



ANNUAL REPORT

(2019-20)



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



Banki Research Farm Nursery Udaipur



Grass Farm Nursery Jaipur



National bird at Grass Farm Jaipur



ANNUAL REPORT (2019-20)

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

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

FOREWORD

It gives me immense pleasure in bringing out the Annual report 2019-20 of the State Silviculture unit of Rajasthan. Research and Development (R & D) plays a crucial role in overall 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 & IIFM Bhopal to make inputs relevant to contemporary issues of society and stakeholders.

Forest department has conducted a number of research studies and has developed technologies which are relevant for use by different stake holders 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 acquired.

The on-going projects and other various activities taken up by the Silviculture division in the year 2019-20 are being published in a concise format. I hope this document will shorten the distance 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.

Smt. Shruti Sharma

Rajiv Chaturvedi
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भा.व.से.



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 carried out by Silviculture wing during the year 2019-20 are being published in the form of Annual Report for the benefit of stake holders. The scientists, technical personnel, administrative, finance and front line staff of the workforce have put in their best efforts in fulfilling the mandate of the Silviculture wing and also in achieving the targets set during the financial year.

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

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

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.

1.1.1 The State is deficient in natural forest resource. The recorded forest area of the state is 32845.30 km² which is 9.597% of the state's geographical area. Forest Survey of India has published the State of Forest Report, 2019. Based on interpretation of satellite data pertaining to October to December, 2017, the forest cover in the state has been assessed to the tune of 16629.51 Km² which is only 4.86% of the Geographical Area of the State.

1.1.2 The estimated tree cover in the state is 8,112 km² which is 2.37 % of its geographical area. The forest and tree cover of the state is presented in Table 1.1.2

Table 1.1.2: Forest and Tree Cover of Rajasthan

(Area in km ²)		
Category	Area	% of Geographical Area
Tree Cover	8,112	2.37
Forest Cover	16,629.51	4.86
Total Forest and Tree Cover	24,741.51	7.23

Source: India State of Forest Report 2017 (FSI)

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

- 1.1.3 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.

- 1.1.4 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 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 agroforestry for increasing the tree cover outside forest on wastelands under Government, community and private ownership.

- 1.1.5 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

There is, therefore, 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.

- 1.1.6 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.

1.2 Excerpts from Rajasthan State Forest Policy 2010 relevant to Research:

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

1.2.1 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.

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 selecting 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.

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

1.2.2 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.

Identification of problems for research and their prioritization through periodic dialogue among all stakeholders then approved by research Advisory Groups comprising of forest officials, scientists from Research Organizations and representatives of Stakeholders.

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.

The department will make use of the expertise available in various research projects. Collaborative research shall be encouraged with reputed forestry research institutions.

2. ADMINISTRATIVE SETUP

- 2.1 The Principal 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 Conservator of Forests, one Deputy Conservator of Forests (Research), One Assistant Conservator of Forest, Two Research Officers and five Range Forest Officers.
- 2.2 Designation and name of officers and their work tenure during the year 2019-20 are as below:

S.No	Designation	Name of the Officer	Work Tenure
1	Additional Principal Chief Conservator of Forest Principal Chief Conservator of Forest	Sh. Mohan Lal Meena	01.04.2019-31.12.19
		Sh. Mohan Lal Meena	01.01.2020-31.03.20
2	Conservator of Forest	Vacant	01.04.2019-31.03.20
3	Deputy Conservator of Forest	Sh. Mukesh Tiwari (Addl.Charge)	01.04.2019-30.09.20
		Sh. S.K Agrawal	01.10.2019-31.03.20
4	Assistant Conservator of Forest (silviculture)	Sh. Mukesh Tiwari	01.04.2019-31.03.20
5	Research Officer (Seed)	Sh. Ramavtar Dodwal	01.04.2019-31.03.20
6	Research Officer (Soil & Water)	Sh. O.P. Sharma	01.04.2019-30.09.20
		Sh. Ramavtar Dodwal	01.10.2019-31.03.20
7	Range Forest Officer Grass Farm Nursery, Jaipur	Sh. Rajpal Sharma (Addl.Charge)	01.07.2019-31.03.20
8	Range Forest Officer Seed Collection & Storage, Jaipur	Sh. Ram Lal Kala	01.04.2019-31.03.20
9	Range Forest Officer Research Farm, Govindpura, Jaipur	Sh. Ram Lal Kala (Addl.Charge)	01.04.2019-31.03.20
10	Range Forest Officer World Forestry Arboretum, Jaipur	Sh. Rajpal Sharma	01.04.2019-31.03.20
11	Range Forest Officer Research Farm, Banki, Udaipur	Sh. Chhaju Ram Sharma	01.04.2019-18.12.20
		Sh. Mahendra Singh (Addl.Charge)	19.12.2019 – 31.03.20

3. RESEARCH CENTERS & EXISTING INFRASTRUCTURE

There are four Forestry Research Centers in the State:-

- 3.1 Grass Farm, Khatipura, Jaipur
- 3.2 Research Farm, Govindpura, Jaipur
- 3.3 World Forestry Arboretum, Jhalana, Jaipur
- 3.4. Research Farm, Banki, Udaipur

3.1 Research Centre, Grass Farm, Khatipura, Jaipur:

Research Centre Campus popularly known as Grass Farm is a forest area spread over an area of 27.72 Ha (68.50 Acres) and notified as Reserved Forest (RF) named “Beed Grass Farm, Khatipura Nursery and Forest Research” vide preliminary notification dated March 18, 1993 published in Rajasthan Gazette dated February 18, 1994.

Research Centre houses a nursery popularly known as Grass Farm Nursery. Raising of quality plants for distribution to the citizens and other public and private institutions is the main activity and plants of more than 60 species are raised and distributed.

The nursery has state of art technology that include Agrinet house, Vermicompost unit and Soil-manure grinding machine.



Nature Trail at Grass Farm, Jaipur



Grass Land at Grass Farm Nursery, Jaipur

Traditional Nursery is having the capacity to raise nearly 3Lakh plants. In addition to this nearly 1Lakh plants may be raised in Agrinet houses. A vermicompost unit is also operational at the research centre.

1.7 Km. long Nature trail is the most loved feature of this Research Centre which provides the opportunity of watching the wild flora and fauna in the midst of highly populated urban area. Bio-diversity of the Research Farm is unique.

240 species of flora, 22 species of insects, 102 species of birds and 13 species of mammals have been listed in a rapid survey the area.

This area is very good Peacock habitat and is home to large numbers of beautiful national bird, Peafowl (*Pavo cristatus*). These are freely roaming, feeding and breeding here in the research centre.

Cenchrus ciliaris (Dhaman grass) is another important attribute of the area. Dhaman grass is growing profusely 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 species of reptiles.

Presence of 8 species of raptors (birds of prey) belonging to family Accipitridae and Strigidae indicate the high bio-diversity index of the area.

Following offices/ facilities are also housed in the campus:

1. Principal Chief Conservator of Forests, Silviculture
2. Range Forest Officer, Grass farm, Research Centre
3. Seed testing laboratory
4. Soil and water testing laboratory
5. Resource Centre cum Library
6. Forest Rest House

3.1.1 Seed Testing Laboratory

Seed samples are tested for germination percentage and other physical parameters at the laboratory to facilitate the field units of the department and help them in their efforts for successful afforestation programs.

3.1.2 Soil & Water Testing Laboratory

Samples of soil and water are analyzed for pH and EC at the laboratory. Besides Forest department samples, laboratory also receives samples from citizens, farmers, institutions etc. Results of analysis and suggestions for choice of species for planting are also provided based on analysis. No fee is charged for analysis of the samples.



3.2 Research Farm, Govindpura, Jaipur

Research Farm, Govindpura is spread over nearly 71 Ha. area of Govindpura Beed Reserved Forest having total forest area of 161 Ha. This research farm is mainly dedicated for tree improvement activities.

Experiments relating to Tree improvement programme of *Azadiracta indica*, *Dalbergia sissoo*, *Eucalyptus* etc. have been conducted at the research farm and large number 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 Provenance Trial of *Azadirachttta indica* (Neem), 3 provenance trials, 1 of *Ailanthus excelsa* (Ardu), 1 of *Balanitis aegyptica* and 1 of *Tecomella undulata* (Rohida), 2 Progeny Trial of *Azadirachttta indica* (Neem) were established by AFRI, Jodhpur at this Farm. These experiments were revisited during the year by joint team of AFRI and Rajasthan Forest Department on the request of state Silviculturist and found that except international provenance trial of *Azadirachttta indica* (Neem), 2 Progeny Trial of *Azadirachttta indica* (Neem) and 1 SSO of *Acacia nilotica* (Babool) most of the plants of all other SSOs and CSOs have died and if some individuals are surviving, those are not at all quality plants to fulfil the objectives of the experiment. Detailed report of the joint team is given in chapter.

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 do 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 farm.

Campus of the Research Farm also houses:

1. Office of the Range Forest Officer, Govindpura
2. Nursery
3. Vermicompost Unit



3.3 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. 35 Ha. area opposite to the arboretum on main road was added in 1989 and named as Amrita Devi Udyan dedicating it to the martyrdom of Amrita Devi who sacrificed her life along with 363 men and women for saving Khejri Trees from the Jodhpur Maharaja's men who were attempting to cut green Khejri trees nearly 290 years back in Khejarli village.

Salient Features of Arboretum:

1. Flora of Aravallis
2. World Assembly of Plants
3. Cacti Park
4. Bougainvillea Garden
5. Palm House.
6. Green House.
7. Herbal Garden
8. Jhalana Ridge Wood Nature Trail
9. Red House
10. Bambusetum
11. Panchwati
12. Clonal orchard of Commiphora wightii
13. Vermicompost unit
14. Forest food park
15. Ethnomedicinal plant garden

Salient Features of Amrita Devi Udhyan

1. Commemoration of Martyrs
2. Resting points (Jhonpas)



3. Open Air Theatre
4. Plant Conservatory
5. Vegetation Map of Rajasthan

3.4 Research Farm Banki, Udaipur

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

The species propagated on the site include *Acacia sinuata*, *Adhatoda vasica*, *Aegle marmelos*, *Argyrea nervosa*, *Abrus precatorius*, *Asparagus racemosus*, *Aloe vera*, *Bixa orellana*, *Bryophyllum pinnatum*, *Bauhinia racemosa*, *Cymbopogon flexuosus*, *Celastrus paniculatus*, *Commiphora wightii*, *Diospyros Montana*, *Gymnema sylvestre*, *Nyctanthes arborescens*, *Ocimum sanctum*, *Oroxylum indicum*, *Phyllanthus emblica*, *Putranjiva roxburghii*, *Piper longum*, *Rauvolfia serpentina*, *Stereospermum suaveolens*, *Sapindus emarginatus*, *Terminalia bellirica*, *Vitex negundo* etc.

Existing Infrastructure:

1. Office of the Range Forest Officer
2. Nursery for Plant Distribution
3. Vermicompost Unit
4. Watch Tower
5. Sample Plot of Medicinal Plants
6. Walking Trails



Banki Research Farm, Udaipur



4. RESEARCH ACTIVITIES

4.1 Research Advisory Group and Research Activities:

4.1.1 Research Advisory Group: A 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:



RAG Meeting at Rajasthan Forestry and Wildlife Training Institute, Jaipur

- | | | | |
|----|--|---|------------------|
| 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 |

Research Advisory Group Meeting

Research Advisory Group (RAG) meeting was held on June 14, 2019 at RFWTI Jaipur. Following officers participated in the meeting:

1. Shri N C Jain, PCCF, WP&FS, Rajasthan, Jaipur
2. Shri A K Singh, Chairman, State Biodiversity Board, Rajasthan, Jaipur
3. Shri Deepak Bhatnagar, PCCF, Administration, Rajasthan, Jaipur
4. Shri Y K Dak, PCCF, FCA, Rajasthan, Jaipur
5. Dr. M R Baloch, Director, Arid Forest Research Institute, Jodhpur.
6. Shri Mohan Lal Meena, Member Secretary & APCCF, Silviculture, Rajasthan, Jaipur.
7. Smt. Shruti Sharma, APCCF (NTFP), Rajasthan, Jaipur
8. Shri Bharat Taimini, APCCF (Production), Rajasthan, Jaipur.
9. Shri D N Pandey, APCCF (Development), Rajasthan, Jaipur
10. Shri S K Dubey, APCCF (HQ), Rajasthan, Jaipur
11. Shri Indraj Singh, APCCF (M&E), Rajasthan, Jaipur.
12. Shri Arijit Banerjee, APCCF (Forest Protection), Rajasthan, Jaipur
13. Shri G S Bhardwaj, Director, RFWTI, Jaipur.
14. Dr. (Mrs.) Madhu Verma, Professor, IIFM Bhopal
15. Shri KCA Arunprasad, CCF, Jaipur
16. Shri B R Bhadu, Member Secretary, State Biodiversity Board, Rajasthan, Jaipur
17. Shri Giriraj Mangal, Rajasthan State Medicinal Plant Board, Jaipur.
18. Shri Brij Gopal, Retd, (Professor), JNU
19. Dr. (Mrs.) Soumana Datta, Professor, Maharani College, Jaipur
20. Shri S R Baloch Scientist, AFRI, Jodhpur.
21. Dr. U K Tomar, Scientist, AFRI, Jodhpur.
22. Dr. Bilas Singh, Scientist, AFRI, Jodhpur.
23. Dr. Bhavna Sharma, Scientist, AFRI, Jodhpur.
24. Shri Ramesh Malpani, DCF, AFRI, Jodhpur.
25. Executive Director, ARAVALI, HCM RIPA, Jaipur
26. Shri Sundaram Verma, Progressive Farmer, Village: Danta, Dist. Sikar.
27. Shri S K Agrawal, DCF, O/O CCF Banas Project, Jaipur.
28. Shri Mukesh Tiwari, I/C DCF (Research), Jaipur.

29. Shri Devendra Bhardwaj, DCF, RFWTI, Jaipur.
30. Shri Ramavtar Doodwal, Research Officer, Silva, Jaipur.
31. Shri O.P. Sharma, Research Officer, Silva, Jaipur.
32. Shri Umesh Bansal, ACF, Udaipur.
33. Shri Ram Lal Kala, Range Officer, Govindpura Research Farm, Jaipur.
34. Shri Narendra Singh, Range Officer, Grass Farm, Jaipur.
35. Shri Rajpal Sharma, Range Officer, Arboretum, Jaipur.

4.1.2 Review of ongoing projects and approval of new Proposals of Collaborating Institutions:

Following collaborative research studies/activities conducted by AFRI, Jodhpur and IIFM Bhopal were presented before the RAG for review of progress and new research proposals for approval:

S.No.	On Going Project
1.	Study on the effects of tree on soil fertility and crop production in Rajasthan (AFRI)
2.	Documentation of Flora and fauna of Raj Bhawan of Jaipur and Mount Abu. (AFRI)
3.	Development of Nursery Manual for Forest Tree Species of Rajasthan (AFRI)
4.	Forest resource accounting: Valuation of Economic Contribution of Forests and Protected Areas in Rajasthan and Capacity Building of Forestry Personnel on the subject (IIFM)
Presentation of new proposals for approval of RAG by AFRI	
1.	Study on impact of plantation on under canopy regeneration, diversity of plants and carbon sequestration in arid zone of Rajasthan.
2.	Study on floral diversity and people perceptions for conservation of Haldeshwar forest Area of Siwana Ring Complex of Barmer District, Rajasthan.
3.	Rehabilitation of limestone mine over-burden arid area of Rajasthan.



Presentations of the Projects at RAG Meeting

4.1.3 Review of ongoing projects/ activities of Silviculture wing of the state:

Following on-going studies/activities were presented before RAG for review of progress:

S.No.	Location of study	Name of Experiment
1	World Forestry Arboretum, Jaipur	Creation of Ethno Medicinal Plant Garden at World Forestry Arboretum, Jaipur
2.	World Forestry Arboretum, Jaipur	Status Assessment, propagation and reintroduction of <i>foliata</i> (Unth Phog)
3.	World Forestry Arboretum, Jaipur	Tree Talks: An awareness programme for stakeholders
4.	World Forestry Arboretum, Jaipur	Establishment of a Forest Food Park
6.	Govindpura Research Farm, Jaipur Banki Research Farm, Udaipur World Forestry Arboretum, Jaipur	Tall tree raising at of native or lesser known plants of Rajasthan
7	Grass Farm Nursery, Jaipur	Establishment of Herbal Garden
8	DCF Research, Jaipur	Collection of quality seeds from Seed production Areas
9	Banki Research Farm, Udaipur	Development of state tree india plot
10	DCF Research	Workshop on “possibilities of collaborative forestry research with universities and research institutions



View of World Forestry Arboretum, Jaipur



View of Amrita Devi Park, Jaipur

4.1.4 New Proposals of Silviculture wing of the state for approval of RAG:

Following new projects/ activities were presented by Silviculture wing of the Forest Department for consideration and approval of RAG:

S.No.	Location of Study	Title of Experiment
1	Research Farm, Banki, Udaipur	Developing propagation technique of <i>Dalbergia latifolia</i>
2	Research Farm, Banki, Udaipur	Developing propagation technique of <i>Buchanania lanzan</i> (Charoli)
3	World Forestry Arboretum, Jaipur	Creation of “RASHI VAN” (cultural forest) at Amrita Devi Park, Jaipur
4	Research Farm, Banki, Udaipur	Developing propagation protocol of some useful indigenous medicinal plants
5	Grass Farm, Jaipur	Study and documentation of flora of Grass farm campus
6	Govindpura Research Farm, Jaipur	Development & Improvement of Seedling Seed Orchards at Govindpura Research Farm, Jaipur
7	World Forestry Arboretum, Jaipur	Habitat Improvement, Renovation & Biodiversity Conservation work at Amrita Devi Park, Jaipur
8	Govindpura Research Farm, Jaipur	Establishment of Vermicomposting unit at Govindpura Research Farm, Jaipur
9	DCF Research	To study the effect of Pusa Hydrogel on plants
10	Grass Farm, Jaipur	Developing alternatives to poly bags
11	Grass Farm, Jaipur	Introduction of native species of Rajasthan under <i>Acacia tortilis</i>
12	DCF Research, Jaipur	Collection of quality seeds from Seed Production Areas
13	DCF Research	Organisation of RAG meeting; documentation, publishing and dissemination of annual report, technical bulletins of lesser known species & other research findings

4.2 Progress of Research Projects/Activities by Silviculture Wing.

4.2.1. Status Assessment, propagation and re-introduction of *Ephedra foliata* (Unth Phog)

Introduction:

Ephedra foliata Boiss. & Kotschy. (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. Male flowers in spikes, 1 to 3 together, on 1-2 cm long peduncles. Bracts 1.5-2 X 1.2-15 mm, rotund, obtuse, connate, ciliate. Perianth-lobes 2.5 mm long,

obovate, ciliate. Staminal column slightly exserted. Female spikes 2 to 3 flowered, subsessile, in pedunculate cymes. Bracts connate: outer ca 1mm long; inner ones 4-5mm long. Fruits 6-7 X 5.5- 6.5mm, ovoid-globose, fleshy, white. Seeds 2, 5-6 X 2-2.5mm, plano-convex, acute at apex, glabrous, brown. Fl. & Fr.: Sep.-Dec. *Ephedra foliata* is a typical Gymnosperm of hot deserts. it is distributed in Barmer, Jodhpur and Jhunjhunu 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.

Medicinal Properties:

Ephedra plant has been used traditionally to treat symptoms of bronchial asthma, cold, 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 area: Jaipur district and World Forestry Arboretum, Jaipur,

Project Investigator: Shri Mukesh Tiwari, ACF, Silviculture, Jaipur

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

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Project Duration	Year Wise Expenditure (Lakh Rs)				
		2016-17	2017-18	2018-19	2019-20	Total Expenditure
3.0	04 Years	0.99	0.50	0.24	0.39	2.12

Progress up to 2019-20:

1. Distribution of *Ephedra foliata* in Jaipur district including population and male female ratio assessed and recorded for the 9 Tehsils of Jaipur District.
2. Fresh cuttings of *Ephedra foliata* were collected from Chomu, Samod & near by areas during March 2017 and again in July 2017 for studying the rooting potential of cuttings for vegetative propagation.
3. 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.
4. 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.
5. Total 1350 fresh cuttings were planted for study of vegetative propagation.

(a) Vegetative propagation of *Ephedra foliata*

General details of Cutting Collection & Sprouting

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

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	

Observation/ results of rooting & sprouting

Month of Cutting planted	Total no. of Cutting Planted	No. of Cutting 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.

General details of Seed Collection and Germination

Date of the seed collection	Place / source of collection	Date of the 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

Observation/results of Germination and Survival

Soil mixture type	No. 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% survival of germinated plants was found during 2018-19 by seeds. Natural forest soil gives best results with 73 % Germination and 68% Survival. Hence propagation of *Ephedra foliata* is successful by seeds.



(C) Status Assessment of *Ephedra foliata*

Distribution of *Ephedra foliata* including population and male-female ratio & threat status have been assessed and recorded in Chomu, Sambhar, Amer, Phagi, Chaksu, Kotputli, Sanganer, Shahpura and Virat Nagar tehsils of Jaipur district . Status Assessment of Bassi, Jamua Ramgarh, and Jaipur tehsils will be done in 2020-21 and a status report on *Ephedra foliata* will be prepared..

S.No.	Name of Tehsil	Area with GPS coordinates	No of plants Counted	Sex Ratio		Support plants	Threats
				Male	Female		
1	Chomu	Samod area 27.2067°N, 75.7953° E	109	55.50	44.50	96% plants were found on <i>Maytenus emarginata</i>	Grazing, & Illegal cutting
2	Sambhar	Kalkah dam area 26.9702°N, 75.3791° E	65	54.44	45.56	60% plants were found on <i>Maytenus emarginata</i> and rest on other spp. & fencing of fields	Grazing, & Illegal cutting
3	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 <i>Maytenus emarginata</i>	Grazing, & Illegal cutting
		Kukas Area 27°02'56.1"N E75°52'58.8" E	38	51	49	99. % plants were found on <i>Maytenus emarginata</i>	Grazing, & Illegal cutting
		Kukas Area 27.048897°N 75.881405°E	38	51	49	99. % plants were found on <i>Maytenus emarginata</i>	Grazing, & Illegal cutting
4	Phagi,	Not Found					
5	Chaksu	Not Found					
6	Kotputli	Not Found					
7	Shahpura	Not Found					
8	Viratnagar	Not Found					
9	Sanganer	Not Found					
	Total		391	54	46		

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.No.	Planting Area	GPS Co-ordinates of Area	No of plants	Operations During the year	Survival percent	
					Dec.19	March 20
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%
2	Grass Farm Nursery jaipur	26°56'16"N 75°45'30"E	50		70%	36%
3	World forestry, Arboretum Jaipur	26°52'37"N 75°49'19"E	50		78%	58%
	Total		400		78.5%	53%

Project extension for the year 2020-21

Project was initially planned for 4 Years. Most of the activities of the project have been completed. Status assessment of distribution and male female ratio of *Ephedra foliata* in 3 Tehsils is yet to be completed and will be completed during 2020-21. Maintenance of plants planted in field during 2019-20, Study of growth and survival of these plants is also required and therefore project period is extended for one year and these works will be taken up during 2020-21.



4.2.2 Tree Talks: An awareness programme for stakeholders :

Introduction:

Tree Talks: Talk about Trees is an interactive, science-based program basically for students. These programs shall be facilitated by academicians and naturalists.

The Program:

This unique forest education program is aimed basically for students, as well as for prominent organizers coming from Colleges, Universities, Forest Department, Forest Training Schools and members of civil society. The program gives an overview of forest ecology, management practices and forest product use.

Objectives:

- To encourage awareness and appreciation for the value of trees and forests in our daily lives in urban and rural landscapes.
- To encourage an understanding about the protection, management and conservation of the forest.



Project Area:

World Forestry Arboretum, Jaipur, Rajasthan. & near by forest and wild life areas

Project Investigator: Mukesh Tiwari, Assistant Conservator of Forests, Silviculture, Jaipur

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

Year of start: 2016-17

Duration of the project: 4 years

Project Cost and Expenditure Details

Project Cost Year (Lakh Rs)	Wise Expenditure (Lakh Rs)				Total Expenditure
	2016-17	2017-18	2018-19	2019-20	
4.00	0.99	0.99	0.71	0.55	3.24

Project outlay could not be utilized fully due to curtailment of budget during the years 2018-19 and 2019-20. This program is an awareness generation programme for appreciation of the value of trees and forests among stakeholders and there for will be continued during the year 2020-21.

Topics: Trained facilitators come in an open classroom for presentation and hands-on activities to enhance learning. The theme of the presentation focuses on the biological processes of trees and forests. Topics include:

- Tree Classification / Identification
- Benefits of Trees
- Renewability / Reforestation
- Tree Growth / Structure of a Tree
- Conservation & Forest Management

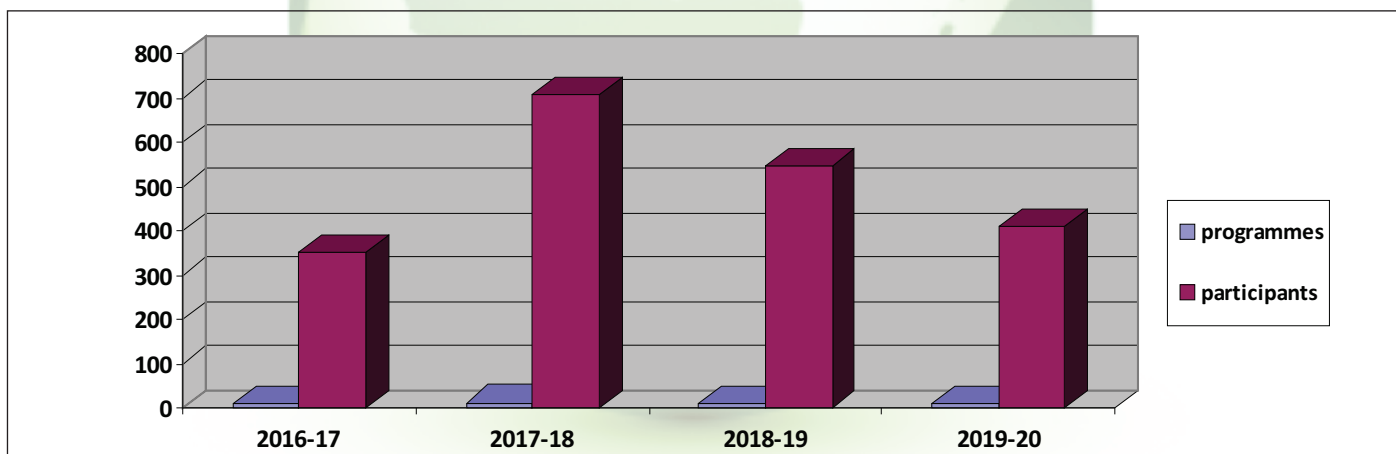
Additional Programs to enhance experiential learning:

- Outdoor Program: Take the students and members of civil society to the outdoor classroom to experience tree identification, tree- wild life interactions and much more.
- Extraordinary popular community participants from all walks of life may joined hands in the morning hours to focus on tree relations, to enjoy refreshing melodies sung by local musicians , to have glimpses of tree poetry recited by reputed poets, to gather valuable historical, mythological , taxonomical inputs told by historians , elders , folk and botanical expert, to get local folk healing information as practiced in the villages, to foster community bonding and share common tree knowledge, to taste lesser known beverages, recipes, dishes, sweets, country cuisines.
- A multicolored hand book & CD on Flora & Fauna of World Forestry Arboretum, Jaipur has been published for ready reference for stakeholders/students/botanist/ researchers which will help them to identify the flora & fauna of the arboretum.



Progress upto year 2019-20:

Schools, colleges, institutions, Forest Trainees classes and Local people/visitors were among the stakeholders who took benefit of this programme. Details of the participants who took part in tree talk programme during the project is given as under:



DETAILS OF TREE TALK PROGRAMMES (2019-20)

S.No.	Name of institution	No of programmes	No. of participants	Theme	Tree species of tree talk
1	School students*	2	105	Identification & Benefits of Trees	Neem, Khejri, Rohida Banyan, Senjana
2	University/College students	4	192	Structure of a Tree & Conservation of Forest	Kainth Khejri Senjana
3	Institutes	1	45	Conservation of Forest	Khejri, Khirni
	Total	7	342	-	-
Extra programme					
1	Local people/ visitors	2	28	Benefits of Trees	Senjana, Tulsi, giloy
2	Forest Trainees	1	40	Conservation & Forest Management	Khirni Rohida
	Grand Total	10	410	-	-

*One tree talk programme for special children organised

4.2.3 Establishment of a 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 people 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, & spreading knowledge of their importance and traditional uses.

Rajasthan region boasts of a tremendous diversity of plant, the forests are source for many of the 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 databases 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 popularizing use of local medicinal plants and Indian system of medicine.
- To develop and standardize the value addition of these plants.
- To develop a gene-pool of these indigenous plant species.

Project Cost and Expenditure Details

Project Cost Year (Lakh Rs)	Wise Expenditure (Lakh Rs)				
	Project Duration	2017-18	2018-19	2019-20	Total Expenditure
9.00	3 Years	5.43	0.89	1.12	7.44

Project requires to be extended for one year due to fund flow problems during the original project period. Project will be continued during the year 2020-21.

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 will be introduced. People belonging to various backgrounds, like Teachers, Students, Researchers, Herbal healer of various age groups are already visiting the World Forestry Arboretum, Jaipur. The basic information about the food plants will be made available to them on the spot. And propagation protocol will be developed.

Progress upto 2019-20

The area has been fenced with mesh wired fencing. Area of the park is 0.34 hect. More than 27 forest species have been planted. Following works have been done this year

1. Fixing of Main board of the park
2. Fencing of area
3. Lay out & landscaping of the Garden
4. Cleaning & removal of weeds
5. Making pathways by curb stone and cement tiles
6. Development of irrigation system
7. Identification, Procurement and Planting of different species of forest food plants



Proposed /planted Species

S.N.	Name of Species	Status	S.N.	Name Of Species	Status
1	Jamun <i>Syzygium cumini</i>	PL	25	Kair <i>Capparis deciduas</i>	PR
2	Lisoda <i>Cordia dichotoma</i>	PL	26	Khejri <i>Prosopis cineraria</i>	PL
3	Mango <i>Mangifera indica</i>	PL	27	Senjna <i>Moringa oleifera</i>	PL
4	Lemon <i>Citrus limon</i>	PL	28	Fog <i>Calligonum polygonoides</i>	PR
5	Karonda <i>Carissa carandas</i>	PL	29	Kheep <i>Leptadenia pyrotechnica</i>	PL
6	Anvala <i>Phyllanthus emblica</i>	PL	30	Khirni <i>Manilkara hexandra</i>	PL
7	Bada ber <i>Ziziphus mauritiana</i>	PL	31	Gundi <i>Cordia gharaf</i>	PL
8	Tendu <i>Diospyros melanoxylon</i>	PR	32	Peelu <i>Salvadora oleiodes</i>	PL
9	Khajoor <i>Phoenix dactylifera</i>	PL	33	Gular <i>Ficus glomerata</i>	PL
10	Mahua <i>Madhuca longifolia</i>	PL	34	Bad <i>Ficus benghalensis</i>	PL
11	Bel patr <i>Aegle marmelos</i>	PL	35	Peepal <i>Ficus religiosa</i>	PL
12	Gwar paatha <i>Aloe vera</i>	PL	36	Sita phal <i>Annona squamosa</i>	PL
13	Pathaar chatta <i>Bryophyllum pinnatum</i>	PL	37	Ram phal <i>Annona reticulata</i>	PL
14	Jhadi Ber <i>Ziziphus numularia</i>	PR	38	Jungle Jalebi <i>Pithecellobium dulce</i>	PL
15	Dansar <i>Rhus mysorensis</i>	PR	39	Jungli Azwaayan <i>Trachyspermum ammi</i>	PL
16	Shahtut <i>Morus alba</i>	PL	40	Kari patta <i>Murraya paniculata</i>	PL
17	Falsa <i>Grewia asiatica</i>	PL	41	Kachri <i>Cucumis pubescens</i>	PL
18	Panwar <i>Cassia tora</i>	PL	42	Edible Grasses/suggested	PR
19	Amrud <i>psidium guava</i>	PL	43	Rose	PL
20	Kamrakh	PL	44	Kachnaar	PL
21	Kela	PL	45	Grapes	PL
22	Kainth	PL	46	Santhi	PL
23	Papaya	PL	47	Kheenp	PL
24	Tamrind	PL	48	Anar	PL

** More plants may be included in the list

Proposed – PR

Planted- PL

Works to be undertaken during the year 2020-21

Following works will be carried out in the forest food park:

- Procurement of more plants with food value from different agro climatic zones & Planting of the same species in cluster.
- Display of planted species with appropriate signage. Hindi description will also be made available to visitors.
- Drip irrigation will be developed for the area.
- Regular maintenance of the garden including replacement of dead plants will be done
- Interpretation programme will be organized for students, stakeholders & forest trainees.
- Herbarium of the species planted in food park will be made available for visitors.
- A brochure will also be published for ready reference.
- Record keeping of all operations including species growth measurement and survival % of the plants will be made.



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

Introduction:

A Herbal Garden is a garden that provides a visual introduction of several species of medicinal plants that are used by the indigenous traditional system. A herbal garden reflects the long- standing tradition of conserving and using plants products for health care and cooking. Some 80% of the world's people use herbs as the main form of medical plants from herbal market. But while herbal plants are in demand, the traditions and culture associated with them are fading. Making a herbal garden is an opportunity to grow herbs for use, while spreading knowledge of their importance and traditional uses, and saving plants that are threatened. Rajasthan region boasts of a tremendous diversity of plant and animal life, the forests are source of herbal medicine for many of the local ethnic communities. This indigenous system of medicine thrives on naturally occurring floral diversity, collectively referred to as medicinal plants. However, interest in Ayurveda and traditional medicine, which has a known history of treating and curing mankind across five millennia, has increased globally; it is becoming homeless in its own birthplace. 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 databases on 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, Siddha and Tibetan. To popularizing use of local medicinal plants and Indian system of medicine.
- To develop and standardise the protocol for propagation techniques for important medicinal plants
- To developing a gene-pool of indigenous and exotic plant species.

Project area: Grass Farm Nursery, Jaipur, Rajasthan

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



Project Cost and Expenditure Details

Project Cost Year (Lakh Rs)	Wise Expenditure (Lakh Rs)			
	Project Duration	2018-19	2019-20	Total Expenditure
6.00	3 Years	2.29	2.02	4.31

Following works have been carried out up to 2019-20

- Cleaning & removal of weeds
- Lay out of Garden
- Layout of beds for planting species of medicinal value
- Fencing and Land scaping of the area.
- Identification of different species.
- Procurement of different species of plants.
- Planting of the same species in cluster.
- Maintenance of the garden.

Methodology:

Establishment of herbal garden shall include preparation of land and landscaping, collection and planting of medicinal plants, development of irrigation and lighting facilities, and development of propagation protocol. A large spectrum of stakeholders from different backgrounds (Ayurveda traditional practioners, pharmacists, students of Ayurveda, Teachers, researchers, herbal healers) and of various age groups are already visiting the Grass Farm Nursery. The basic information about the plants is made available on the spot to them. Establishing a herbal garden will maximize visitor satisfaction and also add conservation value to the site.

List of species planted at Garden

S.N.	Local Name	Botanical Name	S.N.	Local Name	Botanical Name
1	Akash Neem	<i>Millingtonia hortensis</i>	20	Karonda	<i>Carissa carandas</i>
2	Arjun	<i>Terminelia arjuna</i>	21	kainth	<i>Limonia acidissima</i>
3	Ashwa gandha	<i>Withania somnifera</i>	22	Kewda	<i>Pandanus odorifer</i>
4	Adusa	<i>Justicia adhatoda</i>	23	Lemon Grass	<i>Cymbopogon flexuosus</i>
5	Bad	<i>Ficus benghalensis</i>	24	Lajwanti	<i>Mimosa pudica</i>
6	Bans	<i>Dendrocalamus strictus</i>	25	Meetha Neem	<i>Murraya koenigii</i>
7	Bhumi Amla	<i>Phyllanthus niruri</i>	26	Maul shri	<i>Mimaousups elengi</i>
8	Chitrak	<i>Plumbago zeylanica</i>	27	Mehndi	<i>Lawsonia inermis</i>
9	Chirmi	<i>Abrus precatorius</i>	28	Neem	<i>Azadirachta indica</i>
10	Dama bel	<i>Tylophora indica</i>	29	Nirgundi	<i>Vitex negundo</i>

S.N.	Local Name	Botanical Name	S.N.	Local Name	Botanical Name
11	Giloy	<i>Tinospora cordifolia</i>	30	Pipal	<i>Ficus religiosa</i>
12	Gudmar	<i>Gymnema sylvestre</i>	31	Peepla mool	<i>Piper longum</i>
13	Gugal	<i>Commiphora wightii</i>	32	Patthar chatta	<i>Bryophyllum pinnatum</i>
14	Gwar	patha <i>Aloe vera</i>	33	Shatawari	<i>Asparagus racemosus</i>
15	Harsingar	<i>Nyctanthes arbor-tristis</i>	34	Sada bahar	<i>Catharanthus roseus</i>
16	Had jod	<i>Cissus quadrangularis</i>	35	Sita fal	<i>Annona squamosa</i>
17	Imli	<i>Temrindus indica</i>	36	Sudarshan	<i>Crinum latifolium</i>
18	Kalmegh	<i>Andrographis paniulata</i>	37	Tulsi	<i>Ocimum sanctum</i>
19	Khirenti	<i>Sida cordifolia</i>	38	Vajra danti	<i>Barleria prionitis</i>

Following work will be carried out in 2020-21

- Layout of new beds for planting species of medicinal value
- Develop appropriate irrigation system (drip system) for the area.
- Procurement and Planting of different species of plants.
- Display of plants with appropriate signage
- Regular maintenance of garden.
- Remaining work of path making

Proposed List of plant species to be planted at Garden

S.N.	Local Name	Botanical Name	S.N.	Local Name	Botanical Name
1	Akol	<i>Alangium salviifolium</i>	10	Mal Kangni	<i>Celastrus paniculatus</i>
2	Aak safed	<i>Calotropis gigantea</i>	11	Maruwa	<i>Eleusine coracana</i>
3	Arand	<i>Ricinus communis</i>	12	Mor pankhi	<i>Thuja occidentalis</i>
4	Beeja Sal	<i>Pterocarpus marsupium</i>	13	Mulethi	<i>Glycyrrhiza glabra</i>
5	Datura	<i>Datura stramonium</i>	14	Nag fani	<i>Opuntia ficus-indica</i>
6	Dudhi	<i>Holarrhena pubescens</i>	15	Safed Aak	<i>Calotropis gigantea</i>
7	Danda thor	<i>Euphorbia royleana</i>	16	Sarp Gandha	<i>Rauwolfia serpentina</i>
8	kachnar	<i>Bauhinia variegata</i>	17	Shikakai	<i>Acacia concinna</i>

4.2.5 Habitat Improvement, Renovation & Biodiversity Conservation work at Amrita Devi Park, Jaipur

Introduction:

Part B of World forestry arboretum is known as Amrita Devi Park. Part B of arboretum was dedicated to nation as Amrita Devi Park 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 Park is spread over an area of 35 ha. It has been aesthetically designed as an ideal educational recreation 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/children's park
6. Walking trail
7. Bird view point/Jhoonpa



Park infrastructure is in a _dilapidated condition and needs urgent renovation to bring it to its original glory. Therefore this renovation project has been proposed.

Objectives:

- To promote in situ and ex-situ conservation of forest plants biodiversity.
- To develop a multi-disciplinary databases on forest plants.
- To educate, encourage and promote knowledge of these plants to all stakeholders
- To develop a gene-pool of these indigenous plant species.

Project area: Amrita Devi Park, World Forestry Arboretum, Jaipur, Rajasthan

Project Investigator: Range officer, World Forestry Arboretum, Jaipur,

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure/ Layout (Lakh Rs)				Total
	Project Duration	Expenditure during 2019-20	Proposed Layout for 2020-21	Proposed Layout for 2022-23	
8.00	3 Years	1.92	4.58	1.50	8.00

Methodology of work

The methodology for Habitat improvement & biodiversity conservation work at Amrita Devi Park, 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 during the year 2019-20

Vegetation map of Rajasthan Area

- Cleaning & removal of weeds
- Lay out of landscaping /making paths of the area by fixing 430 Rmt.kerb stone on paths
- Identification, Procurement of plants from different agro climatic zones
- Regular maintenance of garden

Circular garden, Plant conservatory

- Cleaning & removal of weeds
- Cleaning, repairing and Painting work was done in Igloo Garden.



- Identification, Procurement of plants from different agro climatic zones.
- Repairing works were taken up at Jhopas / Resting huts.

Work to be undertaken during the year 2020-21

Rajasthan map, Circular garden and plant conservatory

- Cleaning & removal of weeds
- Fencing of the area
- Landscaping of the area and development of pathways
- Development of Appropriate irrigation system (Drip irrigation)
- Identification, procurement, planting and upkeep of plants for restoration of Vegetation map, plant conservatory etc. and for development of the Area.
- Display of planted species with appropriate signage. Hindi description will also be made available to visitors.
- Measurement of Growth and Survival % of the plants will be observed and recorded regularly.
- Record of all operations, progress of species will be kept.
- A brochure will be developed and published
- Herbarium of the plant species will be prepared for ready reference of the visitors.
- Sewage water is available nearby. It is proposed to utilise the sewage water for irrigation of plants in the area.

4.2.6 Development & Improvement of seedling seed orchards at Govindpura research farm, Jaipur

Introduction:

Govindpura research farm, Jaipur is a 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.

The Govindpura research farm, Jaipur is spread over an area of 68 hectares. 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.No.	Details of seedling seed orchard	Year	No. of plants survived
1	Seedling seed orchard of <i>Aegle marmelos</i>	1998	128
2	Seedling seed orchard of <i>Phyllanthus emblica</i>	1998	186
3	Experimental plot of <i>Prosopis cinreria</i>	2016	279

Aegle marmelos

Aegle marmelos locally known as Bael, 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, possess anti-micro filarial, antifungal, analgesic, anti-inflammatory, antipyretic, hypoglycaemic, 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 high rainfall. Variability in thorniness on stem, fruit shape, scull thickness and pulp characteristics.

Phyllanthus emblica

The tree locally known as amla is small to medium in size, in height. The branchlets are not glabrous usually deciduous; the leaves are simple, subsessile 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 cineraria 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 agroforestry setting, because it has a single-layered canopy, it is a nitrogen fixer.

An experimental plot of *Prosopis cineraria* in Govindpura Research Farm 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 we want 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*. Thus to high yield of fruits and quality seeds.
- To improve the biodiversity of the area with the help of silvicultural intervention.
- To develop the experimental plot of *Prosopis cineraria* as a seedling seed orchard.

Project Area: Research farm Govindpura, Jaipur, Rajasthan.

Project Investigator: Range officer, Research farm Govindpura, Jaipur

Duration project: 3 Years

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Expenditure/ Layout (Lakh Rs)					Total
	Project Duration		Expenditure during 2019-20	Proposed Layout for 2020-21	Proposed Layout for 2022-23	
	Original	Revised				
5.00	2 Years	3 Years	2.67	1.50	0.83	5.00

Following work carried out in year 2019-20

Following work were carried out for improvement of seedling seed orchards.

(A) Silvicultural work**(i) Seedling seed orchard of *Aegle marmelos***

S.No.	Opertations	Details of the operations
1	Cleaning & Removal of Weeds	October 2019
2	Making of Thanvla	July 2019
3	Watering	5 times in May, June, Nov.2019, January and March 2020
4	Weeding Hoeing	5 times in May, June, Nov.2019, January and March 2020
5	Application of manure	20 kg per plant –goat manure in June and November 2019
6	Other treatments	Neem khali 1kg per plant in water solution in march 2020
7	Pruning	October 2019

(ii) Seedling seed orchard of *Phyllanthus emblica*

S.No.	Opertations	Details of the operations
1	Cleaning & Removal of Weeds	October 2019
2	Making of Thanvla	July 2019
3	Watering	5 times in May, June, Nov.2019, January and March 2020
4	Weeding Hoeing	5 times in May, June, Nov.2019, January and March 2020
5	Application of manure	20 kg per plant –goat manure in June and November 2019
6	Other treatments	Neem khali 1kg per plant in water solution in March 2020
7	Pruning	October 2019

(iii) Experimental plot of *Prosopis cinreria*

S.No.	Opertations	Details of the operations
1	Cleaning & Removal of Weeds	October 2019
2	Making of Thanvla	July 2019
3	Watering	5 times in May,june,nov.2019 ,January and march 2020
4	Weeding Hoeing	5 times in May, June, Nov.2019, January and March 2020
5	Application of manure	5 times in May, June, Nov.2019, January and March 2020
6	Other treatments	Neem khali 1kg per plant in water solution in March 2020
7	Pruning	October 2019, January 2020

Besides these Soil and Water samples were also tested for PH and EC and results were found normal.

General Observations

- Positive Change has been seen in growth and amount of bel patra fruit.
- Fruiting in *Phyllanthus emblica* was almost nil, only two 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

Work to be taken up during year 2020-21

- Cleaning & removal of weeds at the seedling seed orchards.
- Develop appropriate irrigation system for the area
- Repairing of thavla, need based watering, weeding hoeing, apply of bio manure/ fertilizer etc.
- Pruning, thinning operations will be made as per requirement
- Regular maintenance, protection, of the plants will be done.
- Display of appropriate signage.
- Silvicultural intervention plan of the orchards will be prepared through a continuous and close study of the orchard
- All Observations and Results will be noted
- Record keeping of all operations
- Measurement of Biomass Productivity and other growth parameters and fruit production will be taken.
- Survival % of the plants will be recorded
- Specific results and conclusions will be drawn

4.2.7 Establishment of Vermicomposting unit at Govindpura research farm Jaipur

Introduction:

Govindpura research farm, Jaipur generate 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 farm, Jaipur is being taken up for the proper utilization of waste from farm through vermicomposting and obtaining the nutrient rich organic manure.

Govindpura research farm, Jaipur is a 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. The Govindpura research farm, Jaipur is spread over an area of 68 hectares. 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 Area: Research farm Govindpura, Jaipur, Rajasthan.

Project Investigator: Range officer, Research farm Govindpura, Jaipur,

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

Methodology:

Establishment of Vermicomposting unit at Govindpura research farm will include following components:

- Levelling and earth filling for vermicompost sheds
- Fencing and gate
- Vermicompost beds
- Godown/ Store
- Implements and machinery
- Water provision
- Electrical installation
- Furniture & fixtures
- Earthworms

Progress during 2019-20

Following works have been carried out during the year 2019-20 for establishment of Vermicomposting unit at Govindpura research farm.

- Cleaning & removal of weeds at the site
- Appropriate shade for vermicomposting.
- Fixing of kota stone tiles in vermicompost shade

Works to be undertaken during the year 2020-21

- 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.

4.2.8 Developing propagation protocol of useful medicinal plants (*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 Tree 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; bracteoles 2, falling off; 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, obovate, 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. Indian Kino Tree is found in Peninsular India and Sri Lanka. Flowering: September-October.

Medicinal uses

Decoction of the heartwood of Bija sal is useful in skin diseases diabetes, anaemia 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, anaemia, and excess of kapha and obesity.

Objective:

- To develop propagation protocol of *Balanites aegyptiaca*, *Leptadenia reticulata* and of *Pterocarpus marsupium*
- To raise Red List plants to enrich the bio- diversity of forest area of Rajasthan

Project area: Banki Research Farm, Udaipur

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

Project Details:

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

Methodology:-

Following works have been carried out during the year 2019-20

- The seeds of *Pterocarpus marsupium* were collected from kevda ki naal forest of Udaipur on 21-06-19
- The collected seeds were given pretreatment and were kept in fresh cow dung for 36 hours.
- Seeds were sown directly into polybags as 90% mortality was observed in transplanting.
- Seeds germination was found to be 65%. Plant survival was found to be 58% in March 2020.

Following work will be carried out during the year 2020-21

- Seeds will be collected for resowing.

- Seeds will be sown in polybags as well as in mother beds.
- Transplanting of plants from mother beds will be done in favourable season.
- Observations and Record keeping will be done for all operations.
- Shifting and maintainance of plants will be done as per requirement.
- Plant growth will be measured regularly.
- Survival % of the plants will be recorded.
- Propagation protocol of the species will be standardized and published.



4.2.9 Maintenance of Ethno Medicinal Plant Garden at World Forestry Arboretum, Jaipur.

Introduction:

The ethno medicinal plant garden is a knowledge park that provides a visual introduction of several species of medicinal plants from various agro-climatic zones that are used by the indigenous traditional system of medicine. A special effort has been made to collect and grow plants from different bio-geographical regions. A perusal of the list of species in the garden will also reveal the extent of coverage of various species used by different Indian systems of medicines: Ayurveda, Unani, Siddha, Homoeopathy, and Folk.

Project was initiated with the following objectives:

- To promote *in-situ* and *ex-situ* conservation of medicinal plant biodiversity used in traditional medicine system.
- To develop Multi-disciplinary databases on medicinal plants
- To establish theoretical foundations and epistemology of traditional medicine.



- To disseminate local knowledge of plants through ethnobotanical garden. This knowledge may have several dimensions, namely, nomenclature, schemes of classification, ecological insights, traditional conservation practices, and multiplicity and diversity of uses.

Project was initiated in 2014-15 and completed in the project period. Since then it is being maintained for proper upkeep.

Project Cost and Expenditure Details

Project Cost (Lakh Rs)	Year Wise Maintenance Expenditure/ Layout (Lakh Rs) (After Creation)				
	Project Duration & year of Start	Maintenance Expenditure			
		2018-19		2019-20	
		Allotment	Expenditure	Allotment	Expenditure
10.00	4 Years 2014-15	1.00	0.64	0.75	0.61

Procurement and planting of more plants with medicinal value and regular irrigation and maintenance of the Garden was made during the year 19-20

Work to be undertaken during the year 2020-21

Following work will be carried out in ethno medicinal garden:

- Procurement of more plants with medicinal value from different agro climatic zones. Planting of the same species in cluster for display. Progress of species will be observed.
- Display of planted species with appropriate signage. Hindi description will be available to visitors. Maintenance of signage.
- Interpretation programme will be organized for students, stakeholders & forest trainees.
- Regular maintenance of the garden. Herbarium of the same species will be made available for visitors.
- A brochure of the garden will be made for ready reference.

List of plant species displayed at Ethnomedicinal Garden

S.N.	Local Name	Botanical Name	S.N.	Local Name	Botanical Name
1	Akash Neem	<i>Millingtonia hortensis</i>	38	Kheep	<i>Leptadenia pyrotechnica</i>
2	Akol	<i>Alangium salviifolium</i>	39	Kat Sagwan	<i>Pterospermum acerifolium</i>
3	Ashwa gandha	<i>Withania somnifera</i>	40	Kewda	<i>Pandanus odorifer</i>
4	Adusa	<i>Justicia adhatoda</i>	41	Lajwanti	<i>Mimosa pudica</i>
5	Aak safed	<i>Calotropis gigantean</i>	42	Lal Imli	<i>Terminalia indica</i>
6	Arand	<i>Ricinus communis</i>	43	Lemon Grass	<i>Cymbopogon flexuosus</i>
7	Bans	<i>Dendrocalamus strictus</i>	44	Mal Kangni	<i>Celastrus paniculatus</i>
8	Beeja Sal	<i>Pterocarpus marsupium</i>	45	Maruwa	<i>Eleusine coracana</i>
9	Bhumi Amla	<i>Phyllanthus niruri</i>	46	Meetha Neem	<i>Murraya koenigii</i>
10	Chitrak	<i>Plumbago zeylanica</i>	47	Mor pankhi	<i>Thuja occidentalis</i>
11	Chirmi	<i>Abrus precatorius</i>	48	Mulethi	<i>Glycyrrhiza glabra</i>
12	Datura	<i>Datura stramonium</i>	49	Mehndi	<i>Lawsonia inermis</i>
13	Dudhi	<i>Holarrhena pubescens</i>	50	Neem	<i>Azadirachta indica</i>
14	Dama bel	<i>Tylophora indica</i>	51	Nirgundi	<i>Vitex negundo</i>
15	Danda thor	<i>Euphorbia royleana</i>	52	Nag fani	<i>Opuntia ficus-indica</i>
16	Gada Palash	<i>Erythrina suberosa</i>	53	Pahadi Pipal	<i>Ficus arnottiana</i>
17	Giloy	<i>Tinospora cordifolia</i>	54	Peepla mool	<i>Piper longum</i>
18	Gudmar	<i>Gymnema sylvestre</i>	55	Patthar chatta	<i>Bryophyllum pinnatum</i>
19	Gugal	<i>Commiphora wightii</i>	56	Ramphal	<i>Annona reticulate</i>
20	Gwar patha	<i>Aloe vera</i>	57	Safed Aak	<i>Calotropis gigantean</i>
21	Harsingar	<i>Nyctanthes arbor-tristis</i>	58	Sarpgandha	<i>Rauvolfia serpentine</i>
22	Hingot	<i>Balanites aegyptiaca</i>	59	Shatawari	<i>Asparagus racemosus</i>
23	Had jod	<i>Cissus quadrangularis</i>	60	Shikakai	<i>Acacia concinna</i>
24	Jungli Gulab	<i>Rosa rubiginosa</i>	61	Sada bahar	<i>Catharanthus roseus</i>
25	Kalmegh	<i>Andrographis paniulata</i>	62	Sita fal	<i>Annona squamosa</i>
26	Kalp Vriksh	<i>Adansonia digitata</i>	63	Sonamukhi	<i>Cassia augustifolia</i>
27	Khirenti	<i>Sida cordifolia</i>	64	Sudarshan	<i>Crinum latifolium</i>
28	Karonda	<i>Carissa carandas</i>	65	Tulsi	<i>Ocimum sanctum</i>
29	kainth	<i>Limonia acidissima</i>	66	Tamboliya	<i>Ehretia laevis</i>
30	kachnar	<i>Bauhinia variegata</i>	67	Vajra danti	<i>Barleria prionitis</i>
31	Baheda	<i>Terminalia bellarica</i>	68	Bapchi	<i>Psoralea corylifolia</i>
32	Jamun	<i>Syzygium cumini</i>	69	Peela Santha	
33	Kanteli	<i>Solanum virginianum</i>	70	Kheenp	<i>Leptadenia pyrotechnica</i>
34	Jhojhru	<i>Tephrosia purpurea</i>	71	Ephedra	<i>Ephedra foliate</i>
35	Bhadraksh	<i>Scavola Taccada</i>	72	Arjun	<i>Terminalia arjuna</i>
36	Gundi	<i>Cordia rothii</i>	73	Belpatra	<i>Aegle marmelos</i>
37	Shahtoot	<i>Morus alba</i>			

4.3 Progress of Collaborative Research Activities

4.3.1 Forest Resource Accounting (FRA): Valuation of economic contribution of forests and protected areas in Rajasthan and capacity building of forestry personnel on this subject (IIFM Bhopal)

Introduction

Management of forests and wildlife is a knowledge-intensive endeavour. Robust Scientific research is necessary to provide usable and actionable knowledge for evidence based management. New Research Activity approved under CAMPA during meeting of Steering Committee of the Rajasthan State CAMPA held on 11.4.2016 at Government Secretariat, Jaipur Thus, a provision of Rs. 29.50 lac for collaborative research project with Indian Institute of Forest Management, Bhopal (an autonomous institute of MoEFCC, Government of India) was agreed by the Executive Committee. The subject of the research approved by the committee is: "Forest Resource Accounting (FRA): Valuation of economic contribution of forests and protected areas in Rajasthan", and capacity building of forestry personnel on this subject.

Study Execution Team: Shri Deepak Bhatnagar, Shri G V Reddy, Shri N C Jain,
Shri Pankaj shrivastav, Dr D N Pandey, Smt. Shruti Sharma,
Shri Mohan lal meena Mukesh kumar tiwari

Project Investigator: Smt. Madhu Verma
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Contributining Lead Prabhakar Panda, Sumit Anand, Charu Tiwari,

Authors

Duration: 24 months (18 Months+ 6 months extention)

Funded by: CAMPA fund Rajasthan

Project Cost: INR 29.50 lakhs

Sanctioned on: 11.4.2016

Expenditure up to 19-20: INR 13.11 Lakhs

Total Expenditure: INR 19.56 Lakhs (Including INR 6.45 Lakhs liabilities)

Study Objectives :

- To value economic contribution of forests and protected areas in Rajasthan
- To develop Framework for Forest Resource Accounts (FRA) for Rajasthan using United Nations SEEA 2012 and other prevalent Frameworks and internalize values of forest resources thereof
- To suggest appropriate instruments/incentive based mechanisms for sustainable management of Rajasthan Forests
- To build capacity of departmental personnel on Economic Valuation and Accounting of Forest Resources

Executive Summary

Introduction

The state of Rajasthan is known as "land of kings" and featured the Indus valley civilisation in historic India. It is also home to the Thar Desert with its unique ecosystem representing the Western sandy plains. According to the Forest Survey of India, the forests in Rajasthan covers around 4.84% of the state's geographical area. The total forest area is 16,572 sq km of which 78 sq km is Very Dense Forest (VDF) 4,340 sq km is Moderately Dense forest (MDF), and 12,154 sq km is Open Forest (OF). Between 2015-2017, the state has added about 466 sq km of forest cover through plantation, regeneration and conservation (FS, 2017).

The natural resources of Rajasthan are limited to the eastern half of the state and sparsely distributed. Despite this, the state brings revenue and benefits to the people through its diverse resources. The recorded contribution of the natural resources, i.e. agriculture, forestry, fishing, livestock in Gross State Value Added is 24.82%. The forestry sector contributes to about 3.35% to the state's Gross State Value Added (GSVA) at constant prices (2011-12) for the year 2017-2018 and the GSVA at current prices for 2017-2018 was Rs. 22,497.19 crores (DES-Rajasthan, 2018b). It is evident that forestry contributes to only 3.35 % share of GSVA; therefore, it is crucial to conduct an economic valuation of the ecosystem services that these forests and protected areas deliver to society.

Methodology

Acknowledging the fact that our understanding of natural processes and their associated values are limited, this study uses a VALUE+ approach. The VALUE' represents all benefits for which monetary economic valuation is possible and conducted, while the '+' represents all those benefits for which economic valuation is currently not possible either on account of lack of accepted methodologies knowledge and/or understanding. The economic values derived in the study are thus conservative. Valuation took into consideration varied approaches depending on the ecosystem goods and services. The study has used multiple frameworks including Total Economic Value; Millennium Ecosystem Assessment; Stock and Flow; Tangible and intangible Benefits; EPA benefits categories; Human Values and Ecosystem Assets and Nature's Contribution to People Framework to communicate the diverse values embedded and emanating from the forests of Rajasthan.

Valuation of Forest Ecosystem Services

The study provides economic estimates of 17 identified ecosystem services from the forests and protected areas of Rajasthan. Different methods and values from established studies are used for deriving the economic benefits of the services. The study findings indicate that the monetary value of flow value from Rajasthan forests for all the districts are approximately Rs. 33,244.63 crores annually. The estimated annual flow value is about Rs 45,194 per hectare (lower bound). Also the forests protect and conserve Carbon stock of about Rs. 52433.17 crores annually. Value of timber This study attempts to estimate the economic value of natural capital stored in the forests and protected areas of Rajasthan. Recognising these benefits could enable targeted and enhanced investment for sustained delivery of ecosystem services.

Our limited understanding of natural processes and their associated values have enabled us to use a VALUE+ approach. The VALUE' represents all benefits for which monetary economic valuation is possible and

performed, while the '+' represents all those benefits for which economic valuation is currently not possible either on account of lack of acceptance, methodologies, knowledge and/or understanding. This shows that our results of economic values are conservative.

The study provides economic estimates of 17 identified ecosystem services from the forests and protected areas of Rajasthan.

Large proportions of the ecosystem flow benefits including the stock benefits are intangible and therefore, unaccounted for in the market transaction.

The study findings indicate that the monetary flow benefits are approximately Rs. 14,836.56 crores annually. It is equivalent to an annual flow value of about Rs. 45,194 per hectare (lower bound) of Rajasthan forests. Additionally, Rajasthan forests conserve stocks comprising the value of land and carbon storage, and these are estimated at Rs. 95,73,597.42 crores.

The study also estimated the economic value of the protected areas of Rajasthan and a sacred grove. The economic value of National Parks is estimated at Rs. 10.13 crores/sq.km and that of Wildlife Sanctuaries and Conservation Reserves are about Rs. 5.06 crores/sq.km. The flow value of studied sacred grove is estimated at Rs. 141.86 crores annually.

The study has demonstrated available tools for biophysical assessment and application of INVEST tool used for mapping ecosystem services. Two models have been performed, and the results indicate the potential use of INVEST in identifying ecosystem service hotspots and providing valuable management prescriptions for forest managers.

The study has also attempted to prepare forest resources accounts as per the System of Environmental-Economic Accounting (SEEA). The SEEA provides the internationally agreed framework for providing indicators that directly respond to the demand of integrated policymaking, reversing the historical 'information silo' approach to statistics.

The study highlights available incentive-based mechanisms for the identified ecosystem services of Rajasthan forests and protected areas. These mechanisms are crucial for long-term and diversified sources of revenue and also to ensure the sustainable utilisation of forest benefits.

Findings of the Study

- The study has identified about 17 ecosystem services that are provided by the Rajasthan forests and protected areas
- Most of these services are intangible and therefore, unaccounted in the market transactions
- The annual monetary flow value is approximately Rs. 33,244.63 crores
- It is equivalent to an annual flow value of Rs. 45,194 per hectare
- The economic value of National Parks is estimated at Rs. 10.13 crores / sq.km and that of Wildlife Sanctuaries and Conservation Reserves are about Rs. 5.06 crores / sq.km.

ECONOMIC VALUE OF DIFFERENT ECOSYSTEM SERVICES

S.No.	Ecosystem services	Value (INR crores)
1	Carbon stock	52,433.17
2	Employment generation	5,301.80
3	Fuelwood + Timber	19.63
4	Bamboo	2.94
5	NTFP	32.13
6	Carbon sequestration	2,334.46
7	Water provisioning	320.66
8	Water purification	4,630.68
9	Sediment regulation	129.01
10	Nutrient cycling	78.01
11	Biological control	234.72
12	Pollination	640.15
13	Habitat for species	832.20
14	Recreation	24.09
15	Gas regulation	256.06

Economic value of different ecosystem services

Valuation By Millennium Ecosystem Assessment Framework

Ecosystem Service	Rajasthan Ecosystem Service (Flow values)	Economic Value (INR Crores)	Physical volume
Provisioning Services (A)	Employment Generation	5,301.80	23,70,225 man days
	Fuelwood + Timber	19.63	4.05 lakh quintals (2016-17)
	Bamboo	2.94	18.05 lakhs culms (2016-17)
	NTFP	32.13	3.57 lakh manak bora (2018)
	Total	5,356.50	
Regulating Services (B)	Genepool protection	18,408.07	NA-based on benefit transfer
	Carbon sequestration	2,334.46	41,76,144 tonnes/year
	Water provisioning	320.66	17,39,90,245.7 m ³ /year
	Water purification	4,630.68	4630.68 billion m ³ /year

Ecosystem Service	Rajasthan Ecosystem Service (Flow values)	Economic Value (INR Crores)	Physical volume
	Soil conservation/ sediment retention	129.01	54,31,931 tonnes of sediment/year
	Biological control	234.72	Benefit transfer: Rs. 715/ha/year
	Pollination	640.15	Benefit transfer: Rs. 1950/ha/year
	Gas regulation	256.06	Benefit transfer: Rs. 780/ha/year
	Total	27,031.83	
Cultural Services (C)	Recreation	24.09	4,90,942 individuals visited
	Total	24.09	
Supporting Services (D)	Habitat / refugia	837.20	Benefit transfer: Rs. 2535/ha/year
	Nutrient cycling	78.01	54,31,931 tonnes of sediment/year
	Total	910.21	
	Total Flow value - (A+B+C+D)	33,244.63	

Valuation in Stock and Flow Benefits

Type of benefits	Rajasthan Forests Ecosystem services	Economic Value (INR crores)	Physical Volume
Stock benefits	Carbon stock	52,433.17	8,96,50,000 tonnes
	Land stock	95,21,164.25	32,828.34 km ²
	Total Stock Value	95,73,597.42	
Flow benefits	Employment Generation	5,301.80	23,70,225 man days
	Fuelwood + Timber	19.63	4.05 lakh quintals (2016-17)
	Bamboo	2.94	18.05 lakhs culms (2016-17)
	NTFP	32.13	3.57 lakh manak bora (2018)
	Carbon sequestration	2,334.46	41,76,144 tonnes / year
	Water provisioning	320.66	17,39,90,245.7 m ³ /year
	Water purification	4,630.68	4630.68 billion m ³ /year
	Soil conservation sediment retention	129.01	54,31,931 tonnes of sediment/year
	Nutrient cycling retention	78.01	54,31,931 tonnes of sediment/year

Type of benefits	Rajasthan Forests Ecosystem services	Economic Value (INR crores)	Physical Volume
	Biological control	234.72	Benefit transfer: Rs.715/ha/year
	Pollination	640.15	Benefit transfer: Rs. 1950/ha/year
	Habitat/refugia	832.20	Benefit transfer: Rs. 2535/ha/year
	Recreation	24.09	4,90,942 individuals visited
	Gas regulation	256.06	Benefit transfer: Rs. 780/ha/year
	Total Flow Value	14,836.56	

Valuation based on Tangible and Intangible Benefits

Type of benefits	Rajasthan Forests Ecosystem services	Economic Value (INR crores)	Physical Volume
Tangible Benefits (A)	Employment Generation	5,301.80	23,70,225 man days
	Fuelwood + Timber	19.63	4.05 lakh quintals (2016-17)
	Bamboo	2.94	18.05 lakhs culms (2016-17]
	NTFP	32.13	3.57 lakh manak bora (2018)
	Total	5,356.50	
Intangible Benefits (B)	Carbon storage	52,433.17	8,96,60,000 tonnes
	Genepool protection	18,408.07	NA-based on benefit transfer
	Carbon sequestration	2,334.46	41,76,144 tonnes/ year
	Water provisioning	320.66	17,39,90,245.7 m/year
	Water purification	4,630.68	4630.68 billion m/year
	Soil conservation sediment retention	129.01	54,31,931 tonnes of sediment/year
	Nutrient cycling retention	78.01	54,31,931 tonnes of sediment/year
	Biological control	234.72	Benefit transfer: Rs. 715/ha/year
	Pollination	640.15	Benefit transfer: Rs. 1950/ha/year
	Habitat/refugia	832.20	Benefit transfer: Rs. 2535/ha/year
	Recreation	24.09	4,90,942 individuals visited
	Gas regulation	256.06	Benefit transfer: Rs. 780/ha/year
	Total	80,321.29	
	Total Value (A+B)	85,677.79	

Valuation using Total Economic Value Framework

Type of Value	Value	Unit
Direct Use Value	5612.56	INR crores
Employment Generation, Fuelwood + Timber (Flow), Bamboo (flow), NTFP, Gas regulation		
Indirect Use Value	9223.99	INR crores
Carbon sequestration, Water provisioning, Water purification, Soil conservation/sediment retention, Nutrient retention, Biological control, Pollination, Habitat/refugia, Recreation		
Option Value	18408.07	INR crores
Genepool protection		
Total Flow Value	33244.63	INR crores

Progress of the Project:

- Study was completed and findings were presented in the Capacity building program at RFWTI in November 2019
- Study report was published and 100 copies of the report have been submitted to the department
- Report has been made available to senior officers of the department and sent to Field officers through Registered Parcel Post for outstation officers in the month of Feb., 2020
- Report has also been uploaded on the official website of the Forest Department. (<https://forest.rajasthan.gov.in/content/dam/doitassets/forest/ForestDepartment/PDFs/IIFM%20BHOPAL.pdf>)
- Capacity Building Programme has been organised for Senior level Officers as well as for Field officers up to the level of ACF in the month of November 2019. Opening Session of the Capacity Building Program was Chaired by Shri Dipak Bhatnagar, PCCF and HoFF, Rajasthan.
- Officers of the rank of APCCF, CCF, CF, DCF, ACF participated in the one Day capacity building program and Officers of the Rank of DCF, ACF and RO participated in the Two days capacity building Programme.
- The Details of programme were as under:

Day 1 : 5th November, 2019 Venue- RFWTI, JAIPUR

Participants: APCCF, CCF, CF and DCF, ACF

Speakers:

- 1 Dr. Madhu Verma, IIFM, Bhopal

- 2 Dr. Advait Edgaonkar, IIFM, Bhopal
- 3 Mr. Zuhail Thatey, IIFM, Bhopal
- 4 Mr. Prabhakar Panda, IIFM, Bhopal
- 5 Mr. Sumit Anand, IIFM, Bhopal
- 6 Ms. Charu Tiwari, IIFM, Bhopal

Topics Covered in the Programme include:

Opening Remarks By Shri Deepak Bhatnagar, PCCF(HoFF) Rajasthan Major findings of the study – Dr. Madhu Verma
Introduction: Economic Valuation and Environmental Accounting and their relevance to Rajasthan state
Ecosystem Services : a. Concept, Classification and Frameworks (MA, TEEB, IPBES) b. ES from Rajasthan Forests
Mapping Ecosystem Services a. Importance of mapping b. Tools and software c. Invest mapping in Rajasthan
Valuing Ecosystem Services a. Cardinal and Ordinal methods b. Protocols for Data Collection
Data for economic valuation a. Requirements b. Sources c. Availability and gaps d. Data collection
Forest Resource Accounting a. Concept b. SEEA Framework c. FRA of Rajasthan Forest d. Way Forward
Conclusion

Day 2: 6th November, 2019 Venue- RFWTI, JAIPUR

Participants: DCF, ACF, ROs

Speakers:

- 1 Dr. Advait Edgaonkar, IIFM, Bhopal
- 2 Mr. Zuhail Thatey, IIFM, Bhopal
- 3 Mr. Prabhakar Panda, IIFM, Bhopal
- 4 Mr. Sumit Anand, IIFM, Bhopal
- 5 Ms. Charu Tiwari, IIFM, Bhopal

Topics Covered in the Programme include:

Opening Session –

Welcome, Introduction and Brief summary of findings of the Study

Session 1:

Introduction Ecosystem Services, Economic Valuation and Forest Resource Accounting

Session 2:

Ecosystem Services of Rajasthan Forests

Data Collection Protocols Provisioning: Employment generation, Timber (flow & stock), Fuelwood, NTFP

Supporting: Habitat for species, Nutrient cycling Cultural: Recreation

Regulating:

Carbon stock & sequestration, Gene-pool protection, Water provisioning and purification, Pollination, Sediment regulation, Gas regulation, Biological control

Day 3 : 7th November, 2019 Venue- Sariska Tiger Reserve Visit

Participants: DCF, ACF, ROs

Speakers and Excercise conductance:

- 1 Dr. Advait Edgaonkar, IIFM, Bhopal
- 2 Mr. Zuhail Thatey, IIFM, Bhopal
- 3 Mr. Prabhakar Panda, IIFM, Bhopal
- 4 Mr. Sumit Anand, IIFM, Bhopal
- 5 Ms. Charu Tiwari, IIFM, Bhopal

Participants were taken to sarika for field exercise



4.3.2 Study and Documentation of Flora and fauna of Raj Bhawan of Jaipur and Mount Abu, by Arid Forestry Research Institute (AFRI), Jodhpur

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 features vital for human health and well-being. Furthermore, wildlife is not limited in forest area 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, insect 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.

Park and garden attract local residence and improve social bonding. Besides these, urban park enhance beauty of city and make attraction point for tourists also. Some of the urban parks are also biodiversity hot spot where many native and exotic species of plants are maintained and preserved. There is a need to develop appropriate management tools for the conservation, enhancement and management of biodiversity and the green environment. In India urban forests are not well studied except Delhi, Pune, Bangaluru, Chandigarh, Jaipur and Bhopal. Likewise, very little studies are available about documentation of flora and fauna of this important ecosystem and hence biological diversity.

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 and 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.

Date of Sanction	:	Year 2018-19
Project duration	:	One year
Name of Principal Investigator	:	Dr. G. Singh, Scientist G, AFRI
Co-Investigator	:	Mrs Bhawana Sharma, Scientist – D
	:	Mr. S.R. Baloch, Scientist C
Project staff	:	Mr. P. R. Nagora, S.T.O.
Project Fellow	:	Mr. Gourav
Category of Work	:	Survey, identification and documentation
Division	:	Forest Ecology and Climate Change Division

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. Each block was enumerated separately for recording available plants species. 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, i.e. winter and spring seasons.

Rajbhawan of Jaipur and Mt Abu cover an area of about 4.2 ha and 3.46 ha respectively. Seasonal surveys were conducted during November 27 - December 4, 2018 at Raj Bhawan, Jaipur and January 2-9, 2020 at Raj Bhawan, Mount Abu.

Raj Bhawan, Jaipur

It was the very first tour conducted of this project and the objectives were to collect the data of complete enumeration of plants including GBH and height of trees and collar diameter and height of small shrubs. For the ease and precision in data collection, complete area was divided into 10 different blocks and each single species of plant were measured for their height and girth. Photograph was also taken for further identification and illustration purpose (Fig 1).



(a)



(b)



(c)



(d)

Figures 1. Some flowering plant species in Raj Bhawan at Jaipur.

(a). *Plumeria pudica*, (b). *Cassia javanica*, (c). *Dombeya spectabilis* and (d). *Guazuma ulmifolia*.

For calculation of diversity indices of the plants, plots of 10 m x 10 m sizes were laid in each block and data were collected which included measuring the population and growth of each species and plants during November 27 - December 4, 2018. During March 25 to March 28, 2020, some of the plants that showed flowering and fruiting in this season were: *Grevillea robusta*, *Holoptelea integrifolia*, *Mimusops elengii*, *Jatropha integerrima*, *Putranjiva roxburghii*, *Bauhinia purpurea*, *Bauhinia alba*, *Plumeria alba* etc. Photographical data and specimens of different plants were collected showing their general morphological and phenological characteristics (Fig 2). Photographs of birds and insects were also recorded during that particular season.



(a)



(b)



(c)



(d)

Figure 2. Flowering and fruiting in different species.

(a). *Spathodea campanulata*, (b). *Bauhinia alba*, (c). *Mimusops elengii*, and (d). *Bauhinia purpurea*.

Raj Bhawan, Mount Abu

This site is a dense with large trees and the area is diversified with the beautiful garden, walkway, rocky mountain, dense forest like area because of the obvious climatic conditions of Mount Abu. During January 2-9, 2020, total area was divided into 11 different blocks and complete flora were enumerated that including each and every single plant species for their respective height and girth. Plots of 10 m x 10 m sizes were also laid in each block to count and measure individual plants of each species in the plot. Photographs of plant were also taken collected and specimens collected for illustration and herbarium preparation (Fig 3).



(a)



(b)



(c)



(d)

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

During April 13 to April 17, 2020 the plants showed flowering and fruiting were *Grevillea robusta*, *Jacaranda mimosifolia*, *Carissa carandas*, *Dalbergia latifolia*, *Bauhinia purpurea*, *Plumeria alba* etc. and many ornamental plants were also observed viz. *Lilium candidum*, *Gazania rigens*, *Hemerocallis fulva*, *Sambucus nigra*, *Alcea rosea* and *Gomphrena globosa* etc (Fig 4).



(a)



(b)



(c)



(d)

Figure 4 Some ornamental plants observed in flowering conditions in Mt Abu area during spring season.
(a). *Pentas lanceolata*, (b). *Jacaranda mimosifolia*, (c). *Lilium candidum*, and (d). *Gazania rigens*.

Bird and insect activities were observed during the morning hours. Some of the birds identified were: White spotted fantail bird, Red spurfowl, Turtle dove, Red whiskered Bulbul, Grey Babbler, Magpie robin and Green avadavat etc (Fig 5).

BIODIVERSITY STATUS

After the complete enumeration and analysis of phytographical and phenological data in Raj Bhawan, Jaipur, a total of 152 species of plants have been identified till now. This includes 66 trees, 63 shrubs, 12 herbs, 9 climbers and 2 grasses. Likewise, at Raj Bhawan, Mount Abu, a total of 194 plant species have been identified till now that incorporated 61 trees, 73 shrubs, 32 herbs, 17 climbers and 11 grasses (Annexure I). This indicates that species diversity of plants at Rajbhawan, Mount Abu is greater as compared to Raj Bhawan, Jaipur.



(a)



(b)



(c)



(d)



(e)



(f)

Figure 5. 6 Some bird species seen at Raj Bhawan, Mount Abu. (a) Red whiskered bulbul (b).Turtle Dove, (c). Plum headed parakeet, (d) Red spurfowl, (e) White spotted Fantail bird, and (f) Magpie robin

Some of the plants were lesser in number at both of the sites. These plants are: *Ficus krishnae*, *Gliricidia sepium*, *Kigelia africana*, *Terminalia bellerica*, *Delonix regia*, *Pinus roxburghii*, *Manilkara hexandra*, *Pithecellobium dulce*, *Plumeria pudica*, *Spathodea campanulata*, *Tabebuia rosea*, *Vitex negundo* etc. Diversity indices and importance value index (IVI) calculated for both the sites indicate that ***Polyalthia longifolia*** and ***Putranjiva roxburghii*** are the dominant (maximum IVI) tree species at Raj Bhawan, Jaipur, whereas ***Mallotus philippensis***, ***Cassia fistula*** and ***Phoenix sylvestris*** are the most dominant tree species at Raj Bhawan, Mount Abu.

Progress 2019-20

- 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 are in the process and likely to be submitted in two weeks.
- Extension sought up to September 2020 for finalising printing of the book.

4.3.3 Development of Nursery Manual for Forest Tree Species of Rajasthan

Duration	: 06 Months
Total Cost	: INR 2.25 lakhs
MOU Signed	: 29.02-2016
Sanctioned on:	March 2016.
Project Team :	Sh. P.H. Chawhaan, Scientist F Dr. K. K. Srivastava, Scientist F Dr. D.K. Mishra, Scientist F Sh. Uma Ram Choudhary, IFS Sh. A.K. Sinha, Scientist D Dr. U. K. Tomar, Scientist F Sh. N. Bala, Scientist F

Nursery manual has been published and 50 copies have been submitted to Rajasthan Forest Department. Manual has also been uploaded on the official website of the forest department.

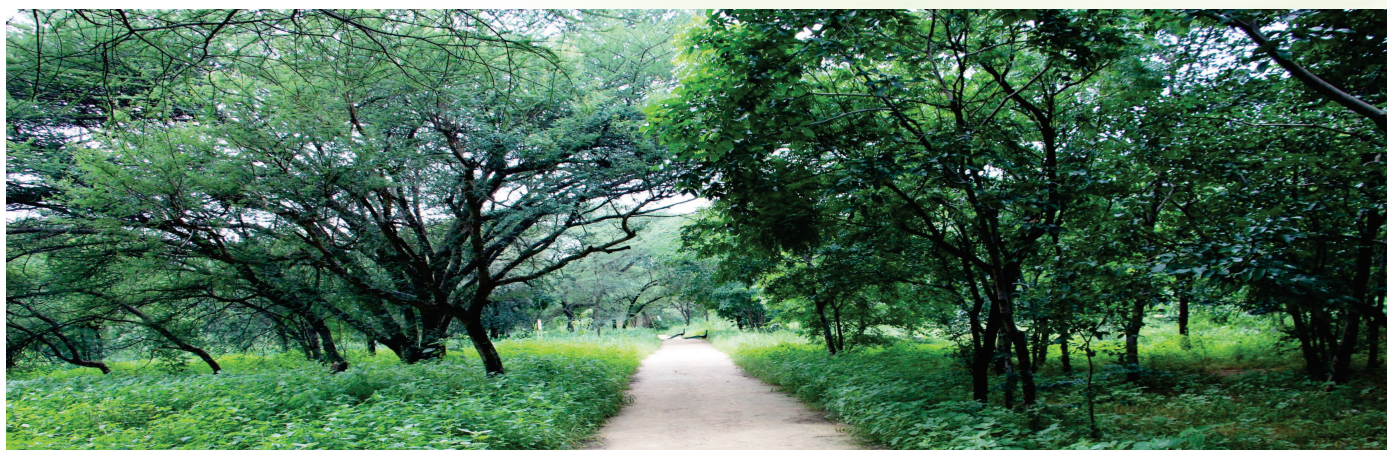
(<https://forest.rajasthan.gov.in/content/dam/doitassets/forest/ForestDepartment/PDFs/Model%20Nursery.pdf>)

5. OTHER ACTIVITIES

Silviculture wing of the department has taken up various other activities also during the year at its research centres. A brief discription of activities is given here under:

5.1. Grass Farm Research Centre:

1. Plant raising and distribution at Grass Farm Nursery, Jaipur is very important activity. Quality plants of more than 65 species were raised at the nursery. In all 2,80,472 plants were distributed during the year to general public, intitutuions, government departments etc as per the policy of government.
2. 1,55,000 plants of normal size for distribution during the year 2020-21 and 60000 Tall plants for distribution during the year 2021-22 raised during the Year.
3. Plants of lesser known species of high ecological and medicinal importance like Commiphora wightii, Manilkara hexandra, oroxylum indicum, Sapindus mukorossi were also raised in the nursery.
4. Nature trail developed in the Grass Farm Research Centre campus is allowed to be used by citizens for walk during morning and evening hours. More than 295 walkers in the morning and about 140 walkers in the evening visit the forest area and enjoy the nature's bounty on nature trail every day. Entry of the citizens on nature trail has been banned as safety measure due to CORONA Pandeminc since March, 2020.
4. Several schools organized visits to the Grass Farm Research Centre, nursery and nature trail with the objective of imparting environmental education and creating awareness about nature conservation among students and teachers.
5. Research Centre is an excellent habitat for wild animals and birds. Every care is taken to maintain the habitat in good condition so as to ensure availability of fodder and water round the year for faunal biodiversity of the area. Gaps in the fencing have been plugged and every care is taken to avoid entry of dogs in the campus to save fauna of the area.
6. Research Centre is a great conservatory of National Bird “peafowl” (*Pavo cristatus*) and can be termed as Peafowl Sanctuary. Peafowl inhabit the area in large numbers and are breeding very well. Various protection measures have been adopted to facilitate their breeding in the area.



- 7 It was emphasised to prepare the plants by material procured from known sources only so as to ensure distribution of quality seedlings to the stake holders.
- 8 Old and abandoned net/poly houses have been revisited and have been repaired by taking essential repairing works like painting of structure, cleaning of inner portion of the structure, refixing of new green net etc. One large size (28 feet x 100 feet) abandoned sturcture has been converted in to a green net house so as to increase the net house capacity of plant raising and thereby reducing dependence on traditional nursery which is becoming more difficult day by day due to increase in avi-fauna population specially peafowls. Another net house of size (30 feet x 70 feet) repaired during the year 2018-19, is being utilized for raising of plants.
- 9 Vermicompost unit is being used for making vermicompost and about 40 cubic meter vermicompost was produced during the year at the unit and was utilized in the nursery.
- 10 As an innovation 70 root trainer stands (with a capacity of $10 \times 24 \times 70 = 16800$ cells of 150 cc) of 0.80 cm height have been procured/ got manufactured, for using them on pilot basis in net houses so as to improve the working conditions.

5.2 Seed Testing Laboratory:- 150 Seed samples belonging to 39 plant species were received from 17 Divisions for germination percentage test at the laboratory. Results of the germination percentage analysis were communicated to the concerned divisions and are reproduced hereunder.

Seed Samples in 2019-20

S.No.	Name of Office	Date of Test	Species	Germination %
1	DCF (Research), Jaipur	30.04.2019	Sadar	2%
2	RFO, Grass Farm Nursery, Jaipur	30.04.2019	Pam	0%
3	RFO, Grass Farm Nursery, Jaipur	10.05.2019	Kalpvrash	57%
4	DCF, Wildlife, Jaipur	15.05.2019	Tortilis	47%
5	DCF, Wildlife, Jaipur	15.05.2019	Kumtha	72%
6	RFO, Seed collection and Storage, Jaipur	22.05.2019	Desi Babool	89%
7	RFO, Seed collection and Storage, Jaipur	23.05.2019	Khejdi	92%
8	DCF, Jalore	04.06.2019	Khair	86%
9	DCF, Jalore	04.06.2019	Khejdi	89%
10	DCF, Bharatpur	12.06.2019	Clean Ber	73%
11	DCF, Bharatpur	13.06.2019	Kumtha	77%
12	DCF, Bharatpur	13.06.2019	Ronjh	42%
13	DCF, Bharatpur	13.06.2019	Deshi Baboo	192%
14	DCF, Bharatpur	13.06.2019	Khair	3%
15	DCF, Jaipur (North)	14.06.2019	Deshi Baboo	192%
16	DCF, Jaipur (North)	19.06.2019	Kumtha	66%
17	DCF, Jaipur (North)	19.06.2019	Ronjh	69%
18	DCF, Jaipur (North)	18.06.2019	Churail	71%
19	DCF, Jaipur (North)	20.06.2019	Ardu	42%
20	DCF, Jaipur (North)	18.06.2019	Hamata Grass	13%

S.No.	Name of Office	Date of Test	Species	Germination %
21	RFO, Seed collection and Storage, Jaipur	20.06.2019	Khejdi	94%
22	RFO, Seed collection and Storage, Jaipur	20.06.2019	Deshi Baboo	188%
23	DCF, (Project), Tonk	26.06.2019	Chila	89%
24	DCF, (Project), Tonk	26.06.2019	Khejdi	93%
25	DCF, (Project), Tonk	26.06.2019	Kumtha	83%
26	DCF, (Project), Tonk	25.06.2019	Ratanjot	44%
27	DCF, (Project), Tonk	25.06.2019	Dhaman Grass	0%
28	DCF, (Project), Tonk	25.06.2019	Arandi	55%
29	DCF, (Project), Tonk	26.06.2019	Deshi Baboo	186%
30	DCF, (Project), Tonk	26.06.2019	Ronjh	69%
31	DCF, Bharatpur	26.06.2019	Papdi	42%
32	DCF, Bharatpur	28.06.2019	Ronjh	78%
33	DCF, Bharatpur	28.06.2019	Kumtha	81%
34	DCF, Bharatpur	28.06.2019	Deshi Baboo	189%
35	DCF, Bharatpur	28.06.2019	Tortilis	87%
36	DCF, Jaipur (North)	28.06.2019	Dhaman Grass	59%
37	DCF, Jaipur (North)	28.06.2019	Savan Grass	11%
38	DCF, Jaipur (North)	28.06.2019	Rohida	57%
39	DCF, Sikar	02.07.2019	Kumtha	78%
40	DCF, Sikar	02.07.2019	Ronjh	81%
41	RFO, Tonk	05.07.2019	Deshi Baboo	184%
42	RFO, Tonk	05.07.2019	Kumtha	73%
43	RFO, Tonk	05.07.2019	Ronjh	78%
44	RFO, Tonk	05.07.2019	Khejdi	85%
45	RFO, Tonk	05.07.2019	Ardu	28%
46	RFO, Tonk	05.07.2019	Ber	53%
47	DCF, Dausa	09.07.2019	Kumtha	81%
48	DCF, Dausa	09.07.2019	Ronjh	78%
49	DCF, Dausa	05.07.2019	Dhaman Grass	32%
50	DCF, Dausa	09.07.2019	Deshi Baboo	187%
51	SCO, (Sojat Road) Pali	11.07.2019	Deshi Baboo	189%
52	SCO, (Sojat Road)	Pali11.07.2019	Ronjh	76%
53	SCO, (Sojat Road) Pali	09.07.2019	Kumtha	81%
54	SCO, (Sojat Road) Pali	05.07.2019	Dhaman Grass	37%
55	SCO, (Sojat Road) Pali	09.07.2019	Karanj	68%
56	SCO, (Sojat Road) Pali	05.07.2019	Ratanjot	81%



**Capacity building programme on “Forest Resource Accounting (FRA)”
Organised by IIFM Bhopal: 5-6 November, 2019 at RFWTI, JAIPUR**

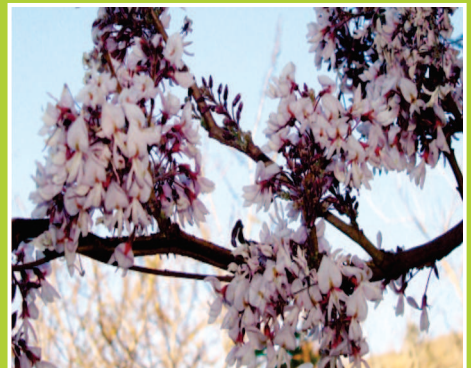


Seedling Seed Orchard at Govindpura Research Farm Jaipur

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