3. ADMINISTRATIVE SETUP

3.1 At present Chief Conservator of Forests, Silviculture, Rajasthan, Jaipur is State Silviculturist and overall in charge of all forestry research activities in the State Forest Department. State Silviculturist is assisted by one Deputy Conservator of Forests (Research) and one Assistant Conservator of Forests, two Research Officers and five Range Forest Officers.

3.2 Designation and name of the officers and their work tenure for the year 2020-21 are as below:

S.No	Designation	Name of the Officer	Work Tenure
1	State Silvicultrist of Rajasthan	Sh.M.L Meena PCCF	01.04.20 - 4.08.20
		Sh.Rajiv chaturvedi CCF	04.08.20- 31.03.21
2	Deputy Conservator of Forest	Sh. S.K.Aggarwal	01.04.20-1.12.20
		Sh. Mukesh Tiwari (Addl.Charge)	01.12.20-31.03.21
3	Assistant Conservator of Forest	Sh. Mukesh Tiwari	01.04.20-31.03.21
4	Research Officer (Seed)	Sh.Ramavtar Dodwal	01.04.20-31.03.21
5	Research Officer (Soil & Water)	Sh.Ramavtar Dodwal (Addl.Charge)	01.04.20-31.03.21
6	Range Forest Officer Grass Farm, Jaipur	Sh. Rajpal Sharma (Addl.Charge)	01.04.20-31.03.21
7	Range Forest Officer Seed Collection, Jaipur	Sh. Ram Lal Kala	01.04.20-31.03.21
8	Range Forest Officer Research Farm, Govindpura, Jaipur	Sh. Ram Lal Kala (Addl.Charge)	01.04.20-31.03.21
9	Range Forest Officer World Forestry Arboretum, Jaipur	Sh. Rajpal Sharma	01.04.20-31.03.21
10	Range Forest Officer Research Farm, Banki, Udaipur	Sh. Mahendra Singh	01.04.20-28.05.21
		Sh Mitesh Sharma	29.05.20-31.03.21

4. RESEARCH CENTERS & EXISTING INFRASTRUCTURE

There are four Forestry Research Centers in the State:-

4.1 Forestry Research Center Grass Farm, Jaipur.

4.2 Forestry Research Center, Govindpura, Jaipur.

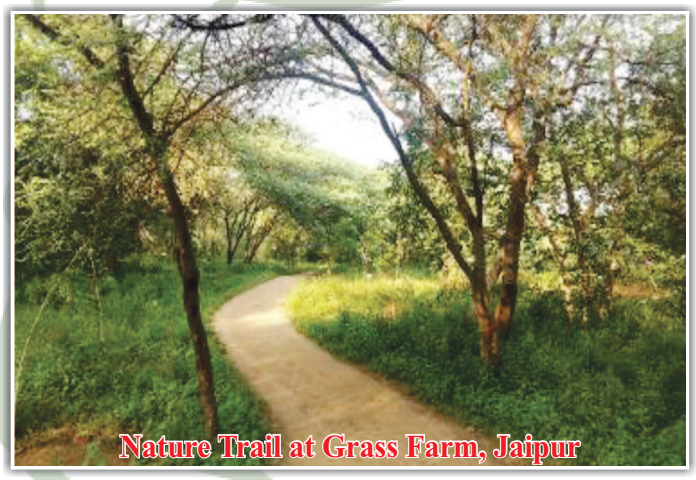
4.3 Forestry Research Center, World Forestry Arboretum, Jaipur.

4.4 Forestry Research Center Banki, Udaipur.

4.1 Forestry Research Center Grass Farm, Jaipur:

- The land popularly known as Grass Farm Nursery is a part of Reserved Forest (RF) named "Beed Grass Farm, Khatipura Nursery and Forest Research" having an area of 27.72 Ha (68.50 Acres) as per preliminary notification issued on March 18, 1993 and published in Rajasthan Gazette dated February 18, 1994.
- Plant raising is one of the major activities of Grass Farm Nursery. High-quality seedlings of more than 60 species are being raised and distributed to general public, farmers and institutions. The nursery includes Poly house, Agrinet house and Vermicompost unit.
- 1.7 Km. long nature trail gives a glimpse of bio-diversity of the Research centre campus. The area has

Peacock at Grass Farm, Jaipur



Nature Trail at Grass Farm, Jaipur

unique bio-diversity. According to a rapid survey conducted in July 2019, the area has about 240 species of flora, 22 species of insects, 102 species of birds and 13 species of mammals. The area is Peacock Conservation site , as large numbers of Peafowl Pavo cristatus, also known as the Indian Peafowl, National Bird, are present here and the area is an excellent habitat for their breeding.

- Repository of Cenchrus ciliaris (Dhaman grass) is perhaps the biggest attribute of this area. Dhaman grass is growing profusely here and is an important breeding and ambush habitat for juveniles of peafowl, ground nesting avifauna like partridges, lapwings, quails, curlews, sand grouse, larks etc; mammals like wild hare, mongoose, mole rat and several other species of reptiles.
- Presence of 8 species of raptors (birds of prey) belonging to family Accipitridae and Strigidae indicate the high biodiversity index of the area.

Existing Infrastructure at Research Centre, Grass Farm campus Jaipur

1. Office of the Chief Conservator of Forests, Silviculture, Jaipur
2. Office of the Deputy Conservator of Forests, (Research) Jaipur
3. Range Office
4. Traditional Nursery with a capacity to raise 4 lakh plants.
5. Agrinet house Nursery with a capacity to raise 1 lakh plants
6. Seed testing laboratory
7. Soil and water testing laboratory
8. Vermicompost unit
9. Resource Centre cum Library
10. Forest Rest House

4.1.1 Seed Testing Laboratory: Seed samples received from various forest divisions are tested for germination percentage and other physical parameters. Experiments on seed germination of various species are also carried out here.

Seed Lab at Grass Farm Nursery, Jaipur

4.1.2 Soil & Water Testing Laboratory: Samples of soil and water received from individuals, farmers, institutions as well as forest divisions are analyzed for PH and EC. The report is forwarded with the proper advice for planting of suitable plant species. Soil samples of sites on which research experiments are to be conducted are also analyzed here.No fees is charged for this work.

Soil and Water Lab at Grass Farm Nursery, Jaipur

4.2 Forestry Research Centre Govindpura, Jaipur


View of Research Center Govindpura, Jaipur

Research Centre Govindpura is spread over nearly 161ha. This area is known as Govindpura Beed Reserved Forest. This research centre is mainly dedicated for tree improvement activities.

Experiments relating to Tree improvement programmes of Azadiracta indica, Dalbergia sissoo, Eucalyptus etc. have been conducted at the research centre and large numbers of these have been conducted with the collaboration of AFRI, Jodhpur.

13 Clonal Seed Orchards (CSOs): 1 of Eucalyptus (Safeda) and 12 of Dalbergia Sisso (Sisham), 7 Seedling Seed Orchards (S.S.Os): 5 of Eucalyptus (Safeda), 1 of Dalbergia Sisso (Sisham) and 1 of Acacia nilotica (Babool), 1 International Provinance Trial of Azadirachtta indica (Neem), 3 Provenance Trials: 1of Ailanthus excelsa (Ardu), 1 of Balanitis aegyptica and 1 of Tecomella undulata (Rohida), 2 Progeny Trial of Azadirachtta indica (Neem) were established by AFRI, Jodhpur at this centre. These experiments were revisited in year 2019, by joint team of AFRI and Rajasthan Forest Department.

State Silviculture wing has also established 1 Seed Production Area of Ailanthus excelsa (Ardu), 4 Seedling Seed Orchards (SSOs): 1 Medicinal SSO of Emblica officinalis (Anwla), 1 of Aegle marmalos (Belpatra), 1 of Prosopis cineraria (Khejri), 1 of Acacia jacumontii (Banwli) and 5 experimental trials one each of Maytenus emerginata (Kankera), Anogeissus seracia (Indrokh), Bahunia recemosa (Jinjha), Dichrostchys nutans (Nutan) and Salvadora persica (Khara Jal). Plants of many of these experiments exist on site but none of these are in use. All these experiments were visited during the year and silvicultural operations like ploughing for weed removal and moisture conservation, pruning of excess branches on main trunk, thanwala making etc were taken up during the year. A research project for improvement of SSOs of Emblica officinalis (Anwla), Aegle marmalos (Belpatra), Prosopis cineraria (Khejri) has also been taken up to make improvements in these SSOs. Improvement measures like rain water harvesting, silvicultural operations like ploughing for weed removal and moisture conservation, pruning of excess branches on main trunk, thanwala making etc were taken up during the year for many of the experiments from Maintenance Budget of the research centre.

Existing Infrastructure of Research Centre Govindpura, Jaipur:

1. Range Office
2. Water tanks
3. Vermicompost Unit.
4. Nursery for raising seedlings.

4.3 Forestry Research Centre, World Forestry Arboretum, Jaipur

The World Forestry Arboretum is a biodiversity conservation site. It caters to the needs of research, education and recreation. It was established in the year 1986 over an area of 145 Ha. at the foot hills of Jhalana Doongri. In the year 1989, area of the Arboretum was increased by adding adjoining 35 Ha. area dedicated to the martyrdom of Amrita Devi, who protested against the Maharaja's men who were attempting to cut green Prosopis cineraria trees, named as Amrita Devi Udyan.

4.3.1 Existing Infrastructure of Forestry Research Centre, World Forestry Arboretum:

1. Range Office
2. Nursery for raising seedlings
3. Green House
4. Red House for endemic species
5. Vermicompost unit
6. World Assembly of Plants
7. Bougainvillea Garden
8. Palm House
9. Herbal Garden
10. Jhalana Ridge Wood Nature Trail
11. Bambusetum
12. Ethno medicinal plant garden
13. Clonal orchard of Commiphora wightii
14. Forest food park

4.3.2 Existing Infrastruture of Amrita Devi Udyan

1. Commemoration of Martyrs
2. Circular garden (Igloo- jhonpa)
3. Resting points or view points
4. Plant Conservatory
5. Vegetation Map of Rajasthan


Plant Conservatory at Amrita Devi Park, Jaipur

View of World Forestry Arboretum, Jaipur

View of Amrita Devi Park, Jaipur

4.4 Forestry Research Centre Banki, Udaipur

This Research centre spread over an area of 140 Ha. is situated near Sisarama village of Udaipur. This centre is mainly dedicated to research related to medicinal plants. Medicinal plants of more than 35 species are being raised here for distribution to different stakeholders like Forest Department, Ayurved & Agriculture universities, farmers & other institutions, NGOs etc for plantation on government, community and private land.

Existing Infrastructure of Forestry Research Centre, Banki, Udaipur:

1. Range Office
2. Nursery for raising seedlings.
3. High Tech Nursery
4. Vermicompost Unit
5. Watch Tower
6. Bambusetum

5. RESEARCH ACTIVITIES

5.1 Research Advisory Group:

Research Advisory Group (RAG) was constituted in the year 2005-2006 to give direction to the applied and adaptive research activities in accordance with the requirement of the forest department and other stakeholders. Mandate of the RAG is to discuss the research needs of different stakeholders, prioritize and approve the proposed research projects on the basis of their utility and to review the progress of ongoing research projects. Present Research Advisory Group has been reconstituted by PCCF (T.R.E.E), Rajasthan vide his order no.F(1) Silva/RAG 05/253 dated 22.02.2012 as under:

1.	Principal Chief Conservator of Forest, (T.R.E.E), Rajasthan	-	Chairperson
2.	Project Director, RFBP Phase II, Jaipur, Rajasthan	-	Member
3.	APCCF (Development), Rajasthan, Jaipur	-	Member
4.	Chief Conservator of Forest, Jaipur	-	Member
5.	Member Secretary, Biodiversity Board, Rajasthan, Jaipur	-	Member
6.	Conservator of Forest (Medicinal Plant), Rajasthan, Jaipur	-	Member
7.	Chief Conservator of Forest, Silviculture, Rajasthan, Jaipur	-	Member Secretary

This year an online WebEx meeting of Research Advisory Group (RAG) was held on June 09, 2020. This RAG meeting was chaired by Shri Y.K. Dak, PCCF, Development, Rajasthan. Following officers /stakeholders participated in the meeting.

1. Shri Y.K. Dak, Principal Chief Conservator of Forest (Development),Rajasthan
2. Shri Ashok B.Ramteke, APCCF (CAMPA), Rajasthan, Jaipur
3. Shri P.K. Upadhyay, APCCF & PD, RFBP, Phase -2, Jaipur
4. Ms. Shikha Mehra, APCCF, Development, Rajasthan, Jaipur
5. Shri K C A Arun Prasad, Chief Conservator of Forest, Jaipur.
6. Shri Rajiv Chaturvedi, CCF, Medicinal Plants, Jaipur
7. Shri D.S.Dular, Member Secretary, State Biodiversity Board, Rajasthan, Jaipur.
8. Dr. Brij Gopal, Retd. Professor, JNU, Jaipur
9. Dr. Soumana Dutta, Professor, Rajasthan University, Jaipur.
10. Dr. G. Singh, Scientist-G, AFRI, Jodhpur
11. Dr. U.K. Tomar, Scientist-F, AFRI, Jodhpur
12. Smt. Sangeeta Tripathi, CTO, AFRI, Jodhpur
13. Smt. Desha Meena, Scientist-C, AFRI, Jodhpur
14. Dr. N.K. Bohra, Scientist-C, AFRI, Jodhpur
15. Dr. Advait Edgaonkar, IIFM, Bhopal
16. Shri Sundaram Verma, Progressive Farmer and Padma Shri Award Recipient,
17. Shri S.K. Agarwal, DCF, Research, Jaipur
18. Shri Mukesh Tiwari, ACF, Silviculture, Jaipur
19. Shri Ramavatar Doodwal, Research Officer Seed, Jaipur

5.2. Research projects:

Minutes of the Research Advisory Group (RAG), held on June 09, 2020 is as follows:

5.2.1 Review of the collaborative research projects:

1. Documentation of Flora and Fauna of Raj Bhawan of Jaipur and Mount Abu

Detailed progress of the project was presented by Shri G Singh, Scientist G, AFRI Jodhpur. He stated that Surveys for documentation of available plant and animal species have been completed for the designated areas of the Raj Bhawans, Jaipur and Mount Abu. Each specimen of plant and animal observed during survey were recorded and photographed. Text matter on different species and preparation of coffee table book and designing of signage are in final stage and draft is likely to be submitted to department in a week's time. He also sought six months extension of the project for publication of final report and coffee table book after its finalization by Forest Department. Extension of period is required and RAG agreed to the proposal of extension.

2. Development of Nursery Manual for Forest Tree Species of Rajasthan

Shri M.L. Meena, PCCF, Silviculture informed that Nursery Manual has been developed and handed over to Forest Department. It has been placed on website of the Forest Department also. Project is completed.

3. Forest Resource Accounting: Valuation of Economic Contribution of Forests and Protected Areas in Rajasthan and Capacity Building

Dr. Advait Edgaonkar, IIFM, Bhopal said that study has been completed and report has been submitted to the department. Findings of the study were presented in the meeting. Shri M.L.Meena informed that report submitted by IIFM has been placed on website of the Forest Department.

5.2.2 Review of ongoing experiments/activities conducted by Silviculture Wing,

1. Status Assessment, propagation and re-introduction of *Ephedra foliata*

Shri Mukesh Tiwari ACF, Silviculture, presented the progress of this project. He informed the participants about the progress of status assessment. He also observed that propagation of Ephedra foliata is easy through seeds but vegetative propagation was not found encouraging. A provision of INR 0.25 Lakhs has been kept for the financial year 2020-21. One year extension is required to complete the project due to financial constraints during two consecutive previous years. RAG approved the proposal.

2. Tree Talks: An awareness programme for stakeholders

Shri Mukesh Tiwari ACF, Silviculture, presented the progress of the project. In all 410 participants were benefited in 10 talks conducted during the year 2019-20. A provision of INR 0.76 Lakhs has been kept for the financial year 2020-21. RAG approved the proposal.

3. Establishment of Forest Food Park at World Forestry Arboretum, Jaipur

Shri Mukesh Tiwari ACF, Silviculture, presented the progress of the project. Work of the park was initiated during the year 2017-18 and so far 50 different forest food bearing species have been planted. Provision of INR 1.56 Lakhs has been kept for the financial year 2020-21. RAG approved the proposal.

4. Establishment of Herbal Garden at Grass Farm Nursery, Jaipur

Shri Mukesh Tiwari ACF, Silviculture, presented the progress of the project. He discussed about objectives of the Herbal Garden. 38 species of medicinal plants have been planted in the garden and more species will be planted during the financial year. A provision of INR 1.69 Lakhs has been kept for the financial year 2020-21. RAG approved the proposal.

5. Habitat improvement, renovation & biodiversity conservation work at Amrita Devi park,Jaipur

Shri Mukesh Tiwari ACF, Silviculture, presented the project progress. He requested for allocation of INR 4.58 Lakhs for the financial year 2020-21. RAG approved the proposal.

6. **Development & Improvement of seedling seed orchards at Govindpura Research Centre, Jaipur**

Shri Mukesh Tiwari ACF, Silviculture, presented the progress of the project. He requested for allocation of INR 1.50 Lakhs for the financial year 2020-21. RAG approved the proposal.

7. **Establishment of Vermicomposting unit at Govindpura Research Centre**

Shri Mukesh Tiwari ACF, Silviculture presented progress of the project. He requested for allocation of INR 0.53 Lakhs for the financial year 2020-21. RAG approved the proposal.

8. **Developing propagation protocol of some useful indigenous medicinal plants (**Pterocarpus marsupium**):**

Shri Mukesh Tiwari ACF, Silviculture, presented progress of the project. He requested for allocation of INR 0.14 Lakhs for the financial year 2020-21. RAG approved the proposal.

9. **Maintenance of Ethno Medicinal Garden at World Forestry Arboretum, Jaipur**

Shri Mukesh Tiwari ACF, Silviculture, presented progress of the project. He requested for allocation of INR 0.50 Lakhs for the financial year 2020-21. RAG approved the proposal.

5.2.3 Proposed collaborative research projects of AFRI for approval

1. **Survey and Selection of Candidate Plus Trees and Identification of Seed Production Areas for Broad leaved Species of Rajasthan**

Smt. Sangeeta Tripathi, Chief Technical Officer, AFRI, presented the project. She discussed the objectives, methodology and costing of the project. Project duration is three years with a cost estimation of Rs 15.68 Lakhs. APCCF, Development, Ms Sikha Mehra suggested that proposal of selection of 25CPTs of each Species is less and at least 50 or more number of CPTs may be selected. PCCF Development Shri Y.K Dak, suggested that number of species is less and more species may be selected for CPTs identification. He also suggested that species other than Anogeissus may be given preference in the initial stage. Project Invistigator (PI) may incorporate the suggestions. RAG approved the project.

2. **Development of Seed Production Areas of Economically Important Tree Species of Rajasthan**

Mrs Desha Meena, Scientist-C, AFRI, presented the project. She discussed the objectives, methodology, expected outcome and costing of the project. Project duration is three years with a cost estimation of Rs 14.98 Lakhs. PCCF Development suggested that some of the species like Salvadora does not fit with the title of the project. Shri M.L.Meena, informed the participants that Salvadora species are important species of the arid region and hence were included in the project. Shri Dak suggested that title of the project may be suitably amended and other important species may also be included. RAG approved the project.

3. **Evaluation of Neem Progeny trial at Govindpura for seed Production, yield and oil estimation**

Dr. N.K. Bohra, Scientist C, AFRI, presented the project. He discussed upon the objectives,

methodology, expected outcome and costing of the project. Project duration is three years with a cost estimation of Rs 14.75 Lakhs. RAG approved the project.

4. **Studies on the impact of plantation on under canopy regeneration, diversity of plants and carbon sequestration in arid zone of Rajasthan**

Shri G. Singh, Scientist-G, AFRI, presented the project. He discussed the objectives, observation to be recorded and expected outcome of the project. Project duration is three years with a cost estimation of Rs 44.55 Lakhs. RAG approved the project.

5. **Studies on floral diversity and people perceptions for conservation of Haldeshwar Mahadev forest area of Siwana Ring complex of Barmer district, Rajasthan**

Shri G. Singh, Scientist-G, AFRI, presented the project and explained the wide diversity of plants available in the proposed project area. He discussed the objectives, observation to be recorded and expected outcome of the project. Project duration is two years with a cost estimation of Rs 10.28 Lakhs. RAG approved the project.

5.2.4 Proposed research projects /activities of Silviculture Wing, Rajasthan for approval

1. **Developing propagation technique of Dalbergia latifolia**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. He deliberated about the objective and methodology of the project. Total cost of the project is INR 0.30 Lakhs for a duration of 2 years. He requested for allocation of INR 0.20 Lakhs for the financial year 2020-21. RAG approved the project.

2. **Developing propagation technique of Buchanania lanzan (Charoli)**

Shri Mukesh Tiwari ACF, Silviculture presented the project. He deliberated about the objective and methodology of the project. Total cost of the project is INR 0.30 Lakhs for a duration of 2 years. He requested for allocation of INR 0.20 Lakhs for the financial year 2020-21. RAG approved the project.

3. **Collection of quality seeds from Seed Production Areas**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is for 3 Years and total cost is INR 17.0 Lakhs. He also informed that seeds of Acacia senegal, Vachellia nilotica , Prosopis cineraria were collected from different Seed Production Areas. In all 3590 kg. seed was collected during the year 2019-20. The collected seed was distributed to different forest divisions. A provision of INR 5.00 Lakhs has been kept for the collection of quality seeds from SPAs for the year 2020-21. RAG approved the project.

4. **Improving facilities of seed testing laboratory, Grass farm, Jaipur**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. The equipments used in the laboratory like Seed germinator are very old and need replacement for quick and precise results on time. Project duration is for 1 Year and total cost is INR 2.50 Lakhs. RAG approved the project

5. **Promoting human health through raising and distribution of common useful Medicinal plants**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is for 4 Year and total cost is INR 3.00 Lakhs. He requested for allocation of INR 0.70 Lakhs for the financial year 2020-21. RAG approved the project.

6. **Developing protocol to identify indigenous species to be planted under Acacia tortilis**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is 5 Year and total cost is INR 6.10 Lakhs. He requested for allocation of INR 4.60 Lakhs for the financial year 2020-21. RAG approved the project.

7. **To study the effect of Pusa Hydrogel on plants**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is for 2 Year and total cost is INR 1.60 Lakhs. He requested for allocation of INR 1.20 Lakhs for the financial year 2020-21. RAG approved the project.

8. **Creation of "RASHI VAN" (cultural forest) at Amrita Devi Park, Jaipur**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is for 2 Year and total cost is INR 3.0 Lakhs. He requested for allocation of INR 2.0 Lakhs for the financial year 2020-21. RAG approved the project.

9. **To Organise Forest Food Festival at World Forestry Arboretum**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Provision of INR 2.00 Lakhs has been kept for the financial year 2020-21. RAG approved the project

10. **Study and documentation of flora of Grass Farm campus, Jaipur**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is for 2 Year and total cost is INR 1.0 Lakh. He requested for allocation of INR 0.50 Lakhs for the financial year 2020-21. RAG approved the project.

11. **Organising a workshop with stakeholders for identification of research topics related to field problems and for dissemination of forestry research**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Project duration is for 1 Year and total cost is INR 1.0 Lakhs. He requested for allocation of INR 1.0 Lakhs for the financial year 2020-21. RAG approved the project.

12. **Organization of RAG meeting; procurement of books and periodicals; documentation, publication and dissemination of annual report, technical bulletins of lesser known species & other important research findings to stakeholders and organizing a workshop on shaping the future of Forestry Research:**

Shri Mukesh Tiwari ACF, Silviculture, presented the project. Members observed that organization of

RAG meeting, documentation, publication and dissemination of Annual Report, technical bulletins of lesser known species, other important research findings are essential part of the research activities. A provision of INR 2.0 Lakhs has been kept for reviewing and evaluating progress of research activities, documentation, publication and dissemination of Annual Report, technical bulletins of lesser known species, other important research findings etc.

RAG approved the above proposals and also authorised DCF (Research) to priorities the projects with the approval of State Silviculturist according to allocation of the budget to his office and available funds as per requirement.

5.3 Collaborative Research Projects with Arid Forest Research Institute (AFRI), Jodhpur:

Following collaborative research projects are ongoing with AFRI, Jodhpur:

5.3.1 Study and Documentation of Flora and Fauna of Raj Bhawan of Jaipur and Mount Abu

5.3.1 .1 INTRODUCTION

Urban areas in general are viewed as concrete jungles, with significantly low level of fauna and flora dominated by non-natives and homogenous taxa. Such views are understandable but in reality urban areas house a great deal of species both native and nonnative to the surrounding region. A number of species and the overall diversity in a city rely on the size, quantity and quality of urban green spaces which are also vital features for human health and well-being. Furthermore, wildlife is not limited in forest areas rather it can also exist in city's garden, park and other landscape. Thus urban park or green patches provide habitats to different animals, birds, insects etc. These park and garden provide many direct and indirect benefits to urban dwellers by absorption of pollutant, providing oxygen, conserving soil, mitigating the effect of global warming, sequestering carbon and conserving biodiversity.

Rajbhawan of Rajasthan situated at Jaipur as well as at Mount Abu have lush green lawn with variety of tall trees and flower beds blooming with seasonal flowers and are attractive places in terms of biological diversity. Raj Bhawan of Mt Abu is situated in foothill of Gurushikhar, the highest peak of Mount Abu and supports wide variety of flora ranging from xeromorphic to subtropical evergreen species. Because of luxurious vegetation many birds and other fauna are also visible. This project was taken up to document and enlist the flora and fauna of these Raj Bhawans for further records and scientific, social and ecological benefits. Monitoring biodiversity and related environmental quality in urban areas is an important issue offering possibilities to control and improve urban habitat quality as well as to avoid adverse effects on human health.

5.3.1.2 PROJECT BRIEF

Date of sanction	:	Year 2018
Project duration	:	2 Years
Submitted by	:	G. Singh, Scientist G & Head
Submitted to	:	Division of Forest Ecology and Climate Change State Forest Department, Rajasthan.

Name of principal investigator	:	Dr. G. Singh, Scientist G, AFRI
Co-investigator	:	Mrs Bhawana Sharma, Scientist – D
	:	Mr. S.R. Baloch, Scientist C
	:	Mr. P. R. Nagora, S.T.O.
Forest department coordinator	:	Mr. Mukesh Tiwari RFS
Project fellow	:	Mr. Gourav
Title of project	:	Study of Flora and Fauna of Raj Bhawans of Rajasthan
		Category of work
	:	Survey, identification and documentation
Division	:	Forest Ecology and Climate Change Division
Name of institute	:	Arid Forest Research Institute Jodhpur

5.3.1.3 METHODOLOGY

Surveys were conducted in the designated areas of both Raj Bhawans, i.e. Jaipur and Mount Abu, for documentation of available plant and animal species. It was made sure to cover almost 100% area for documentation of flora by dividing the area into different blocks, i.e., 10 at Jaipur and 11 at Mount Abu. Each block was enumerated separately for recording available plants species mostly trees and shrubs. Most of the species recorded were identified and pictorial data was collected for further taxonomic classification and verification. All of the plant species enumerated were measured for Girth at Breast Height (GBH) and total height for trees and collar diameter and height for small trees and shrubs. Herbaceous species and grasses were enumerated in 1 m x 1 m area of different blocks. Specimens of different plants were collected for appropriate herbarium preparation that shows their morphological characteristics and taxonomic classification to identify them. Each specimen of plant and animal observed during survey were recorded and photographed. All of the above data were collected seasonally, 4 times during the study period of December 2018 to December 2019.

5.3.1.4. PROGRESS OF THE PROJECT

Rajbhawans of Jaipur and Mt Abu covering an area of about 4.2 ha and 3.46 ha respectively were surveyed 4 times during December 2018 to September 2019 for plant diversity assessment and twice for recording observation on available fauna, mainly birds and pathological and entomological problems.

5.3.1.4. 1. TOTAL PLANT DIVERSITY

A total of 403 species were identified from areas of both the Rajbhavans, i.e. Jaipur and Mount Abu (Table 1.1). These belong to 75 families and 282 genera of plant kingdom. Among these 98 are tree species, 114 are shrub species, 113 are herbaceous species, 46 are grass species, 34 are climbers, 6 are sedge and two are ferns (Figure 1.1). Seventy eight species are common to both the Rajbhavan areas. Thus, α (alpha) -diversity of Jaipur and Mount Abu Ranjabahvan area are 215 and 293, respectively. β (beta) diversity and γ (gama) diversity are 335 and 413 respectively.

Table 1.1. Plants of different categories identified at Rajbhavans of Jaipur and Mount Abu areas in Rajasthan.

S.N.	Variable	Jaipur	Mt Abu	Total
1	Family	62	71	75
2	Genus	157	216	282
3	Tree	68	58	98
4	Shrub	87	70	114
5	Herb	29	94	113
6	Grass	14	37	46
7	Climber	15	26	34
8	Sedge	2	5	6
9	Fern	0	2	2
10	**Total**	**215**	**293**	**413**

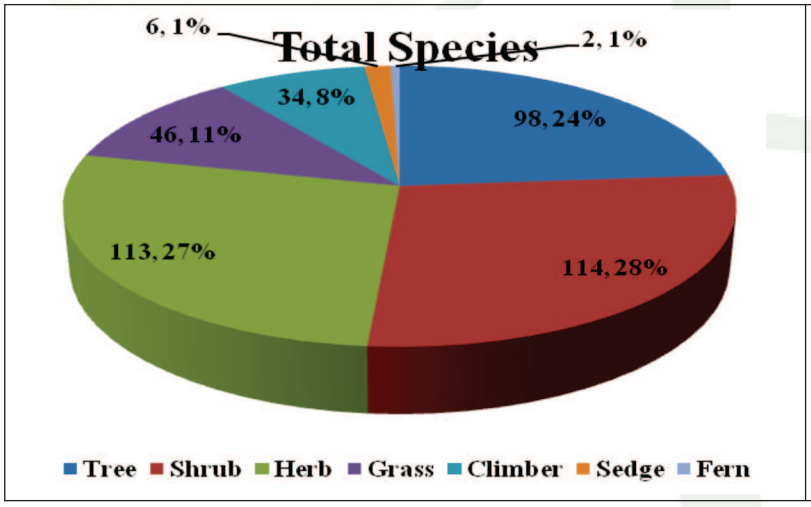


Figure 1.1. Number and percent contributions of different plant forms in Rajbhavan areas of Rajasthan.

5.3.1.4.2. TOTAL DIVERSITY AT RAJBHAVAN

Diversity Rajbhavan Jaipur

There are 215 number of plant species belonging to 62 families and 57 genera in Rajbhavan of Jaipur area. Among these 68 are tree species, 87 are shrub species, 16 are climbers, 29 are herbaceous species, 14 are grass species and 2 sedge species (Figure 1.2).

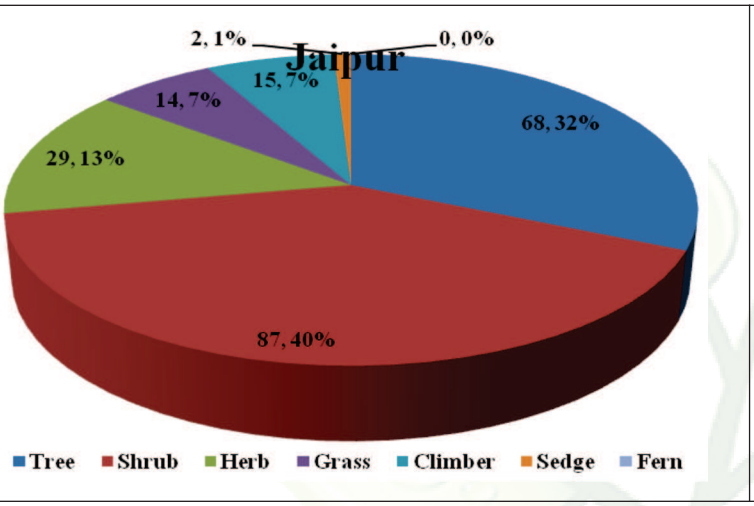


Figure 1.2. Number and pecent contributions of different plant forms in Rajbhavan areas of Jaipur, Rajasthan

Total enumeration was done mostly for tree and shrub. In this a total of 1413 plants were enumerated and measured in 10 different blocks during December 2018 at Rajabhavan Jaipur. Enumerated plants and their growth variables like girth and height along with the conditions of health of the individual (comment) are presented in Table 2.1.Total number of plants enumerated in different blocks are 47 in block one, 114 in block two, 168 in block three, 216 in block four, 294 in block five, 91 in block six, 145 in block seven, 165 in block eight, 92 in block nine and 81 in block 10.

Diversity at Rajbhawan, Mount Abu

Total numbers of species are 293 belonging to 71 families and 216 genera. There are 58 tree species, 70 shrub species, 26 climbers, 94 herbaceous species, 37 are grass species, 5 are sedge species and two are ferns (Figure 1.3). Two thousands four hundred and thirty eight plants (mostly trees and shrubs) were enumerated and measured in 11 different blocks of Rajbhavan, Mount Abu during January 2019. Enumerated plants and their growth variables like girth and height along with the conditions of health of the individual (comment) are presented in Table 1.2. Enumerated plants in different block are 203 in block 1, 50 in block 2, 87 in block 3, 279 in block 4, 141 in block 5, 184 in block 6, 544 in block 7, 250 in block 8, 362 in block 9, 113 in block 10 and 225 in block 11.

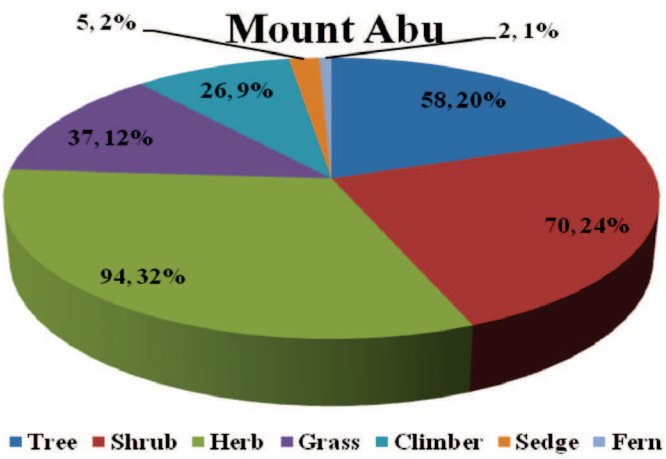


Figure 1.3. Number and pecent contributions of different plant forms in Rajbhavan areas of Mount Abu, Rajasthan

5.3.1.4.3. DIVERSITY INDICES

Diversity indices at Jaipur

Species and their population count on plots basis indicated a total number of 108 species of different plant habits recorded in the 10 block delineated in Rajbhavan area. These species belongs to 85 genera and 44 families. Among these, 41 are tree species, 30 shrub species, 21 are herbs, 2 are climbers, 12 are grass species and two are sedge species. Most dominant family in number of species is species Poaceae followed by Fabaceae.

Number of tree species or tree richness (R) ranges from 5 tree species in Block 9 to 18 species of trees in Block 4. Species richness for shrubs ranges from 2 in Block 1 to 15 in block 9 (Table 1.2). For herbaceous species, richness varies from 4 numbers in Block 9 to 25 numbers in Block 8. Thus block 4, 9 and 8 harbours higher number of trees, shrubs/tree saplings and herbaceous species respectively, including seedlings of trees and shrubs. Shannon-Weiner Diversity index –an indicator of species diversity, vary from 1.39 in Block 9 to 2.68 in block 4 for tree species, from 0.69 in block 1 to 2.18 in Block 9 for shrub species, and from 0.20 in Block 9 to 2.20 in Block 8 for the herbaceous species indicating that block 4 is more diverse in terms of trees, block 9 is diverse in shrubs, and block 8 is more diverse in terms of herbaceous species. Simpson dominance index varies from 0.09 in Block 4 to 0.31 in Block 9 for tree species, from 0.15 in Block 9 to 0.59 in Block 8 for shrub species and from 0.15 in Block 4 to 0.67 in Block 9 for herbaceous species. This indicates low diversity of tree and herbaceous species in block 9 and shrubs species in block 8. Species evenness is an indicator of how evenly the populations of the existing species are distributed in the area. It varies from 0.81 in Block 2 to 0.96 in Block 3 for tree species, 0.52 in Block 8 to 1.00 in Block 1 for shrubs and from 0.14 in Block 9 to 0.75 in Block 4 for herbaceous species indicating that distribution of tree species is more even in Block 3, shrubs species in Block 1 and herbaceous species in Block 4. Tree species richness found related with shrub species and herbaceous species richness by a quadratic relationships.

Table 1.2. Diversity indices of different plant live forms available in different blocks at Rajbhawan area of Jaipur.

Block (Nos.)	Habit	Species Richness (R)	Shannon-Weiner Diversity index (H')	Simpson index of dominance (D)	Species evenness (e')
1	Tree	9	1.82	0.22	0.83
	Shrub	2	0.69	0.50	1.00
	Herb	9	1.19	0.44	0.54
2	Tree	7	1.59	0.27	0.81
	Shrub	7	1.30	0.39	0.67
	Herb	15	1.96	0.22	0.72
3	Tree	6	1.72	0.19	0.96
	Shrub	6	1.59	0.23	0.89
	Herb	8	0.90	0.58	0.43
4	Tree	18	2.68	0.09	0.92
	Shrub	8	1.51	0.34	0.73
	Herb	16	2.08	0.15	0.75
5	Tree	9	1.86	0.20	0.84
	Shrub	13	1.96	0.20	0.77
	Herb	18	1.62	0.33	0.56
6	Tree	6	1.55	0.25	0.86
	Shrub	4	1.09	0.42	0.79
	Herb	19	1.79	0.24	0.60
7	Tree	6	1.73	0.18	0.96
	Shrub	7	1.44	0.31	0.74
	Herb	20	1.34	0.37	0.45
8	Tree	12	2.18	0.16	0.88
	Shrub	5	0.83	0.59	0.52
	Herb	25	2.20	0.15	0.68
9	Tree	5	1.39	0.31	0.86
	Shrub	15	2.18	0.15	0.81
	Herb	4	0.20	0.67	0.14
10	Tree	7	1.70	0.24	0.87
	Shrub	4	1.01	0.43	0.73
	Herb	13	1.45	0.33	0.56

Diversity indices at Mount Abu

Total species recorded on plot basis in Rajabhavan area of Mount Abu are 201 species belonging to 153 genera and 57 families. Among these 33are tree species, 39 are shrub species, 77 are herb species, 34 are grass species, 10 are climbers, 5 are sedge and 2 are pteridophytes. The area is dominated by Poaceae family followed by Fabaceae with 25 species.

Species richness, Simpson index of dominance, Shannon-Weiner diversity index and species evenness are presented in Table 1.3. Tree species richness ranges from 5 tree species in Block 5 and 6 to 10 species of trees in Block 10. Species richness for shrubs varies from 9 in Block 8 and 10 to 18 in Block 5. For herbaceous species, richness varies from 24 numbers in Block 9 to 62 numbers in Block 1. Thus Block 10, 5 and 1 harbours highest numbers of trees, shrubs/tree saplings and herbaceous species including seedlings of trees and shrubs respectively. Shannon-Weiner Diversity index varies from 1.33 in Block 5 to 2.39 in Block 1 for tree species, from 1.56 in Block 7 to 2.58 in Block 5 for shrub/tree saplings species, and from negligible in Block 3 and 5 to 2.77 in Block 11 for the herbaceous species. Thus Block 1 is more diverse in terms of trees, Block 5 is more diverse in shrubs, and Block 11 is more diverse in terms of herbaceous species. Simpson dominance index varies from 0.10 in Block 1 to 0.31 in Block 11 for tree species, from 0.10 in Block 5 to 0.32 in Block 7 for shrub species and from 0.10 in Block 11 to 0.26 in Block 9 for herbaceous species.

This indicates low diversity of tree in Block 11, shrubs species in Block 7 and herbaceous species in Block 9. Species evenness varies from 0.82 in Block 11 to 0.98 in Block 7 for tree species, 0.18 in Block 5 to 0.89 in Block 8 for shrubs and from 0.59 in Block 9 to 0.71 in Block 6 for herbaceous species indicating that distribution of tree species is more even in Block 7, shrubs species in Block 8 and herbaceous species in Block 6. Tree species richness found related with shrub species and herbaceous species richness by a quadratic relationships. Herbaceous species richness attained found to increase with increase in tree species richness, whereas shrub species richness attained minima at tree species richness of 9 (Fig. 7.2). Thus shrub and herbaceous species richness followed a positive relationship with each other. Area, annual temperature and precipitation appear dominant factors influencing variation in species richness. The relationship between herbaceous species richness and tree species richness appears positively correlated due to relatively high rainfall in Mt Abu but limited at Jaipur, where relationship is quadratic with a maximum in between.

Table 1.3. Diversity indices of different plant forms in different blocks at Rajbhawan, Mount Abu.

Block (Nos.)	Habit	Species Richness (R)	Shannon-Weiner Diversity index (H')	Simpson index of dominance (D)	Species evenness (e')
1	Tree	12	2.39	0.10	0.96
	Shrub	15	2.22	0.16	0.82
	Herbs	62	2.72	0.12	0.60

Block (Nos.)	Habit	Species Richness (R)	Shannon-Weiner Diversity index (H')	Simpson index of dominance (D)	Species evenness (e')
2	Tree	7	1.67	0.26	0.86
	Shrub	12	1.97	0.18	0.79
	Herbs	39	2.55	0.13	0.70
3	Tree	7	1.78	0.20	0.91
	Shrub	10	1.77	0.24	0.77
	Herbs	-	-	-	-
4	Tree	8	2.01	0.14	0.97
	Shrub	12	2.17	0.14	0.87
	Herbs	30	2.11	0.24	0.62
5	Tree	5	1.33	0.28	0.95
	Shrub	18	2.58	0.10	0.18
	Herbs	-	-	-	-
6	Tree	5	1.50	0.24	0.93
	Shrub	16	2.35	0.13	0.85
	Herbs	31	2.44	0.14	0.71
7	Tree	10	2.25	0.11	0.98
	Shrub	10	1.56	0.32	0.68
	Herbs	45	2.54	0.13	0.67
8	Tree	8	1.88	0.17	0.90
	Shrub	9	1.94	0.17	0.89
	Herbs	41	2.51	0.15	0.68
9	Tree	7	1.85	0.17	0.95
	Shrub	12	2.02	0.18	0.81
	Herbs	24	1.86	0.26	0.59
10	Tree	10	2.19	0.13	0.95
	Shrub	9	1.69	0.28	0.77
	Herbs	43	2.49	0.17	0.66
11	Tree	6	1.47	0.31	0.82
	Shrub	10	1.63	0.26	0.71
	Herbs	47	2.77	0.10	0.70

5.3.1.4.4 PLANT PHENOLOGY AND SEASONAL OBSERVATIONS

Rajbhawan, Jaipur

Seasonal observations recorded on plant phenology during December 2018, March 2019, May 2019 and August 2019 indicate varying phonological behaviours of different species (Table 1.4). Almost 26 species of different plant forms observed flowering and 12 species fruiting during winter season of December, 26 in flowering and 15 species in fruiting during March, 23 species in flowering and 7 species in fruiting in May and 24 species in flowering and 8 species in fruiting in August at Jaipur. Some of the species like Abutilon theophrastii, Clerodendrum inerme etc., have extended period of flowering from August to December.

Table 1.4. Seasonal phenology of plants of different forms in Rajbhavan area of Jaipur.

S.N.	Name of Species	Habit	December 2018	March 2019	May 2019	August 2019
1	*Abutilon theophrastii*	Herb	Fl & Fr	-	-	Fl
2	*Acalypha indica*	Herb	Fl	-	-	Fl
3	*Adenium obesum*	Shrub	Fl	-	-	-
4	*Adhatoda vasica*	Shrub	-	Fl	-	-
5	*Aegle marmelos*	Tree	Fr	Fr	-	Fr
6	*Allamanda cathartica*	Climbing shrub	Fl	-	-	Fl
7	*Antigonum leptopus*	Climber	Fl	Fl	-	-
8	*Asparagus setaceus*	Climber herb	Fr	-	-	-
9	*Bauhinia alba*	Tree	-	Fl & Fr	-	-
10	*Bauhinia purpurea*	Tree	Fr	Fl & Fr	-	-
11	*Bombax ceiba*	Tree	-	Fl	-	-
12	*Buddleja asiatica*	Shrub	-	Fl	-	-
13	*Callistemon viminalis*	Tree	-	Fl	-	-
14	*Cassia javanica*	Tree	Fl	Fr	Fl	Fl
15	*Cassia siamea*	Tree	Fl	-	-	-
16	*Citrus sinensis*	Shrub	Fr	-	Fr	-
17	*Clerodendrum inerme*	Shrub	Fl	Fr	Fl	Fl
18	*Dalbergia sissoo*	Tree	-	Fl & Fr	-	Fr
19	*Dombeya spectabilis*	Shrub	Fl	-	Pruned	-
20	*Eragrostis minor*	Grass	Fl	-	-	Fl

S.N.	Name of Species	Habit	December 2018	March 2019	May 2019	August 2019
21	*Euphorbia cotinifolia*	Shrub	Fl & Fr	-	-	Fl & Fr
22	*Galphimia gracilis*	Shrub	Fl	Fl	-	-
23	*Gliricidia sepium*	Tree	-	Fl & Ll	-	V
24	*Grevillea robusta*	Tree	-	Fl	-	-
25	*Guazuma ulmifolia*	Tree	Fl & fr	Fr	Fl	Fr
26	*Holoptelea integrifolia*	Tree	V	Fl & Fr	-	-
27	*Jacquemontia pentantha*	Climbing shrub	-	Fl	Fl	-
28	*Kigelia pinnata*	Tree	Fr	Fr	Fl	-
29	*Leuceana leucocephala*	Tree	-	Fl & Fr	Fr	-
30	*Mangifera indica*	Tree	-	Fl	Fr	-
31	*Manilkara zapota*	Shrub	Fl & fr	Fl	Fl & Fr	Fl & Fr
32	*Mimusops elengii*	Tree	-	Fr	Fl	Fr
33	*Morus nigra*	Tree	-	Fl & Fr	-	-
34	*Murraya koenigii*	Shrub	-	Fl	Fr	-
35	*Nymphaea chromatella*	Water lily	Fl	-	Fl	Fl
36	*Nymphaea hollandia*	Water lily	Fl	Fl	Fl	Fl
37	*Pentalinon luteum*	Climbing shrub	Fl	-	-	-
38	*Phyllanthus emblica*	Tree	Fr	-	-	-
39	*Plumeria pudica*	Shrub	Fl	-	Fl	Fl
40	*Plumeria rubra*	Tree	Fl	-	Fl	-
41	*Pseuderanthemum laxiflorum*	Shrub	Fl	-	-	Fl
42	*Pseuderanthemum reticulatum*	Shrub	Fl	-	Fl	-
43	*Psidium guajava*	Tree	Fr	-	-	Fr
44	*Punica granatum*	Shrub	Fr	Fl	Fr	-
45	*Putranjiva roxburghii*	Tree	Fr	Fl & Fr	-	-
46	*Ravenia spectabilis*	Shrub	Fl	Fl	Fl	Fl
47	*Rondeletia odorata*	Shrub	Fl	Fl	Fl	Fl

S.N.	Name of Species	Habit	December 2018	March 2019	May 2019	August 2019
48	*Santalum album*	Tree	-	Fr	-	Fl
49	*Spathodia campanulata*	Tree	-	Fl	-	Pruned
50	*Syzygium cumini*	Tree	-	-	Fl	-
51	*Tecoma capensis*	Shrub	Fl	-	-	-
52	*Tecoma stans*	Shrub	Fl	Fl	-	-
53	*Tecomella undulata*	Tree	V	-	-	Fl
54	*Verbesina encelioides*	Herb	Fl	Fl	-	Fl
55	*Ziziphus jujube*	Tree	Fr	-	-	-
56	*Plumeria alba*	Shrub	-	Ll	Fl	-
57	*Plumeria obtusa*	Shrub	-	Fr	Fl	Fl
58	*Cordia dichotoma*	Tree	-	-	Fr	
59	*Delonix regia*	Tree	-	-	Fl	Fl
60	*Epipremnum pinnatum*	Climbing herb	-	-	Fl	-
61	*Justicia spicigera*	Herb	-	-	Fl	-
62	*Lagerstroemia speciosa*	Tree	-	-	Fl	Fl
63	*Terminalia arjuna*	Tree	-	-	Fl	-
64	*Vitex negundo*	Tree	-	-	Fl	-
65	*Cycas revoluta*	Cycad	-	-	-	Fl
66	*Cycas circinalis*	Cycad	-	-	-	Fl
67	*Terminalia bellirica*	Tree	-	-	-	Fl & Fr
68	*Passiflora spp.*	Climber herb	-	-	-	Fl

Fl-flowering, Fr-friting, LL-leafless, V- vegetation growth.

Rajbhawan, Mount Abu

Seasonal observations recorded on plant phenology during January 2019, April 2019, June 2019 and September 2019 indicate varying phonological behavious of different species growing in this area (Table 1.5). At Rajbhavan Mount Abu, about 35 plant species of different habit have been observed flowering, whereas 21 species have been observed under fruiting during winter season of January. During April, almost 19 species flower and 12 species fruit. During summer months of June, about 18 species have been observed under flowering and 14 species under fruiting, whereas in September almost 30 species are under flowering and 4 species in fruiting condition. Some species shows extended period of flowering from monsoon to winter season like Cestrum diurnum, Caesalpinia decapetala etc.

Table 1.5. Seasonal phenology of plants of different forms in Rajbhavan area of Mount Abu.

S.N.	Name of Species	Habit	January 2018	April 2019	June 2019	Sept. 2019
1	*Aerva lanata*	Herb	Fl	-	-	Fl
2	*Albizia lebbeck*	Tree	Fr	-	-	-
3	*Aloe vera*	Herb	Fl	Fl	-	Fl
4	*Anogeissus sericea*	Tree	-	Fl	Fr	-
5	*Antigonum leptopus*	Climbing shrub	Fr	-	-	Fl
6	*Arundo donax*	Herb	Fl	-	-	-
7	*Asparagus aethiopicus*	Herb	Fl	-	-	Fl
8	*Asparagus setaceus*	Herb	Fr	-	-	
9	*Caesalpinia decapetala*	Tree	Fl	Fr	Fr	Fl
10	*Carissa carandas*	Shrub	Fl	Fr	-	-
11	*Casearia elliptica*	Tree	-	Fl	-	-
12	*Cassia fistula*	Tree	Fr	-	Fl	-
13	*Cestrum diurnum*	Shrub	Fl	-	-	Fl
14	*Cucumis hardwickii*	Climbing shrub	Fr	-	-	Fl
15	*Cycas revoluta*	Cycad	-	-	Fl	Fl
16	*Dalbergia latifolia*	Tree	Fr	-	Fl	-
17	*Duranta repens*	Shrub	Fr	-	Fl	Fl
18	*Eriobotrya japonica*	Tree	Fr	-	-	-
19	*Erythrina superva*	Tree	Ll	Fl	Fr	-
20	*Euphorbia pulcherrima*	Shrub	Fl	Fl	-	-
21	*Ficus carica*	Shrub	Fl	Fr	Fr	Fr
22	*Ficus glomerata*	Tree	Fr	-	-	-
23	*Ficus virens*	Tree	Fr	Fr	-	-
24	*Gardenia thunbergia*	Shrub	-	-	Fl	-
25	*Girardinia diversifolia*	Herb	Fr	Fr	Fl	
26	*Hibiscus rosa-sinensis*	Shrub	Fl	Fl	Fl	Fl
27	*Hibiscus syriacus*	Shrub	-	-	Fl	Fl

S.N.	Name of Species	Habit	January 2018	April 2019	June 2019	Sept. 2019
28	*Hiptage benghalensis*	Woody climber	Fl & Fr	Fl & Fr	Fl & Fr	-
29	*Holmskioldia sanguine*	Climbing shrub	Fl	-	-	Fl
30	*Hydrangea macrophylla*	Shrub	Fl	-	Fl	-
31	*Ipomoea cairica*	Climbing shrub	Fl	-	-	Fl
32	*Ipomoea obscura*	Climbing shurb	Fl	-	-	-
33	*Jacaranda mimosifolia*	Tree	Fr	-	Fl	-
34	*Jasminum mesnyi*	Shrub	Fl	-	-	Fl
35	*Justicia procumbens*	Herb	Fl	-	-	Fl
36	*Lagerstroemia speciosa*	Tree	-	-	Fl	Fr
37	*Lapidagathis cuspidate*	Shrub	Fl & Fr	-	Fl	-
38	*Mallotus philippensis*	Shrub	Fr	-	-	Fl
39	*Muehlenbeckia platyclados*	Shrub	Fl & Fr	Fl	-	-
40	*Nicotiana plumbaginifolia*	Herb	Fl & Fr	-	-	Fl & Fr
41	*Opuntia elarior*	Shrub	Fl	Fl	Fr	-
42	*Oxalis latifolia*	Herb	Fl	-	-	Fl
43	*Pentas lanceolata*	Shrub	Fl	-	Fl	Fl
44	*Petrea volubilis*	Climbing shrub	Fl	Fl	Fl	-
45	*Pinus roxburghii*	Tree	Fl & Fr	Fr	Fr	-
46	*Plumbago auriculata*	Shrub	Fl	-	-	Fl
47	*Plumbago zeylancia*	Shrub	Fl	-	-	Fl
48	*Plumeria alba*	Tree	Ll	-	Fl	-
49	*Prunus persica*	Tree	Fl	Fr	Fr	Fl
50	*Russelia equisetiformis*	Herb	Fl	-	-	Fl
51	*Ruta chalepensis*	Herb	Fl	-	-	Fl
52	*Salvia splendens*	Herb	Fl	-	-	Fl
53	*Senna septemtrionalis*	Shrub	Fl	-	-	-
54	*Solanum seaforthianum*	Climber	Fl & Fr	-	-	Fl

S.N.	Name of Species	Habit	January 2018	April 2019	June 2019	Sept. 2019
55	*Sphagneticola trilobata*	Shrub	Fl	-	-	Fl
56	*Thunbergia erecta*	Shrub	Fl	Fl	-	Fl
57	*Tithonia diversifolia*	Herb	Fr	-	-	Fl
58	*Vallaris solanacea*	Shrub	Fl & Fr	Fl & Fr	-	-
59	*Acnistus arborescnes*	Shrub	-	Fl & Fr	Fl & Fr	-
60	*Alcea rosea*	Herb	-	Fl	-	-
61	*Anogeissus acuminata*	Tree	-	Fl & Fr	Fr	
62	*Flacourtia indica*	Shrub	-	Fl	Fr	-
63	*Grewia asiatica*	Shrub	-	Fl	Fl & Fr	-
64	*Lannea coromandelica*	Tree	-	Fl & Fr	Fr	-
65	*Sterculia colorata*	Tree	-	Fl &Ll	Fr & Ll	V
66	*Wrightia tinctoria*	Tree	-	-	Fl	Fr

Fl-flowering, Fr-fruiting, LL-leafless, V- vegetation growth.

(a) (b)

Figure 3. Flowering of different plant species in Raj Bhawan, Mount Abu during December-January 2018-19. (a). *Holmskioldia sanguinae,* (b). *Hydrangea macrophylla,*

5.3.1.4.5 INSECTS AND PATHOGENS

Some of the plants were observed associated with some entomological infestations and pathological problems. Some of them are listed here:

Hibiscus rosa-sinensis: Mealy bug (Pseudococcus martimus) infestation was observed on Hibiscus

rosa-sinensis. These are yellow colored with a whitish powedry wax. Nymphs and adults suck the sap from the tender plants and secret honey dew. Affected plants look withered and get deformed. Crawling of ants on plant parts is sign of mealy bug infestation.

Ficus virens: Bacterial leaf spot on leaves was observed on of F. virens. Dark reddish brown spots were found on affected leaf. Initially the lesions are circular or oval usually less than 5 mm. Dark reddish brown lesions starting at the leaf margin and progressing inward. As the disease progresses, lesions became irregular.

Mangifera indica: Anthracnose disease was found in mango trees. It is a fungal disease caused by Colletotrichum gloeosporioides. It is main field and post-harvest disease of mango worldwide. Symptoms of this disease appear on leaves as small and irregular yellow, brown, dark-brown or black spots. The spots can expand and merge to cover the whole affected area. The color of the infected part darkens as it ages. Mango trees were affected by sooty mold also. This disease is common in the orchards where mealy bug, scale insects and hoppers are not controlled efficiently. In this disease a black sooty mould appear on the leaf surface. The mold may cover an entire leaf surface or appear in spots depending on the severity of the problem. Sooty mold doesn't penetrate the plant tissues but it can weaken plant by blocking sunlight availability.

Ficus religiosa: Sooty mould observed on Ficus religiosa.

Mallotus philippensis: Sooty mould, Rust and insect galls were observed on Mallotus philippensis. Rust disease is a common fungal disease of garden plants. It is responsible for reducing plant vigor. It is most often found on mature plants and primarily symptoms appear on the surfaces of lower leaves. Initially white, slightly raised spots appear on the undersides of leaves. Later, these spots become covered with reddish-orange spore masses. These spore masses are called pustules. Pustules can be orange, yellow, brown, black or rusty brown. The spores are spread by wind or by water splashing back up onto the foliage. Severe infestations will deform yellow leaves and cause leaf drop.

Grewia asiatica: Leaf spot disease was observed on Phalsa. Small brown spots appeared on leaves.

Jatropha integerrima: New leaves become curled and twisted. The twisted areas become thickened and puckered resulting in severely distorted leaves. As the disease progresses, the affected leaves turn yellow or brown and fall prematurely. In more severe infections, shoots may become thickened and die.

Helmithosporium Leaf spot of Antigonum : This diseases caused by a group of fungi can occur at any time of year. However the leaf spot disease occurs during mild, wet periods. Leaf spot symptoms tend to vary with each pathogen/host pair from very small (pinhead size), solid brown to purple lesions or spots to expanded lesions with bleached centers that girdle the leaf blade.

Colletotrichum leaf spot of Palm: This disease appears as small brown spots and water soaked spots. The infected areas expand into circular spots with tan to light brown centers. Young leaves are highly susceptible while older leaves are more resistant to the disease. As the leaf matures, the rate of lesion expansion slows.

However, with adequate moisture, new spots continue to form, resulting in larger, older spots with black edges surrounded by numerous small spots.

Caesera elliptica skeletonizer: The leaf skeletonizers are generally moths belonging to order Lepidoptera. Their larvae feed on the soft outer tissues of foliage, leaving behind a skeletal network of veins, with a very distinct visual effect referred as "skeletonization" of leaves. Severe damage may result in browning of leaves. For management of Skeletonizer we should collect the egg masses and destroy them by burning and crushing, clip severely affected leaves and destroy them, spray Neem Seed Kernel Extract (NSKE) 5%, set up light trap to trap adult moths and spray Quinalphos @ 2 ml/lit.

(a) (b)

Figure 2. Flowering and fruiting in different species. (a). *Mimusops elengii*, and (b). *Bauhinia purpurea.*

5.3.1.5. PROGRESS UP TO MARCH 2021

- Data collection on floral diversity of all four quarters starting from September 2018 to September 2019 have been completed.
- Likewise data on fauna (mainly birds) and pathological/ entomological aspects have also been completed.
- Calculation of diversity variables and preparation of the coffee table books have been completed.
- A committee has been constituted by PCCF (HoFF) to finalize coffee table book.
- Text matter on different species and preparation of coffee table book is in final stage and will be submitted shortly after committee's approval.
- Due to covid 2019 coffee table book could not be finalized and published .One year extension is needed to publish the coffee table book.

5.4. Progress of Research Projects /Activities of Silviculture Wing

5.4.1. Establishment of Forest Food Park at World Forestry Arboretum, Jaipur

Introduction:

Forest Food Park provides a visual introduction of several species of plants that are used as food in indigenous traditional system. Forest Food Park reflects the long standing tradition of conserving and using plants products for health care and cooking. Some 80% of the world's population use herbs as the main form of plants from herbal market. But while herbal plants are in demand, the food traditions and culture associated with them are fading. Making a Food Park is an opportunity to grow plants for use and spreading knowledge of their importance and traditional uses.

Rajasthan region boasts of a tremendous diversity of plants, the forests are sources of many food items for local ethnic communities. There is a need to create awareness among the public about the importance of our traditional food heritage and importance of plants and their conservation. A special effort has been made to collect and grow plants from different bio-geographical regions.

Objectives:

- To promote ex-situ conservation of forest food plants biodiversity.
- To develop a multi-disciplinary database on forest food plants.
- To educate, encourage and promote the concept of traditional knowledge of these plants to all stakeholders
- Provide an opportunity to identify different types of food items made by these plants and be aware of their uses in food and in traditional system.
- To popularize use of local medicinal plants and Indian system of medicine.
- To develop a gene-pool of these indigenous plant species.

Project Investigator: Mukesh Tiwari, ACF, Silviculture, Jaipur

Project co-Investigator: Range Forest Officer, World Forestry Arboretum, Jaipur.

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure (Lakh Rs)					Total Expenditure (Lakh Rs)
	Project Duration	2017-18	2018-19	2019-20	2020-21	
9.00	4 Years	5.43	0.89	1.12	1.56	9.00

Project status: Concluded

Methodology:

The methodology for establishment of Forest Food Park involved preparation of land, fencing, landscaping, collection and planting of food plants, development of irrigation facilities. In all 100 herb/ plants species have been introduced. People belonging to various backgrounds, like Teachers, Students, Researchers, Herbal healers of various age groups are already visiting the World Forestry Arboretum, Jaipur. A brochure has been made for ready reference.

Species planted in the food park

S.N.	Name of Species with botanical name	S.N.	Name of Species with botanical name
1	Jamun *(Syzygium cumini)*	23	Kair *(Capparis deciduas)*
2	Lisoda *(Cordia dichotoma)*	24	Khejri *(Prosopis cineraria)*
3	Mango *(Mangifera indica)*	25	Senjna *(Moringa oleifera)*
4	Lemon *(Citrus limon)*	26	Kheep *(Leptadenia pyrotechnica)*
5	Karonda *(Carissa carandas)*	27	Khirni *(Manilkara hexandra)*
6	Anvala *(Phyllanthus emblica)*	28	Gundi *(Cordia gharaf)*
7	Bada ber *(Ziziphus mauritiana)*	29	Peelu *(Salvadora oleiodes)*
8	Khajoor *(Phoenix dactylifera)*	30	Gular *(Ficus glomerata)*
9	Mahua *(Madhuca longifolia)*	31	Bad *(Ficus benghalensis)*
10	Bel part *(Aegle marmelos)*	32	Peepal *(Ficus religiosa)*
11	Gwar paatha *(Aloe vera)*	33	Sita phal *(Annona squamosa)*
12	Pathaar chatta *(Bryophyllum pinnatum)*	34	Ram phal *(Annona reticulata)*
13	Jhadi Ber *(Ziziphus numuleria)*	35	Jungle Jalebi *(Pithecellobium dulce)*
14	Dansar *(Rhus mysorensis)*	36	Jungli Azwaayan *(Trachyspermum ammi)*
15	Shahtut *(Morus alba)*	37	Kari patta *(Murraya paniculata)*
16	Falsa *(Grewia asiatica)*	38	Kachri *(Cucumis pubescens)*
17	Panwar *(Cassia tora)*	39	Rose *(Rosa spp)*
18	Amrud *(psidium guava)*	40	Kachnaar *(Bauhinia variegata)*
19	Kamrakh *(Averrhoa carambola)*	41	Grapes *(Vitis vinifera)*
20	Kela *(musa spp.)*	42	Santhi *(Boerhavia diffusa)*
21	Kainth *(Limonia acidissima)*	43	Tamrind *(Tamarindus indica)*
22	Papaya *(C. papaya)*	44	Anar *(Punica granatum)*

5.4.2 Status Assessment, Propagation and Re-introduction of *Ephedra foliata* (Unth Phog)

Introduction:

Ephedra foliata (Family; Ephedraceae) Local Name Unth Phog or Andho-Khimp Only Gymnosperm in the Thar Desert, rare in sandy habitat and climbing on shrub or a tree. It is a perennial, climbing fascicled branches, smooth, slender, striated, knotted stems. It is distributed in arid districts of Rajasthan. However, its status in various districts has not been assessed so far. No attempt has been made to propagate this species in ex-situ conditions. The whole Ephedra plant has traditionally been used to treat symptoms of bronchial asthma, colds, influenza, allergies and hives in teas or tinctures.

Objectives:

- To assess the distribution of *Ephedra foliata* (Unth Phog) in Jaipur district including population and male female ratio.
- To conduct the scientific study of this area to prepare a status report of natural regeneration of *Ephedra foliata* in Jaipur district.
- To develop and standardize propagation technique of *Ephedra foliata* .
- To re-introduce *Ephedra foliata* by planting and distributing plants propagated by seed or vegetative method.

Project Investigator: Mukesh Tiwari, ACF, Silviculture, Jaipur

Project Co-Investigator: Range Forest Officer, World Forestry Arboretum, Jaipur.

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure (Lakh Rs)						Total Expenditure (Lakh Rs)
	Project Duration	2016-17	2017-18	2018-19	2019-20	2020-21	
3.00	5 Years	0.99	0.50	0.24	0.39	0.25	**2.12**

Project status: Concluded

Observations/ Progress:

1. Distribution of *Ephedra foliata* in Jaipur district including population and male female ratio assessed and recorded for all 12 Tehsils of Jaipur District.

2. Project was initially planned for four years. One year extension was given in 2020-21. All activities of the project have been completed. Status assessment of distribution and male female ratio of Ephedra foliata in 3 Tehsils completed during current year. Maintenance of plants planted in field during 2019-20 was also done during the current year 20-21.

3. Fresh cuttings of *Ephedra foliata were* collected from Chomu, Samod and near by areas during March 2017 and again in July 2017 for studying the rooting potential of cuttings for vegetative propagation.

4. 50 fresh cuttings (of proper size & thickness) with three replicas (50x3) in all 150 cuttings were planted in the poly bags having ordinary filling mixture without any treatment as a control.

5. 100 fresh cuttings (of proper size & thickness) with three replicas having hormonal treatment (IBA 500, 750 &1000 ppm, dipping of cutting duration 30 minutes) and 4 soil combinations (100x3x4) in all 1200 Cuttings were planted in poly bags.

6. Total 1350 fresh cuttings were planted for study of vegetative propagation.

(A) Propagation of *Ephedra foliata*

(a) Vegetative propagation of *Ephedra foliata*

(I) General detials of Cutting Collection & Sprouting

Date of the collection of cuttings	Places of collection/ source	Dates of planting of Cuttings	Duration of sprouting
27 March, 2017	Forest Land Samod, Chomu	28,29 March, 2017	1April to 15 April 2017
15 July, 2017	Forest Land Samod, Chomu	15,16 July, 2017	25 July to 5 August .2017

(II) Results of Vegetative Propagation (Cuttings Planted During March, 17)

Soil Type	Control (Without) any Treatment)		*IBA 500 PPM*		*IBA 750 PPM*		*IBA 1000 PPM*	
	No. of Cuttings Planted	Rooting %	No. of Cuttings Planted	Rooting %	No. of Cuttings Planted	Rooting %	No. of Cuttings Planted	Rooting %
Natural Forest Soil (100%)	50x3	6	50x2	9	50x2	9	50x2	10
Sand, clay, vermicompost (1:1:1)	0		50x2	8	50x2	8	50x2	6
Sand, clay, goat dung (1:1:1)	0		50x2	7	50x2	7	50x2	6
Natural Forest Soil (30%), sand (50%), & vermicompost (20%)	0		50x2	8	50x2	9	50x2	10
Total	150		400		400		400	

(III) Observations/ results of rooting & sprouting

Month of cutting planted	Total no. of cuttings Planted	No. of cuttings sprouted	Sprouting %	No. of cuttings rooted	Rooting %	No. of. cuttings developed in plant
March, 2017	1350	211	15.62	106	7.9	95
July, 2017	500	48	9.6	19	3.84	15
Total	**1850**	**259**	**14**	**125**	**6.75**	**110 (5.94%)**

(b) propagation of *Ephedra foliata* by seed

(i) Freshly ripened seeds of *Ephedra foliata* were collected from Samod, Chomu area and sown after giving proper treatment.

(ii) Sowing done in 4 soil combinations.

(iii) Observations of sowing recorded & monitored.

(I) General details of Seed Collection and Germination

Date of seed collection	Place / source of collection	Date of sowing	Duration of germination	Month of transplanting
4.05.2018	Samod, Chomu	9.05.2018	18.05.2018 to 30.5.2018=13 days	Aug-18

(II) Observations/results of Germination and Survival

Soil mixture type	No. of seeds sown	Germination		Rooting %	No of plants raised	Avg. height in March 2019
		No. of seeds germination	Germination %			
Natural Forest Soil (100%) **control**	100x2	146	73	68	136	38 cm
Sand,clay, vermicompost (1:1:1)	100x2	90	45	40	80	32 cm
Sand, clay, goat dung (1:1:1)	100x2	86	43	38	76	34 cm
Natural Forest Soil (30%), sand (50%), & vermicompost (20%)	100x2	126	63	52	104	36 cm
In all	**800**	**448**	**56**	**49.5**	**396**	**35 cm**

Conclusion: Cuttings of plant material planted in both seasons in different soil combinations did not yield successful results. Therefore vegetative propagation of *Ephedra* is unsuccessful. However good results were obtained from seeds. Overall 56% Germination and 49.5% survivalof germinatede plants was found during 2018-19 by seeds. Natural forest soil gives best results with73 % germination and 68% survival. Hence propagation of *Ephedra foliata* is successful by seeds.

(B) Re-introduction of Ephedra *foliata* by planting:

Plants raised through seeds were planted near Mytenus emerginata plants as support plant in field during 2019-20. Details are as under:

S. N.	Planting Area	GPS Co-ordinates of Area	No of plants	Operations during the year	Survival percent		
					Dec.19	March 20	March 21
1	Govindpura, Jaipur	26°56'34"N 75°41'37"E	300	Planting date 13-07-2019, Watering and weeding (3 times in the months of july, September 2019 and January 2020)	80%	55%	54%
2	Grass Farm Nursery, Jaipur	26°56'16"N 75°45'30"E	50		70%	36%	30%
3	World Forestry Arboretum, Jaipur	26°52'37"N 75°49'19"E	50		78%	58%	50%
	Total		**400**		78.5%	53%	45%

(C) Status Report of *Ephedra foliata:*

Distribution of *Ephedra foliata* including population and male-female ratio and threat status have been assessed and recorded in all 12 tehsils of Jaipur district. Status Assessment in Chomu, Sambhar, Amer, Phagi, Chaksu, Kotputli, Sanganer, Shahpura and Virat Nagar was done upto 2019-20. Status Assessment of Bassi, Jamua Ramgarh, and Jaipur tehsils done in 2020-21. Out of 12 tehsils *Ephedra foliata* found only in 3 tehsils namely Chomu, Sambhar and Amer. *Ephedra foliata* grows sporadically on sand hills, in open woods and along road side in several tehsils of Jaipur district. It is an important constituent of the arid desert flora of the region. It was found that the restrictions on the new recruitments of *Ephedra foliata* in natural habitat are due to combined effects of biotic factors like grazing and illicit felling. This biotic stress considerably affected the percentage of seed germination, their establishment and maturation into viable adults and these are the causes of dwindling population of *Ephedra foliata* .

S.N.	Name of Tehsil	Area with GPS coordinates	No of plants counted	Sex Ratio		Support plants	Threats
				Male	Female		
1	Chomu	Samod area 27.2067ºN, 75.7953º E	109	55.50	44.50	96% plants were found on *Maytenus emarginata*	Grazing, & Illegal cutting
2	Phagi,	Not Found	-	-	-	-	-
3	Chaksu	Not Found	-	-	-	-	-
4	Sambher	Kalkah dam area 26.9702ºN, 75.3791º E	65	54.44	45.56	60% plants were found on *Maytenus emarginata* and rest on other spp. & fencing of fields	Grazing, & Illegal cutting
5	Kotputli	Not Found	-	-	-	-	-
6	Shahpura	Not Found	-	-	-	-	-
7	Viratnagar	Not Found	-	-	-	-	-
8	Amer	Mundota and Jaloi Raod plantation 26°01'05.56"N 75°35'26.23" E	135	56.40	43.60	99. % plants were found on *Maytenus emarginata*	Grazing, & Illegal cutting
		Kukas Area 27°02'56.1"N E75°52'58.8" E	38	51	49	99. % plants were found on *Maytenus emarginata*	Grazing, & Illegal cutting
		Kukas Area 27.048897°N 75.881405°E	38	51	49	99. % plants were found on *Maytenus emarginata*	Grazing, & Illegal cutting
9	Sanganer	Not Found	-	-	-	-	-
10	Bassi	Not Found	-	-	-	-	-
11	Jamua-Ramgarh	Not Found	-	-	-	-	-
12	Jaipur	Not Found	-	-	-	-	-
	Total		**391**	**54**	**46**		

5.4.3. Establishment of Vermicomposting unit at Research Centre, Govindpura.

Introduction:

Govindpura Research centre, Jaipur generates a large amount of organic waste annually which is either burned or land filled. This creates the major environmental problems. Vermicomposting is the best biotechnology to reduce the load on the treatment and disposal of biodegradable waste. Establishment of Vermicomposting unit at Govindpura research centre, Jaipur is being taken up for the proper utilization of waste from farm through vermicomposting and obtaining the nutrient rich organic manure.

Govindpura Research centre, Jaipur is centre of many Seedling Seed Orchards and Clonal Seed Orchards developed by AFRI and maintained by state forest department. The area has got unique bio-diversity of trees, herbs, shrubs, grasses that co exist to simulate a natural forest. There is an urgent need to improve and manage these SSO's for production of high yield and good quality of seeds. Use of organic manure produced in vermicomposting unit at Govindpura will help in improvement of these CSOs and SSOs.

Objectives:

- To produce organic manure of exceptional quality.
- To improve organically starved soil of Govindpura research farm.
- To manage organic waste to protect the environment.

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure/ Layout (Lakh Rs)				Total
	Project Duration	Revised Project Duration	Expenditure During 2019-20	Proposed Layout for 2020-21	
1.00	1 Years	2 Years	0.47	0.53	1.00

Progress up to 2020-21

Following works have been carried out during the year 2019-20 to 20-21 for establishment of Vermicomposting unit at Govindpura research centre:

- Cleaning & removal of weeds at the site
- Appropriate shade for vermicomposting.
- Fixing of kota stone tiles in vermicompost shade
- Making of Vermi-beds
- Develop appropriate Water Supply System for the unit
- Machinery and implements for cutting (shredding) the raw material
- Purchase of cow dung and earthworms
- Development of Godown/ Store
- Regular upkeep of the unit
- Display of appropriate signage.

Project status: Concluded

5.4.4 Developing propagation protocol of Bija Sal *(Pterocarpus marsupium)*

Introduction:

There are many important medicinal plants whose propagation is very important for the department and for bio diversity conservation. One of them is *Pterocarpus marsupium*

Pterocarpus marsupium (Bija sal) the Indian Kino is a deciduous tree, up to 30 m tall, bark 10-15 mm, surface grey or greyish-black, rough, deeply vertically cracked, exfoliations small, irregular, fibrous; blaze pink; exudation blood-red. Leaves are compound, alternate; stipules small, lateral, dioecious; sepal tube bell-shaped, sepals short, the upper 2 often fused; flowers are protruding; petals 5, all long-clawed, crisped along the margins; standard round, wings oblique, obviate, eard; keel petals oblique, small, slightly fused; stamens 10. Fruit is a pod, 2.5-5 cm across, round-kidney-shaped, broadly winged; seed one, somewhat kidney-shaped. Flowering: September-October.

Medicinal uses:

Decoction of the heartwood of Bija sal is useful in skin diseases, diabetes, anemia and excess of kapha and obesity. In obesity, a decoction of the heartwood of asana should be taken mixed with honey. Decoction of the heartwood of asana is useful in skin diseases, diabetes, anemia, and excess of kapha and obesity.

Bija sal plants at Research Center Banki Nursery, Udaipur

Objectives:

- To develop propagation protocol of *Pterocarpus marsupium*
- To raise Red List plants to enrich the bio- diversity of forest area of Rajasthan

Project area: Banki Research Centre, Udaipur

Project Investigators: Range Forest Officer, Banki Research Centre,Udaipur

Project Details:

Project Cost (Lakh Rs)	Expenditure/ Layout (Lakh Rs)			
	Project Duration	Expenditure During 2019-20	Expenditure 2020-21	Total Expenditure
0.30	2 Years	0.16	0.14	0.30

Project status: Concluded

Methodology / propagation protocol:

- The seeds were collected from Kevda ki naal forest of Udaipur on June 2019.
- Mature fruits may be plucked from trees in May-june before they fall on ground.
- Freshly collected seeds should be used for raising propagules.
- The collected seeds were given pretreatment and were kept in fresh cow dung for 36 hours.
- Before sowing, seeds are treated with fungicide to protect them from fungal infections.
- Seed germination was found 65%.
- Seedlings may also be raised directly in polybags as higher mortality (70%) has been observed in transplanting.
- About 100 gm of viable seeds are required to raise 156 seedlings
- Plant survival was found 58% in March 2020

5.4.5. Habitat Improvement, Renovation & Biodiversity Conservation work at Amrita Devi Udyan, Jaipur

Introduction:

Part B of World Forestry Arboretum is known as Amrita Devi Udyan. Part B of Arboretum was dedicated to nation as Amrita Devi Udyan on 4th September, 1995 in commemoration of martyrdom of Amrita Devi and her 363 fellow persons in the year 1730. Amrita Devi of Khejarali village of the then Jodhpur State led a protest against the cutting of Khejri trees along with 363 other persons. They hugged the trees to save them from cutting and sacrificed themselves to save trees as they were killed while hugging the trees. This is the first and only example of its kind in history of mankind where such a large numbers of people sacrificed their lives for the protection of trees. This Udyan is spread over an area of 35 ha. It has been aesthetically designed as an ideal educational knowledge centre with following features:

1. Vegetation map of Rajasthan
2. Map of India
3. Terrace garden/environmental open air theater.
4. Plant conservatory
5. Igloo garden
6. Walking trail
7. Bird view point/Jhoonpa

Need of project

Park infrastructure is in a dilapidated condition and needs urgent renovation, habitat improvement & biodiversity conservation work to bring it to its original glory. Therefore this project has been proposed.

Objectives:

- To promote in situ and ex-situ conservation of forest plants biodiversity.
- To develop a multi-disciplinary database of forest plants.
- To educate, encourage and promote knowledge of these plants to all stakeholders
- To develop a gene-pool of these indigenous plant species.
- To renovate this park to bring it to its original glory.

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure/ Layout (Lakh Rs)				Total
	Project Duration	Expenditure During 2019-20	Expenditure During 2020-21	Proposed Layout for 2021-22	
8.00	3 Years	1.92	4.58	1.50	8.00

Project status: On going

Vegetation Map of Rajasthan


Walking Trail

Methodology of work

The methodology for Habitat improvement & Biodiversity Conservation work at Amrita Devi Udyan, Jaipur will involve preparation of land, fencing, landscaping, collection and planting of plants, development of irrigation facilities. Works will be taken up for restoration of old infrastructure like vegetation map of Rajasthan, map of India, Plant Conservatory and Igloo garden etc. Required species of trees, shrubs, herbs will be planted. Information about the plants, vegetation and other will be developed and displayed at proper places.

Following works were carried out up to the year 2020-21 :

Vegetation map of Rajasthan area, Circular garden and plant conservatory

- Fencing of the area
- Lay out of landscaping of the area and development of pathways.
- Fixing of 430 rmt.kerb stone on paths ways.
- Cleaning & removal of weeds.
- Cleaning, repairing and painting work was done in Igloo Garden.
- Repairing works were taken up at Jhopas / Resting huts, plant conservatory.
- Development of irrigation system.
- Identification, procurement & planting for restoration of Vegetation map.
- Water pond for fauna of the garden.
- Regular maintenance of garden.

Activity Chart

S.N.	ACTIVITY ↓ YEAR →	2019-20	2020-21	2021-22
1	Cleaning & removal of weeds			
2	Laying of Curb stone Fencing of area			
3	Landscaping and developing pathways			
4	Developing and maintenance of appropriate irrigation system			
5	Identification and procurement of plant species for restoration of Vegetation map, plant conservatory etc. and for development of the area			
6	Planting of identified species plants			
7	Display of plants with appropriate signage			
8	Maintenance of the restored infrastructure			
9	Record keeping of all operations, Measurement of Growth and Survival			

5.4.6 Establishment of Herbal Garden at Grass Farm Nursery, Jaipur.

Introduction:

An Herbal Garden provides a visual introduction of several species of medicinal plants that are used by the indigenous traditional system. This Herbal Garden reflects the long standing tradition of conserving and using plants products for health care. Making an herbal garden is an opportunity to grow herbs for use, while spreading knowledge of their importance and traditional uses. Rajasthan region boasts of a tremendous diversity of medicinal plant, the forests are source of herbal medicine for many of the local ethnic communities. Thus, there is a need to create awareness among the public about the importance of our traditional heritage of herbal healing and importance of medicinal plants and their conservation. A special effort will be made to collect and grow plants from different bio-geographical regions.

Objectives:

- To promote in-situ and ex-situ conservation of herbal plant biodiversity.
- To develop a multi-disciplinary database of herbal plants.
- To educate, encourage and promote the concept of traditional knowledge of herbal gardens to all stakeholders and provide them an opportunity to identify different types of herbs and be aware of their uses in food and in traditional medicinal systems of Ayurveda, Unnani, and Siddha
- To popularize use of local medicinal plants and Indian system of medicine.
- To develop and standardize the protocol for propagation techniques for important medicinal plants.
- To develop a gene-pool of indigenous plant species.

Project Investigator: Range Forest Officer, Grass Farm Nursery, Jaipur

Project Cost and Expenditure Details

Revised Project Cost (Lakh Rs)	Year Wise Expenditure (Lakh Rs)					Proposed Layout for 2021-22
	Extended Project Duration	2018-19	2019-20	2020-21	Total Exp. Upto 2020-21	
6.96	4 Years	2.29	2.02	1.30	5.61	1.35

Project status: Ongoing

Progress up to 2020-21

Following work have been carried out for creation of Herbal garden up to 2020-21

- Fencing and Land scaping of the area.

- Construction of pathways in the area.
- Cleaning & removal of weeds of the area.
- Lay out of Garden and beds for planting species of medicinal value.
- Identification of different species.
- Procurement of different species of plants. Planting of the same species in cluster.

ACTIVITY CHART

S.N.	ACTIVITY ↓ YEAR →	2018-19	2019-20	2020-21	2021-22
1	Cleaning & removal of weeds				
2	Lay out of Garden				
3	Layout of beds for planting				
4	Fencing and Landscaping of the area				
5	Develop appropriate irrigation system				
6	Identification of different species				
7	Procurement of different species of plants				
8	Planting of the same species in cluster				
8a	Replacement of plants				
9	Display of plants with appropriate signage				
10	Regular maintenance of garden				
11	Record keeping of all operations				
12	Measurement of biomass productivity & other growth parameters will be taken				
13	Survival % of the plants will be taken				

List of Plants at Harbal Garden

S.N.	Local Name	Botanical Name	S.N.	Local Name	Botanical Name
1	Akash Neem	*Millingtonia hortensis*	22	Karonda	*Carissa carandas*
2	Aak safed	*Calotropis gigantea*	23	kainth	*Limonia acidissima*
3	Arjun	*Terminelia arjuna*	24	Kewda	*Pandanus odorifer*
4	Ashwa gandha	*Withania somnifera*	25	Lemon Grass	*Cymbopogon flexuosus*
5	Adusa	*Justicia adhatoda*	26	Lajwanti	*Mimosa pudica*
6	Bad	*Ficus benghalensis*	27	Meetha Neem	*Murraya koenigii*
7	Bans	*Dendrocalamus strictus*	28	Maul shri	*Mimausoups elengi*
8	Bhumi Amla	*Phyllanthus niruri*	29	Mehndi	*Lawsonia inermis*

S.N.	Local Name	Botanical Name	S.N.	Local Name	Botanical Name
9	Chitrak	*Plumbago zeylanica*	30	Neem	*Azadirachta indica*
10	Chirmi	*Abrus precatorius*	31	Nirgundi	*Vitex negundo*
11	Dama bel	*Tylophora indica*	32	Pipal	*Ficus religiosa*
12	Dudhi	*Holarrhena pubescens*	33	Peepla mool	*Piper longum*
13	Giloy	*Tinospora cordifolia*	34	Patthar chatta	*Bryophyllum pinnatum*
14	Gudmar	*Gymnema sylvestre*	35	Shatawari	*Asparagus racemosus*
15	Gugal	*Commiphora wightii*	36	Sada bahar	*Catharanthus roseus*
16	Gwar patha	*Aloe vera*	37	Sita fal	*Annona squamosa*
17	Harsingar	*Nyctanthes arbor-tristis*	38	Sudarshan	*Crinum latifolium*
18	Had jod	*Cissus quadrangularis*	39	Tulsi	*Ocimum sanctu*
19	Imli	*Temrindus indica*	40	Tamboliya	*Ehretia laevis*
20	Khirenti	*Sida cordifolia*	41	Vajra danti	*Barleria prionitis*
21	Kachnar	*Bauhinia variegata*			

5.4.7. Development & Improvement of Seedling Seed Orchards at Govindpura Research Centre, Jaipur

Introduction:

Govindpura Research Centre, Jaipur is centre of many seedling seed orchards and clonal seed orchards developed by AFRI and maintained by state forest department. The area has got unique bio-diversity of trees, herbs, shrubs, grasses that co exist to simulate a natural forest.

There are two seedling seed orchards of fruit species. One is of Aegle marmelos and other is of Phyllanthus emblica both species are very important. No Attempts have been made to develop this SSO for seed production so far. So there is an urgent need to improve and manage these SSO's for production of high yield and good quality of fruits and seeds.

Details of these Seedling Seed Orchards are as follows:

S.N.	Details of seedling seed orchards	Year	No. of plants survived
1	Seedling seed orchard of *Aegle marmelos*	1998	128
2	Seedling seed orchard of *Phyllanthus emblica*	1998	186
3	*Experimental plot of Prosopis cinreria*	2016	279

Aegle marmelos

Aegle marmelos locally known as Beel, belonging to family Rutaceae is a medium sized tree of Indian origin. Leaves, roots, seed, bark and fruit etc contain a large number of coumarins, alkaloids, sterols and essential oils, hence it possess anti-micro filarial, antifungal, analgesic, anti-inflammatory, antipyretic, hypoglycemic, immunomodulatory, wound healing, anti-fertility and insecticidal abilities. The fruits are also used to prepare a large number of by products such as candy, panjiri, toffee, jam etc. It has tolerance to arid conditions as well as to high rainfall.

Phyllanthus emblica

The tree locally known as amla is small to medium in size and height. The branchlets are not glabrous usually deciduous; the leaves are simple, sub sessile and closely set along branchlets, light green; the flowers are greenish-yellow. The fruit is nearly spherical, light greenish-yellow, ripening in autumn; the berries are harvested by hand after climbing to upper branches bearing the fruits. In traditional Indian medicine, dried and fresh fruits of the plant are used. All parts of the plant are used in various Ayurvedic medicine herbal preparations, including the fruit, seed, leaves, root, bark and flowers. In Ayurvedic polyherbal formulations, Indian gooseberry is a common constituent, and most notably is the primary ingredient in an ancient herbal rasayana called Chyawanprash.

Prosopis cineraria:

Prosopis cinerarium is a species of family, Fabaceae. It is the state tree of Rajasthan. The wood of Prosopis cineraria is a good fuel source and provides excellent charcoal plus firewood, fodder, green manure and goat-proof thorny fences. The leaves, called "Loong" in India and pods are consumed by livestock and are beneficial forage. In Rajasthan, India, Prosopis cineraria is grown in an agro forestry setting because it has a single-layered canopy. It is a nitrogen fixer.

An experimental plot of Prosopis cineraria in Govindpura Research Centre was done in year 2017-18 and does the comparative study of growth parameters with planting at 3m X 3m and 4m X 4m spacing. The project was concluded but it is proposed to establish / maintain this plot as seedling seed orchards.

Objectives:

- To improve the management of seedling seed orchard of Aegle marmelos & Phyllanthus emblica.
- To improve the fruit and seed quality of Aegle marmelos & Phyllanthus emblica.
- To get high yield of fruits and seeds.
- To improve the biodiversity of the area with the help of silvicultural interventation.
- To develop the experimental plot of Prosopis cineraria as a seedling seed orchard.

Project status: ongoing

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure/ Layout (Lakh Rs)					Total
	Project Duration		Expenditure during 2019-20	Expenditure during 2020-21	Proposed Layout for 2021-22	
	Original	Revised				
5.00	2 Years	3 Years	2.67	1.30	1.03	5.00

Following work carried in year 2020-21:

Following works were carried out for improvement of seedling seed orchards:

S.N.	Silvicultural work	SSO of *Aegle marmelos*	SSO of Phyllanthus emblica	Experimental plot of Prosopis cinreria
1	Cleaning & Removal of Weeds	October 2020	October 2020	September 2020
2	Repaire of Thavla	July 2020	July 2020	July 2020
3	Watering	7 times in, April, May, June, October, December 2020, January and March 2021	7 times in, April, May June, October December 2020, January and March 2021	4 times in May, November, 2020, January and March 2021
4	Weeding & Hoeing	5 times in May, June, November 20 January and March 2021	5 times in May, June, November.20, January and March 2021	5 times in May, June, November .2020, January and March 2021
5	Application of manure	20 kg per plant –goat manure in June and November 20	20 kg per plant –goat manure in June and November 20	5 kg per plant –goat manure in June and November 20
6	Other treatments given	Neem khali -1kg per plant in water solution in August 2020	Neem khali 1kg per plant in water solution in August 2020	Neem khali 500gm per plant in water solution in August 2020
7	Pruning	October 2020	October 2020	March 2021

*10 plants of Phyllanthus emblica planted in month of August 20 to promote for cross pollination after appropriate growth.

** Besides these Soil and Water samples were also tested for Ph and Ec and results were found normal. One Water Tank of 52 cum capacity was constructed at the cost of 1.00 lakhs so as to harvest the rain water for irrigation of plants.

Observations:

- Positive change has been seen in growth and amount of Bel patra fruit.
- Fruiting in Phyllanthus emblica was almost nil, only five plants had little fruiting. Fruit bearing in Phyllanthus emblica trees often suffer from heavy fruit drop which significantly lowers down the yield. Fruit drop often causes poor fruit set and may result in substantial crop loss. Among the major causes for fruit drop are self-incompatibility, inadequate pollination, nutritional deficiency, water stress, insect-pest and disease infestations and hormonal. It is proposed to take appropriate measures to overcome these causes.
- Khejri shown good growth after pruning.
- Amount of fruit per plant increased. Results will be published after fruting in July 2021.
- Leafage biomass increased seen ocular.

5.4.8. Developing propagation technique of *Buchanania lanzan* (Charoli)

Introduction:-*Buchanania lanzan* commonly known as chironji or Charoli is an important medicinal plant and distributed almost all over India. It is cultivated across India, primarily in the northwest. Charoli seeds are used in the Ayurveda and Unani systems of medicine.

Objectives:

- To develop propagation protocol of *Buchanania lanzan.*
- To raise plants of Red List species to help enrich the bio- diversity of forest area of Rajasthan

Project area: Banki Research Centre, Udaipur

Project Investigator: Range Forest Officer, Banki Research Centre, Udaipur

Project Details:

Project Cost (Lakh Rs)	Year Wise Layout (Lakh Rs)		
	Duration	2020-21	2021-22
0.30	2 Years	0.20	0.10

Note: 1000 Plants will be raised in the project

Project status: Ongoing

Material and Methodology

Following works have been carried out up to the year 2020-21:

- The seeds were collected from Sita mata sanctuary forest area of Udaipur in June 20.
- The collected seeds were given pre treatment and were kept in fresh water for 24 hours.
- Seeds sown in polybags as well as in mother beds.
- Seeds germination was found 54 %.
- Transplanting of plants from mother beds done in September 2021.
- Plant survival was found 78% in March 2021.
- Propagation protocol of the species will be standardized and published after March 2022.

5.5.9. Collection of Quality Seeds From Seed Production Areas of Rajasthan

Introduction: Seed collection Range is working under Silviculture Wing for many years. There is a need to collect quality seeds of different species from earmarked Seed Production Areas to make these seeds available to different forest divisions, for better quality of seedlings.

Objectives:

- To collect quality seeds from demarcated Seed Production Areas.
- To provide healthy and good quality seeds for planting and sowing purpose.

Project investigator: Range Forest Officer, Seed collection, Jaipur.

Duration proposed: 4 years **Project status:** Ongoing **Year of start**: 2020-21

Project Cost (Lakh Rs)	Year Wise Proposed Layout (Lakh Rs)				
	Project Duration	Expenditure During 2020-21	2017-18	2018-19	2019-20
17.00	4 Years	2.80	5.50	4.35	4.35

This seed unit has collected seeds of important species during 2020-21 from identified Seed Production Areas are as under:

S. N.	Name of SPA	Species	Division	Quantity collected	Quantity distributed
1	Samod -1992	*Acacia senegal*	Jaipur (North)	970 kg	970 kg
2	Govindpura beed jaipur	*Vachellia nilotica*	Jaipur (Silva)	2000 kg	2000 kg
3	Govindpura beed Jaipur	*Prosopis cinreria*	Jaipur (Silva)	240 kg	240 kg
4	Hokra "C" Pushkar	*Vachellia tortilis*	Ajmer	260 kg	260 kg
			Total	**3470 Kg**	**3470 Kg**

Collected seeds were distributed to various Forest Divisions during the year. It is proposed to collect the seeds of important indigenous species from the identified Seed Production Areas every year.

Methodology:

- ✓ Seeds will be collected from identified SPA of species.
- ✓ Plus trees will be selected for collection of seeds.
- ✓ Standard method of seed collection will be used.
- ✓ Seeds collection will be carried out by trained labourers and field staff.
- ✓ After collection of seeds from SPAs, treatment with insecticides will be done.

6. OTHER ACTIVITIES

Other activities carried out in various Research centers during 2020-21 are as follows:

6.1 Research Center Grass Farm , Jaipur

Apart from regular maintenance of Research Center Grass Farm, Jaipur the other activities executed were as follows:

6.1.1 Raising and distribution of plants is one of the major activities at the Grass Farm Nursery, Jaipur. Good quality saplings of more than 53 species which were raised in year 2020-21 were distributed / sold to the public during the financial year 2020-21. Total 2, 11,077 seedlings were distributed / sold to the public and government offices.

6.1.2 During the financial year 2020-21, total 2, 20,000 seedlings belonging to different plant species including medicinal plants were raised for distribution during 2021-22. and 60000 plants were transplanted to 20cm x40cm size polybags from 15x22.5cm size polybags for preparation of tall plants in farm forestry scheme.

6.1.3 The nature trail in Grass farm nursery is used by local residents for morning and evening walks. About 120 regular morning walkers and 50 evening walkers visit the forest area. School teachers conducted environment education programmes for students during the entire year. Students of different schools visited the campus as well as nature trail during the year. Due to covid conditions some restrictions were also imposed to public as per state government's order.

6.1.4 Waterholes were maintained throughout the year for use of fauna existing in the Grass Farm Nursery Campus.

Plant Nursery at Grass Farm, Jaipur

6.2 Research Center Govindpura, Jaipur:

6.2.1 Clonal Seed Orchards (14), Seedling Seed Orchards (9) and 5 other plots (in total 28 plots) were maintained during the year.

6.2.2 Raising and distribution of plants is also an activity at the Research Center Govindpura, Jaipur. Good quality saplings of more than 21 species which were raised in year 2019-20 were distributed / sold to the public during the financial year 2020-21. Total 20000 seedlings were distributed / sold to the public and government offices. Furthur 2000 plants raised under Research head also distributed during the year.

6.2.3 During the year 2020-21, total 20,000 seedlings belonging to different plant species including medicinal plants were raised for distribution during 2021-22. During the year, 10000 seedlings were raised under Farm Forestry and 10000 seedlings were raised under R.F.B.P.

6.2.4 Social-cost benefit of INR 3.60 lakhs (@Rs 2/kg.) was accrued to villagers adjoining Govindpura Research Center due to harvesting/distribution of Cenchrus ciliaris (Dhaman grass) of 180 ton to 190 families.

6.3 Research Center World Forestry Arboretum Jaipur:

6.3.1 60,000 seedlings belonging to 36 different plant species were raised during 2020-21 for distribution in year 2021-22. Under RFBP. 20000 seedlings of various plant species were raised. 20,000 plants transplanted in 20cmx40cm size polybags for preparation of tall plants in farm forestry scheme.20,000 seedlings belonging to different species were raised for farm forestry

scheme. All these plants will be made available for distribution in year 2021-22.

6.3.2 During the year 25,000 seedlings under RFBP, 5000 seedlings under farm forestry scheme and 4899 remaining plants under CAMPA scheme were distributed to local people.

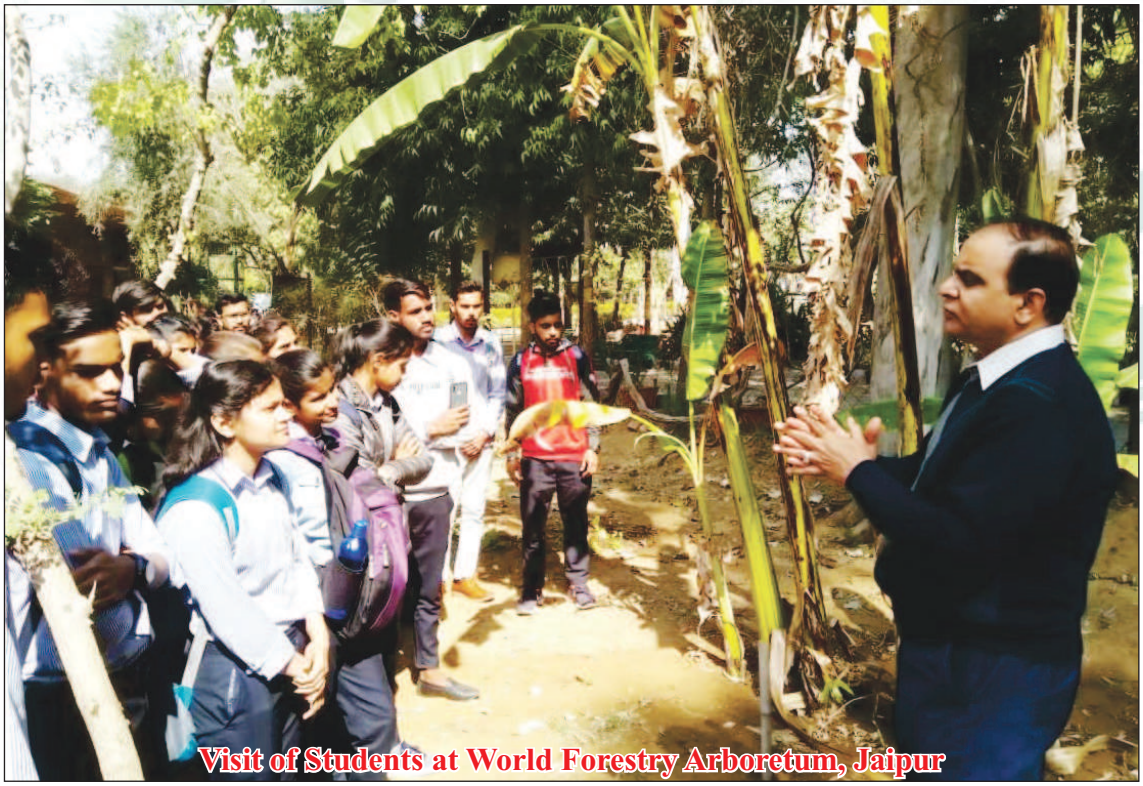
6.3.3 Regular maintenance of Arboretum (145 Ha.) & Amrita Devi Udyan (35 ha.) was done throughout the year.

6.3.4 Clonal orchard of Commiphora wightii (Guggul) was maintained. Survival percentages of plants are above 90 %.

6.3.5 During the year 160 visitors of different schools, colleges, universities and institutions visited Arboretum. Their invaluable remarks are recorded in visitor's book available at the Range Office. Apart from this a large numbers of regular visitors also visited the arboretum. Due to covid pendemic the number of visitors remained restricted.

6.3.6 World Environment Day and World Earth Day were celebrated at Arboretum. Amrita Devi Shahidi Divas was also celebrated in collaboration with Vishnoi Samaj.

6.3.7 A census study of wild life was done. Results of the same were sent to Deputy Conservator of Forest, Jaipur (zoo) jaipur.



Visit of Students at World Forestry Arboretum, Jaipur

6.4 Forest Research Centre Banki, Udaipur:

Apart from regular maintenance of Banki Reserach Center the other activities were as follows:

6.4.1 35,000 Seedlings belonging to 27 different plant species including medicinal plants were raised during 2020-21 for distribution in 2021-22.

6.4.2 During the financial year 39,224 seedlings were distributed to local people and government department.

6.4.3 During the same financial year, undistributed 1,36,933 tall plants in CAMPA scheme, were distributed to local people and government departments.

6.5 Seed Testing Laboratory: Tests for germination percentage conducted at the lab for 162 seed samples received from 16 different forest divisions. The reports were sent to the concerned divisions. Details are as follows:-

S. No.	Number of forest divisions	No. of samples	Number of species tested
1	16	162	51

6.6 Soil & Water Testing Laboratory: 13 samples of soil and 13 samples of water were received from various forest divisions and indivisuls. Samples were analyzed for pH, Electrical Conductivity and results with suggestions were communicated to the concerned divisions/persons.

S. N.	Details of institution/ indivisuls	No. of institution/ indivisuls	No. of soil samples analysed	No. of water samples analysed
1	Forest divisions/Other Offices	13	11	2
2	Indivisuls/ farmers	9	4	5
	Total	**22**	**15**	**7**

6.7 Seed Production Areas, Seed Collection & Storage:

Seed Production Areas (SPAs) are created to produce seeds of the best provenances of forest trees. High quality and healthy seeds are the pre-requisites for developing healthy quality plants. High quality seeds mean the seed which is physically and genetically pure, high in germination and vigour and free from pathological diseases and insect pest infestation.

Use of improved seed from promising provenances and seed of superior known phenotype source will improve survival rate and enhancement of productivity of forests. Seed collection work along with cleaning by seed grading/cleaning machine, testing for germination, purity and moisture and treating the seed with fungicide and insecticides before packing and storage of most commonly found species in the state of Rajasthan

has been undertaken by the seed production and collection unit of Silviculture Wing. Selection of seed production areas (SPA's), collection of quality seeds & its supply to divisions on demand is a major activity which is carried out by Silviculture Wing.

6.7.1 Declaration & deletion of Seed Production Areas (SPAs) in current year:

Following forest areas have been declared or deleted from the list of Seed Production Areas (SPA's) in current year:

S.N.	Name of area	Name of Range & division	Name of species	GPS coordinates	Comments
1.	Navda basai (15Ha.)	Shahbad Baran Division	Acacia catechu (Khair)	25°18'47" N & 77°16'15" E	Declared new SPA by CCF Silviculture Office order no. 1106-14 dated 30-03-21
2	Block Bhaisa Ghat A (100Ha.)	Shahbad Baran Division	Acacia catechu (Khair)	----	Deleted from the list of SPAs by CCF silviculture Office order no.1106-14 dated 30-03-21

6.7.2 List of existing Seed Production Areas (SPAs) as on 31.3.2021:

S.N.	Name of SPA	Area (Ha.)	Species	Division	Year of creation
1.	0-7 RD Sangeeta Distributory, Suratgarh	10	*Eucalyptus*	Sri Ganganagar	1997-98
2.	Punch kund Pushkar	10	*Acacia senegal*	Ajmer	1997-98
3.	Padhajhar Block Rawatbhata	10	*Acacia catechu*	Chittorgarh	1997-98
4.	Bajor Plantation	10	*Vachellia tortilis*	Sikar	1997-98
5.	Jhunjhunu beed	10	*Salvadora oleodis*	Jhunjhunu	1999-02
6.	Block Umaro Ka Mathara, Range Saira, RDF Model I, year 2006	40	*Jatropha curcas*	Udaipur (North)	2008-09
7.	Block Aariwali Barwari, Range Saira 1. RDF Model I, year 2004 2. RDF Model II, year 2006 3. RDF Model II, year 2007	 50 100 100	*Jatropha curcas*	Udaipur (North)	2008-09

S.N.	*Name of SPA*	Area (Ha.)	Species	Division	Year of creation
8.	Bukala-B, Kukas, plantation of year 1994-95 of Amer Range	50	*Acacia senegal*	Jaipur	2008-09
9.	Beed Govindpura, Govindpura Research Farm, Jaipur	95	*Prosopis cineraria*	CCF (Silva)	2011-12
10.	Gurumba Plantation 89-90, Range Pushker	50	*Acacia senegal*	Ajmer	2011-12
11.	Ganoli, Range Mandalgarh	100	*Acacia leucophloea*	Bhilwara	2011-12
12.	Beer Fatehpur, Rage Fatehpur	180	*Acacia senegal*	Sikar	2011-12
13.	Umarjhala Pathara, Range Ghato	l50	*Acacia catechu*	Banswara	2011-12
14.	Forest Block Kalakh, Range Dudu,	50	*Vachellia tortilis*	Jaipur (South)	2012-13
15.	Forest Block Dausa Pahar, Range Dausa.	50	*Acacia senegal*	Dausa	2012-13
16.	OECF Mohangarh, 1440-45 RD main canal	2	*Tecomella undulata*	Jaishalmer	2012-13
17.	OECF Mohangarh, 15-16 RD Sahid Birbal Shakha	3	*Tecomella undulata*	Jaishalmer	2012-13
18.	Forest Block Raydari, Range Ogna	100	*Pongamia pinnata*	Udaipur	2012-13
19.	Forest Block Ogna, Sankhla, Range Ogna	200	*Wrightia tinctoria*	Udaipur	2012-13
20	Oda Plantation, Range Sarada	50	*Acacia senegal*	Udaipur	2012-13
21	Guneshawar Mahadev plantation, Range Sarada	300	*Acacia senegal*	Udaipur	2012-13
22	Gawdapal, Salumber Ist plantation, Range Salumber	50	*Acacia catechu*	Udaipur	2012-13
23	Gawdapal, Salumber IInd plantation,Range Salumber	50	*Acacia catechu*	Udaipur	2012-13
24	Gawdapal, Salumber IIIrd plantation,Range Salumber	50	*Acacia catechu*	Udaipur	2012-13
25	Lunia minor 0-20 RD	35	*Vachellia nilotica*	Sri Ganganagar	2014-15
26	Malkewali distributor 36-55 RD	9.6	*Vachellia nilotica*	Sri Ganganagar	2014-15
27	Gharsana-Rawla road Side - 12KM (Both side)	21	*Vachellia nilotica*	Sri Ganganagar	2014-15
28	Hokra – C, Makadwali Range Pushker	50	*Acacia tortils*	Ajmer	2015-16
29	Samod-1992	10	*Acacia senegal*	Jaipur	2018-19
30	Ram Kunda, Rajas Gram, Range Ogna	20	*Madhuca indica*	Udaipur (N)	2019-20
31	Navda Basai –Forest Area, Shahbad Range	15	*Acacia catechu*	Baran	2020-21

6.7.3 Seed Collection from SPAs:

Seeds of various species are collected from SPAs and distributed to different forest divisions. During the year 20-21 different types of seeds collected from different Seed Production Areas are as below:

S.N.	Name of SPA	Species	Division	Quantity collected	Quantity distributed
1	Samod -1992	Acacia senegal	Jaipur (North)	970 kg	970 kg
2	Govindpura beed Jaipur	Vachellia nilotica	Jaipur (Silva)	2000 kg	2000 kg
3	Govindpura beed Jaipur	Prosopis cinreria	Jaipur (Silva)	240 kg	240 kg
4	Hokra "C" Pushkar	Vachellia tortilis	Ajmer	260 kg	260 kg
			Total	**3470 Kg**	**3470 Kg**

7. High Tech Nurseries

High tech nursery is a combination of poly green house and agrinet house. Vegetative reproduction/ clonal propagation are used in such nurseries to ensure genotypic similarities with the plant source. High tech nurseries overcome the limitations like poor control over climatic factors, low germination percentage, longer duration and high cost involved in conventional methods of plant raising.

7.1 POLY HOUSE

Poly House is erected in direction parallel to East- West over angle irons, pipes or wooden post. It is erected by fixing mild steel pipe at fixed intervals. The structure is covered by Ultra Violet radiation proof polythene sheet made by I.P.C.L. The structure has a cemented floor and cemented working table. Inside Poly Green House Mist Formation Device and Humidity Control System are installed. Temperature is controlled by installing two

exhaust fans in front portion and a cooling pad at its back portion.

There are two Poly Houses under the jurisdiction of Silviculture Wing:

1. Research Center Grass Farm, Jaipur.
2. Banki Research Center, Udaipur.

7.2 AGRINET HOUSE

Agrinet House is a structure fabricated by angle iron post or iron pipe and covered by green agrinet. Tender seedling in poly green house is shifted to agrinet house for further growth in an ideal nutrient soil mixture in root trainer for 30 to 45 days. Irrigation is done by micro sprinkler at certain intervel. Tender seedling is kept 1 to 1.5 months in agrinet house for growth. The agrinet plants are hardened for field conditions by keeping in open atmosphere for about 20 days with restricted watering.

There are three Agrinet House under the jurisdiction of Silviculture Wing:-

1. Research Center Grass Farm, Jaipur.
2. Research Center Banki, Udaipur.
3. Research Center Govindpura, Jaipur.

7.3 ROOT TRAINERS

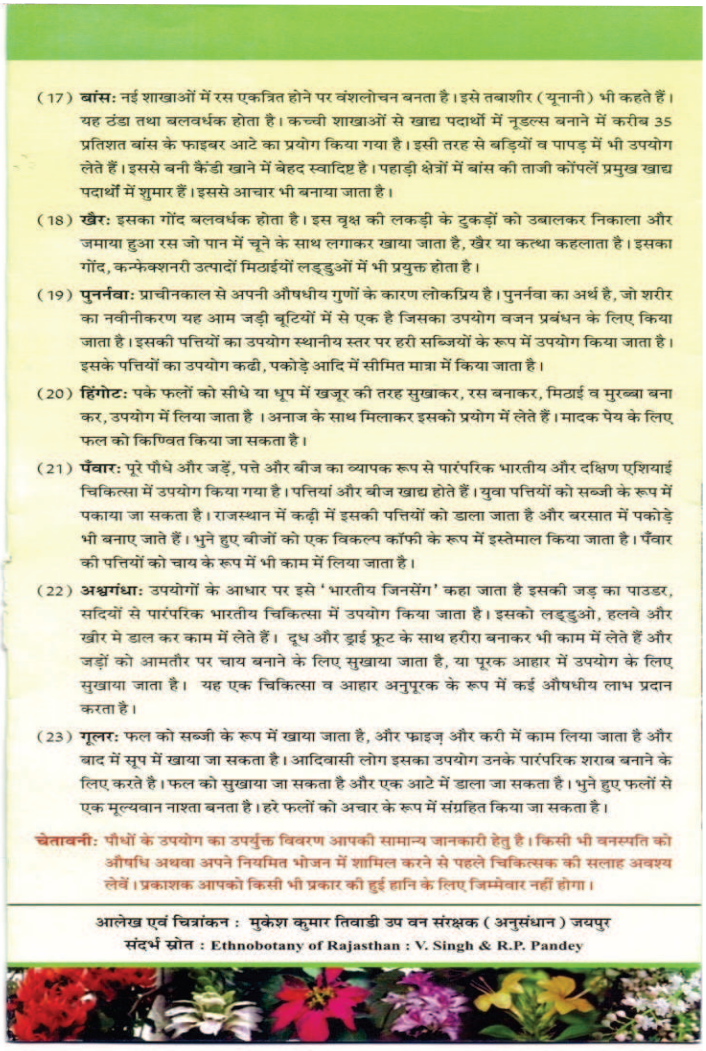
Root trainers are conical cells having 5 to 6 ridges inside and with a small drainage hole on the bottom. Root trainers are available singly or in a block with various volumes like 100, 150, 250, 300 cc each. These cones in fact train the root naturally in a way that roots develop parallel to ridges inside the cone and are self pruned without coiling when come out of drainage hole on contact of air and sun light and for this reason the blocks of root trainer are kept on stands which are about 15 cm. above the ground level. Root trainers blocks can be transported easily are long lasting and require less growth medium and water. The application of fertilizer and insecticide is also easy in root trainer. More plants can be raised in smaller area. Pest control management is also easy in root trainer method.

Root Trainer Nursery at Banki Research Center, Udaipur

8. MISCELLANEOUS

8.1 Publication of brochure of Forest Food Park and Ethno medicinal Garden:

In this financial year, a brochure of Lok Aushadhi Udyan and Forest Food Park located at World Forestry Arboretum, has been published. In this brochure the objectives, importance and use of these gardens have been displayed. This brochure will be made available to the visitors.



8.2 New initiatives: Introduction of Myawaki planting technique:

It is a revolutionary concept of urban afforestation by turning open areas into mini-forests. This method includes planting of only native species , as close as possible in the same area which not only saves space but the planted saplings also support each other in growth and block sunlight reaching the ground, thereby preventing the growth of weeds. The saplings become maintenance-free (self sustainable) after the first three years. The

approach is supposed to ensure that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual. An experimental and demonstrative small plot has been developed at World Forestry Arboretum Jaipur.

8.3. Resource Centre cum Library:

There are around 1200 books on forestry, wildlife and associated subjects in the library. Archive records of old periodicals are being maintained at library. A set of CDs of Indian Forester Information System developed by ICFRE is also available in our library. In this year special gallery has been setup with the books donated by late Sh. A K Upadhyaya Former PCCF of Rajasthan. This year, this library has been dedicated and named after him as "A. K. Upadhyaya memorial Resource Centre cum Library".

8.4. Visitors:

Officers undergoing various training courses at Forestry Training Institutes visit the World Forestry Arboretum Jaipur, Research Centre Banki, Udaipur and Research Centre, Grass Farm, Jaipur campus throughout the year. The officers were acquainted with high-tech nursery set up, soil & water lab facility, methodology adopted for seed, soil & water testing in lab, seed processing unit at State Silviculturist Office, Jaipur. During the year in all 254 visitors of different schools, colleges, universities & institutions visited these Research Centers. Their invaluable remarks are recorded in visitor's book available at the Range Offices.

8.5 Expenditure Report 2020-21 :

S.N.	BUDGET HEAD		Budget	Total Exp.
			Rs. In Lacs	
1	4406-01-800-01-00	63- Vriksharopan	8.14	8.1382
2	4406-01-800-03-01	63- Vriksharopan	13.09	13.0898
3	2406-01-101-20-00	21- Anurakshan	5.27	5.2633
4	2406-01-101-10-00	62-Computerization	1.10	1.0965
5	2406-01-101-18-00	40 Anusandhan mulyankan evam sarvekshan	15.05	15.049
6	2406-04-103-04-01	12- sahaytarth anudaan (cair sanvetan)	14.38	14.3792
7	2406-01-001-02-00	21- Anurakshan	9.19	9.19
8	2406-01-001-04-01	63- Vriksharopan	12.31	12.3096
		Total	**78.53**	**78.5156**

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