INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN

(An Autonomous Council of Ministry of Environment, Forest and Climate Change, Government of India)

ANNUAL REPORT 2019-20

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Indian Council of Forestry Research and Education

(An Autonomous Council of Ministry of Environment, Forest and Climate Change, Government of India)

Dehradun (Uttarakhand)

Patron

Shri A.S. Rawat, IFS
Director General
Indian Council of Forestry Research and Education,
Dehradun

Editors

Dr. Sudhir Kumar, DDG (Extension), ICFRE
Dr. A.K. Pandey, ADG (M. & Extn.), ICFRE
Ramakant Mishra, CTO (M. & Extn.), ICFRE

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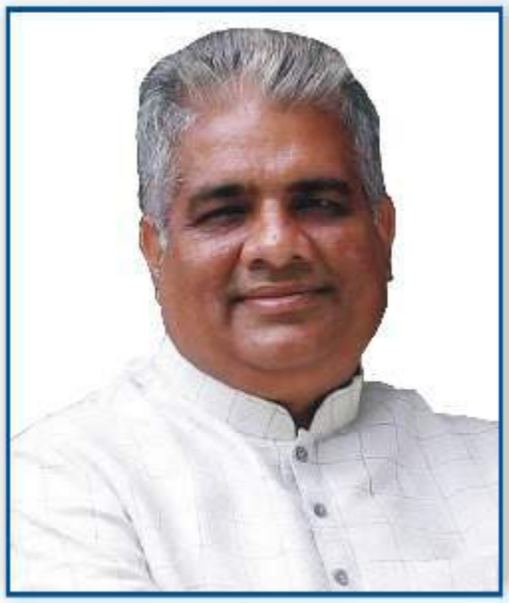

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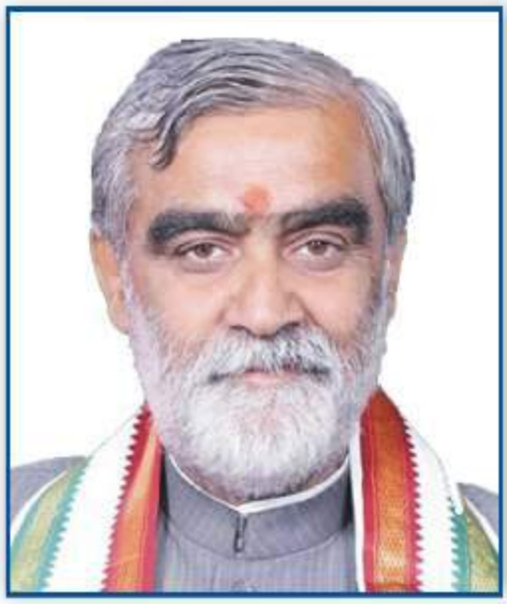
Ministry of Environment, Forest & Climate Change
Government of India



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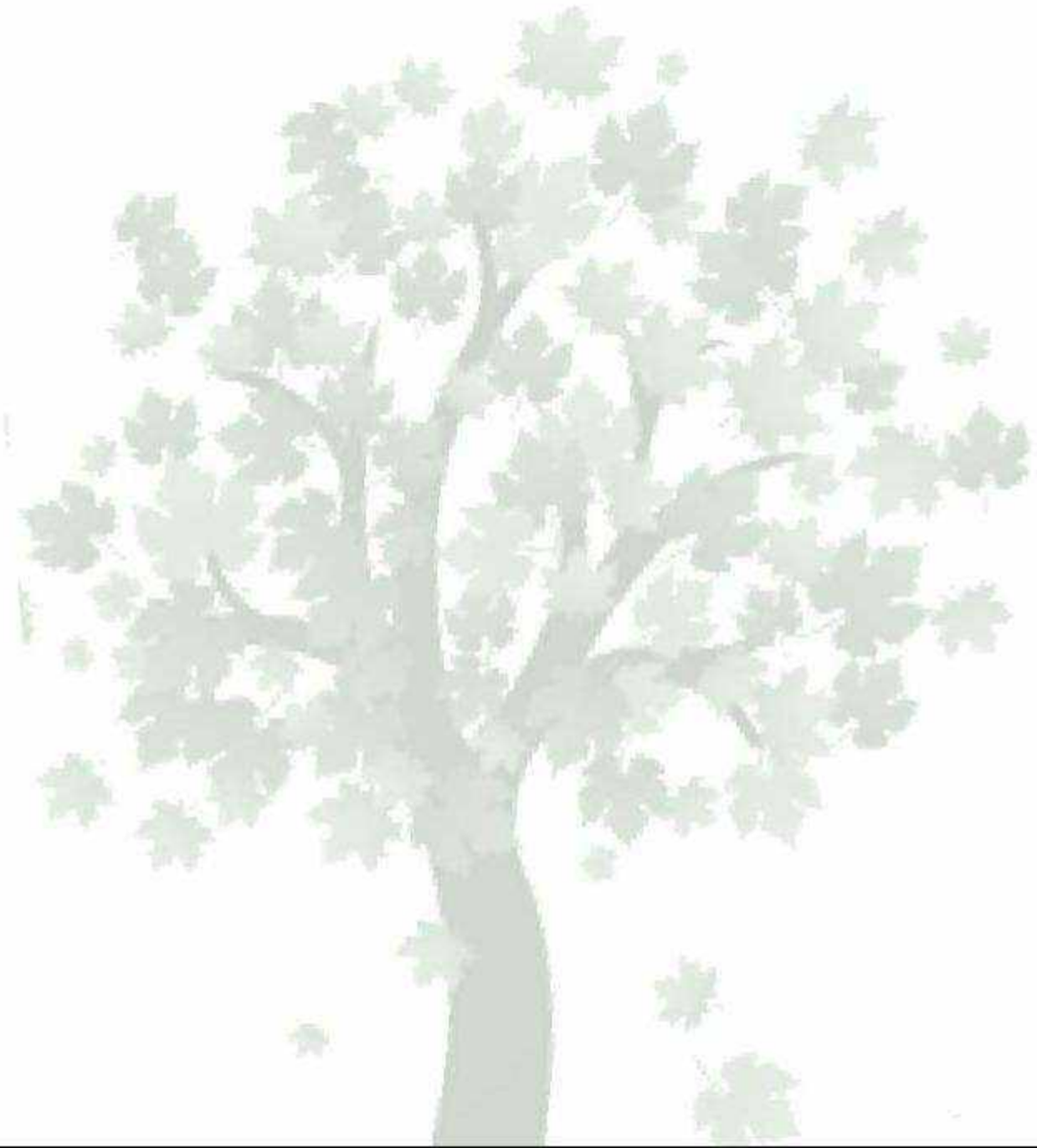
Ministry of Environment, Forest & Climate Change
Government of India



मंत्री
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सूचना एवं प्रसारण और
भारी उद्योग एवं लोक उद्यम
भारत सरकार

सत्यमेव जयते

MINISTER
ENVIRONMENT, FOREST & CLIMATE CHANGE,
INFORMATION AND BROADCASTING AND
HEAVY INDUSTRIES & PUBLIC ENTERPRISES
GOVERNMENT OF INDIA

स्वच्छ भारत
एक कदम स्वच्छता की ओर

प्रकाश जावडेकर
Prakash Javadekar

MESSAGE

Indian Council of Forestry Research and Education is a premier organisation under the Ministry of Environment, Forest and Climate Change that has carved a niche for itself in the global forestry research arena. The council conducts forestry research in a holistic manner to attain the goals of national forest policy and simultaneously assisting in fulfilling national commitments towards the SDGs.

I am happy to see the Annual Report of the council for the year 2019-20 which provides glimpses of vibrant activities performed during the year. The council conducts research on various aspects of forestry including ecology and climate change, biodiversity conservation, non-wood forest products, genetic improvement, forest products, silviculture and management, agroforestry, forest protection, hydrology etc. ICFRE imparts consultancies on EIA, rehabilitation and restoration of mined out areas, hydropower projects and other related sectors.

It is satisfying that towards national commitments to Cancun Agreements of UNFCCC, ICFRE has developed a safeguards information system for providing information on how the seven Cancun safeguards related to forest governance, social, environmental will be addressed and respected throughout the implementation of the REDD+ activities.

It was a moment of pride for ICFRE that Hon'ble Prime Minister has announced to setup a Centre of Excellence at ICFRE to develop scientific approach and facilitate induction of technology on land degradation issue. I hope that the council will take this challenge as an opportunity and fulfill the aspirations with total commitment.

I am confident that the council will continue its splendid contributions in the forestry sector in the years to come.

I wish the council all the success.

Date: 04.02.2021

(Prakash Javadekar)

।। प्लास्टिक नहीं, कपड़ा सही ।।

पर्यावरण भवन, जोर बाग रोड, नई दिल्ली–110 003 फोन : 011–24695136, 24695132, फैक्स: 011–24695329
Paryavaran Bhawan, Jor Bag Road, New Delhi-110 003, Tel.: 011-24695136, 24695132, Fax: 011-24695329
ई–मेल / E-mail : minister-efcc@gov.in

Babul Supriyo
Union Minister of State
Ministry of Environment, Forest & Climate Change,
Government of India

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

बाबुल सुप्रियो
केन्द्रीय राज्य मंत्री
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
भारत सरकार

MESSAGE

Indian Council of Forestry Research and Education is an apex council under the Ministry of Environment, Forest and Climate Change, Government of India actively engaged in conducting research on various aspects of forestry with a people centric approach and keeping synergy with other national and international organizations. The annual report of the council provides insight into its major contributions which are of immense importance to the policy makers as well as the people at large.

The present edition of the annual report unwraps a lot of important information including new records in flora and fauna, documentation of traditional knowledge of tribals, empowerment of tribals through green technologies, wood technologies, development of sustainable harvesting practices for NTFPs including medicinal plants, bamboos. agroforestry models. tree improvement, development of DUS guidelines, biofertilisers, biopesticide, etc. which ensures about a greener future and improved livelihood opportunities to the people in general and to the tribals in particular.

I am happy to know that over 25000 students of over 400 different schools and colleges were educated about the contemporary issues related to environment and forests under Prakriti programme. Tree Grower Melas were important event which benefitted around 1500 farmers, tree growers and other stakeholders. The council is also implementing Green Skill Development Programme (GSDP) of MoEF&CC, in which 15 trainings were conducted at various ICFRE institutes for 286 participants. Preparation of DPRs for rejuvenation of 13 major rivers of India through forestry intervention is an important task being handled by the council.

I am sure that the good work of ICFRE in the service of nation will continue in years to come. My best wishes to ICFRE team for commendable work done during 2019-20 presented in the annual report.

(Babul Supriyo)

Office: 5th Floor, Aakash Wing, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi-110 003
☎ (+91) 11-24621921/22 • Fax: (+91) 11-24695313
Cell: (+91) 9811777143 • 9810711980
E-mail: mos4ef.cc@gmail.com

सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

सत्यमेव जयते

आर पी गुप्ता
R P Gupta

MESSAGE

Forests are the lifeline for all living beings including humans. Our ancestors had discovered this reality and developed a way of life that supports and conserve forests. In modern times, ever-increasing human population combined with technological advancements has put unprecedented developments vis-a-vis posing drastic challenges to the environment and forests. To meet these challenges, we need to conserve forests, increase forest cover and enhance forest productivity on sustainable basis. Indian Council of Forestry Research & Education, Dehradun through the holistic approach towards forestry research, education and extension is shouldering this responsibility assiduously.

Impressive functioning and effective presence of the council in global arena in the field of eco-rehabilitaion has gained a new height when Hon'ble Prime Minister of India, Shri Narendra Modi ji at the XIV Conference of Parties (COP 14) to United Nations Convention to Combat Desertification (UNCCD) announced to set up a Centre of Excellence at ICFRE to promote South-South cooperation to address land degradation related issues.

The council has to its credit a number of important research outcomes during the year including development and standardization and propagation protocols for *Litsea glutinosa* (Maida lakri), an endangered and threatened tree of North-West Himalayas and introduction of sandalwood plantations in Gujarat and Rajasthan beyond its natural boundaries. ICFRE has developed a number of green technologies and products which were extended to tribal people especially women for livelihood enhancement.

I am pleased to see that outcomes were extended with foresight. The Council educated over 25,000 students from over 400 schools and college through its innovative programme Prakriti during the year. The Council also successfully conducted 15 trainings for 286 participants under GSDP, an initiative of the Ministry of Environment, Forest and Climate Change, New Delhi.

I compliment ICFRE team for their praiseworthy work presented in the annual report 2019-20.

(R P Gupta)

इंदिरा पर्यावरण भवन, जोर बाग रोड़, नई दिल्ली–110 003 फोन : (011) 24695262, 24695265, फैक्सः (011) 24695270

INDIRA PARYAVARAN BHAWAN, JOR BAG ROAD, NEW DELHI-110 003, Ph.: 011-24695262, 24695265, Fax: 011-24695270
E-mail: secy-moef@nic.in, Website: moef.gov.in

संजय कुमार
Sanjay Kumar

सत्यमेव जयते

वन महानिदेशक एवं विशेष सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय

DIRECTOR GENERAL OF FOREST & SPL. SECY.
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

MESSAGE

Forestry science is complex as it encompasses multiple disciplines, and any intervention in forest ecosystem made today may manifest decades later. Constant pursuit of new knowledge, therefore, becomes vital so that decisions are backed by strong empirical evidence and theoretical postulates. In such a scenario the contribution of Indian Council of Forestry Research and Education (ICFRE) becomes critically important for the country and the Sector. The Annual Report 2019-20 of the Council provides a glimpse of such a contribution.

The achievements of ICFRE during the year are praiseworthy, particularly on recording new species including a basidio-lichen, 12 mushrooms, 3 species of hymenopteran parasitoids and also pseudovivipary in Costaceae for the first time. The reintroduction of 15,000 plants of five rare and endangered orchids of Mizoram has further strengthened our efforts on *in-situ* conservation.

Today, bamboo has regained its place in the national economy. ICFRE not only succeeded in preparing Bamboo lumber using matured culms of four bamboo species, but also demonstrated that mechanical properties of bamboo lumbers are better than teak. On the NTFP front, post harvest technologies of *Kalmegh* and *Brahmi* have been standardized with regard to quality and six high oil yielding clones of *Calophyllum inophyllum* have been identified for variety release.

The Council is providing consultancies to infrastructure and other agencies on different aspects of environment including on hydro power projects and through such advice is ensuring that India remains at the global fore-front of Green Infrastructure. The Council is also entrusted with preparation of DPRs for rejuvenation of 13 major rivers of India through forestry interventions. This will go a very long way in water and ecological security of the country.

ICFRE is runnimg capacity building programmes for unemployed youth under GSDP besides its regular training programmes under various extension activities. Students at various levels are also being sensitized through a scientist-student connect programme-*Prakriti*. This year over 25,000 students were sensitized under this programme.

With these activities, ICFRE has once again proven itself as being uniquely positioned in terms of providing policy and programmatic inputs for well-being of the forests of the country.

I convey my best wishes to one and all in the ICFRE.

Place: New Delhi
Date: 12.02.2021

(Sanjay Kumar)

इंदिरा पर्यावरण भवन, जोर बाग रोड़, नई दिल्ली–110 003 फोन : (011) 24695278, फैक्सः (011) 24695412

Indira Paryavaran Bhawan, Jor Bag Road, New Delhi-110 003, Ph.: 011-24695278, Fax: 011-24695412
E-mail: dgfindia@nic.in

सत्यमेव जयते

अरूण सिंह रावत, भा.व.से.
महानिदेशक, भा.वा.अ.शि.प.
तथा कुलाधिपति, वन अनुसंधान
संस्थान सम विश्वविद्यालय

Arun Singh Rawat, IFS
Director General, ICFRE
and Chancellor, Forest Research Institute
Deemed to be University

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
(आई.एस.ओ. 9001:2008 प्रमाणित संस्था)
डाकघर न्यूफॉरेस्ट, देहरादून–248006

Indian Council of Forestry Research and Education
(An ISO 9001:2008 Certified Organisation)
P.O. New Forest, Dehradun-248006

Foreword

Indian Council of Forestry Research and Education is an apex autonomous organization in forestry research, education and extension under Ministry of Environment, Forest and Climate Change, Government of India. The Council is engaged in conducting research on various aspects of forestry to address the goals of National Forest Policy, simultaneously addressing the issues of livelihood of forest dependent communities including marginalized rural poor and sustainable development. The Council also represents the nation globally on different forums on environment related issues.

Year 2019-20 was eventful for the Council as Hon'ble Prime Minister of India, Shri Narendra Modi ji announced to set up a Centre of Excellence at ICFRE to promote South-South cooperation to develop scientific approach and facilitate induction of technology on land degradation issues during XIV Conference of Parties (COP 14).

The Council participated in the exhibition at COP 14 and organized a side event on Restoration of Degraded Forest Lands and Combating Desertification at Greater Noida (NCR). It also participated in the exhibition at COP-13 on the Conservation of Migratory Species of Wild Animals held at Gandhi Nagar (Gujarat). ICFRE organized a side event in collaboration with ICIMOD on 'Land Degradation Neutrality and REDD+ Readiness in India' at India Pavilion of Twenty Fifth Session of Conference of Parties (COP 25) of UNFCCC at Madrid (Spain).

In its research endeavors, ICFRE recorded a number of new findings including first report of 103 mushroom species from Mizoram out of which 12 species have been reported for the first time from India. A pathogen, *Alternaria alternata* was reported for the first time on *Ailanthus excelsa* in India while a moth, *Garella ruficirra* infesting young shoots of *Quercus lanata* in Kumaon region of Uttarakhand was reported for the first time. Pseudovivipary was recorded for the first time in Costaceae (*Costus igneus*).

Five rare and endangered orchids of Mizoram were cultivated through tissue culture and 15,000 plants were reintroduced in wild for *in situ* conservation.

Development of DUS descriptors testing guidelines and establishment of Gene Bank is progressed for different indigenous forest tree species such as *Ailanthus excelsa, Tectona grandis* and *Melia dubia*. Over 40 DUS characters were developed for *A. excelsa*.

ICFRE has already initiated establishment of sandalwood plantations outside its traditional areas and developing improved technologies to promote the sandalwood cultivation. The sandalwood propagation was promoted by pelleting methods and using suitable host. A suitable bioinoculant i.e. *Trichoderma viridae* was identified for pelletizing sandalwood seeds along with suitable host, *Pithecellobium dulce* for dry areas.

Post harvest technologies of important medicinal plants e.g., Kalmegh and Brahmi have been standardized for quality herbal produce. Propagation techniques of *Litsea glutinosa* have been standardized which may lead to conservation of this important species.

Bamboo lumbers were prepared using mature culms of four bamboo species. The lumbers were tested for various physical and mechanical properties as per BIS and mechanical properties of bamboo lumbers were found better than teak.

The council is developing and promoting green products such as biopesticides, potting media, growth promoters etc for livelihood generation along with sustainable development. Compost made with weed and flower wastes added into the decomposed coir pith showed an increment of 40-45% in growth of the vegetable seedlings. The technology was transferred to WSHGs of Irular tribes in forest fringe villages in Coimbatore as alternate source of income. 'Bio-Bacillin' (Bacillus valezensis) a biopesticide was released. Also a biopesticide formulation "Simca BC (Bean of paradise)" has been developed.

ICFRE is playing pivotal role in the field of forestry education. At FRI deemed to be University masters degree courses are being run in 04 disciplines. Reasearch is also being persued by the students for Ph.D. degrees. 25 Research Scholars have been registered for Ph.D. and a total of 41 Ph.D. degrees have been awarded. 274 trainings were organised to educate 12853 stakeholders including researchers, scientists, students, officials etc.

ICFRE extended scientific consultancy services for different stakeholders under 11 projects related to various environmental aspects including preparation of reclamation and rehabilitation plans for iron ore mines, monitoring and evaluation of catchment area treatment plans and afforestation plans, cumulative environmental impact assessment of hydroelectric projects in Sutlej river basin, environmental performance evaluation, indexing and environmental audit of coal mines, biodiversity assessment studies with respect to coal and iron ore mines.

Dissemination of technologies developed by the Council to the intended target groups including farmers, SFDs, entrepreneurs, industries, rural poor and unemployed youth is a continuous process through various extension activities/ programmes. This year ICFRE organized 191 Symposia, seminars, workshops etc. in which 9798 persons participated. Under Van Vigyan Kendras, 62 trainings were carried out which were attended by 4760 participants including farmers, SFD personnel and other stakeholders.

The Council is executing Green Skill Development Programme (GSDP) of MoEF&CC, New Delhi under ENVIS scheme. During the year, 15 trainings tailored to suit the specific needs with emphasis on practical skills were conducted for 286 participants mainly school and college dropouts.

Prakriti, a scientist – student connect programme, is operational through all ICFRE institutes across the country. During the year, over 25,000 students and teachers from 232 KVs, 38 JNVs and 151 other schools and colleges have been educated on various aspects of environment and forest.

An Industrial Tree Growers Mela was organized on 22 October 2019 at Jayankondam, Ariyalur district in collaboration with Tamil Nadu Newsprint & Papers Limited (TNPL), Karur. About 450 tree growers/farmers of Tamil Nadu participated in the Mela. A two days "Tree Growers' Mela" 2020 was organized at IFGTB, Coimbatore on 10 and 11 March 2020 for about 1000 tree growers, farmers and scholars etc. A Kisan Mela was also organized in collaboration with Agriculture and Forest Department, Leh at Leh on 6 September 2019. More than 135 people including farmers and foresters participated in the Kisan Mela.

To expand its outreach, ICFRE entered in active cooperation with other organizations like International Union of Forest Research Organizations (IUFRO), Vienna; National Institute for Entrepreneurship and Small Business Development (NIESBUD), Noida; G.B. Pant Institute of Himalayan Environment and Development (GBPNIHESD), Almora; Indian School of Business (ISB), Hyderabad etc. through Memoranda of Understanding.

ICFRE has been entrusted by National Afforestation and Eco-Development Board (NAEB), Government of India for preparation of Detailed Project Report (DPR) for rejuvenation of 13 major Indian rivers Beas, Brahmaputra, Cauvery, Chenab, Godavari, Jhelum, Krishna, Luni, Mahanadi, Narmada, Ravi, Sutlej Yamuna through forestry interventions.

It is my pleasure to present Annual Report of ICFRE for the year 2019-20 which contains brief account of activities of the Council conducted during the year.

(Arun Singh Rawat)

MEMBERS OF ICFRE SOCIETY 2019-20

1. **Shri Prakash Javadekar**
   Hon'ble Minister, Environment, Forest and Climate Change
   Indira Paryavaran Bhawan, Aakash Wing
   Jor Bagh Road, Aliganj
   New Delhi – 110003

2. **Shri C.K. Mishra, IAS**
   Secretary, Environment, Forest and Climate Change and
   Chairman of Board of Governors of ICFRE
   Indira Paryavaran Bhawan, Prithvi Wing
   Jor Bagh Road, Aliganj
   New Delhi – 110003

3. **Dr. T.V. Somanathan, IAS**
   Secretary Expenditure
   Ministry of Finance
   Department of Expenditure
   North Block
   New Delhi-110001

4. **Prof. Ashutosh Sharma**
   Secretary to the Government of India
   Ministry of Science and Technology
   Department of Science and Technology
   Technology Bhawan
   New Mehrouli Road, Delhi-110016

5. **Shri Rajesh Bhushan, IAS**
   Secretary to the Government of India
   Ministry of Rural Development
   Krishi Bhawan
   New Delhi-110001

6. **Shri Sanjay Agarwal, IAS**
   Secretary to the Government of India
   Ministry of Agriculture
   Krishi Bhawan
   New Delhi-110001

7. **Dr. Renu Swroop**
   Secretary to the Government of India
   Ministry of Science and Technology
   Department of Bio Technology
   Block-2, CGO Complex, Lodhi Road
   New Delhi-110003

8. **Shri Anand Kumar, IAS**
   Secretary to the Government of India
   Department of Non-conventional Energy Sources
   Block 14, CGO Complex, Lodhi Road
   New Delhi-110003

9. **Shri Amitabh Kant, IAS**
   Chief Executive Officer
   NITI Aayog
   Parliament Street
   New Delhi-110001

10. **Shri C.K. Mishra, IAS**
    Acting Director General of Forests and Special Secretary to the Government of India
    Ministry of Environment, Forest and Climate Change
    Indira Paryavaran Bhawan, Prithvi Wing
    Jor Bagh Road, Aliganj
    New Delhi – 110003

11. **Dr. Sanjay Kumar, IFS**
    Additional Director General Forests (FC)
    Ministry of Environment, Forest & Climate Change,
    Indira Paryavaran Bhawan, Prithvi Wing,
    Jor Bagh Road, Aliganj,
    New Delhi – 110 003.

12. **Shri Praveen Garg, IAS**
    Additional Secretary and Financial Advisor
    Ministry of Environment, Forest and Climate Change
    Indira Paryavaran Bhawan, Prithvi Wing
    Jor Bagh Road, Aliganj
    New Delhi – 110003

13. **Dr. Suneesh Buxy, IFS**
    Deputy Inspector General of Forests (RT)
    Ministry of Environment, Forest and Climate Change
    Indira Paryavaran Bhawan, Prithvi Wing
    Jor Bagh Road, Aliganj
    New Delhi – 110003

14. **Dr. Trilochan Mahapatra**
    Director General
    Indian Council of Agricultural Research
    Krishi Bhawan,
    New Delhi-110001

15. **Dr. Shekhar C. Mande**
    Director General
    Council of Scientific and Industrial Research
    2, Rafi Marg, Anusandhan Bhawan
    New Delhi-110001

16. Prof. D.P. Singh
Chairman
University Grants Commission
Bahadur Shah Zafar Marg,
New Delhi-110002

17. Prof. Tankeshwar Kumar
Vice Chancellor
Guru Jambheshwar University of Science & Technology
Hisar – 125001 (Haryana)

18. Dr. Parvinder Kaushal
Vice Chancellor
Dr. Y.S. Parmar University of Horticulture and Forestry
Nauni, Solan – 173230 (Himachal Pradesh)

19. Dr. Dhananjai Mohan, IFS
Director
Wildlife Institute of India
Chandrabani, Clement Town
Dehradun-248001 (Uttarakhand)

20. Dr. Pankaj Srivastava, IFS
Director
Indian Institute of Forest Management
Nehru Nagar, Bhopal - 462003 (Madhya Pradesh)

21. Dr. U. Prakasham, IFS
Principal Chief Conservator of Forests & HoFF,
Madhya Pradesh Forest Department
1st Floor, Satpura Bhawan
Bhopal – 482003 (Madhya Pradesh)

22. Shri Shashi Nand Keolyar, IFS
Principal Chief Conservator of Forests & HoFF,
Jharkhand
Van Bhawan, Doranda
Ranchi – 834002 (Jharkhand)

23. Shri Ajai Saxena, IFS
Principal Chief Conservator of Forests & HoFF
Arunachal Pradesh
Forest Department,
Itanagar – 791 111 (Arunachal Pradesh)

24. Shri Punati Sridhar, IFS
Principal Chief Conservator of Forests & HoFF,
Karnataka
Forest Department,
Aranya Bhawan, 18th Cross, Malleshwaram,
Bengaluru – 560 003 (Karnataka)

25. Shri S.K. Chaturvedi, IFS
Managing Director
Forest Development Corporation Gujarat,
78, Vanganga, Alkapuri,
Vadodra – 380007 (Gujarat)

26. Shri Rajiv Kumar, IFS
Managing Director
Forest Development Corporation Limited,
A-84, Kharavela Nagar,
Bhubneshwar – 751001 (Odisha)

27. Dr. Genda Singh
Scientist G
Arid Forest Reseach Institute
Krishi Upaz Mandi
New Pali Road
Jodhpur – 342005 (Rajasthan)

28. Dr. K.K. Pandey
Scientist G
Institute of Wood Science and Technology
P.O. Malleshwaram
Bengaluru – 560003 (Karnataka)

29. Shri S.D. Sharma, IFS
Deputy Director General (Research)
ICFRE
P.O. New Forest
Dehradun – 248006 (Uttarakhand)

30. Dr. M.P. Singh, IFS
Acting Director,
Indian Plywood Industries, Research & Training Institute,
P.B. No.2273,
Tumkur Road,
Bengaluru – 560022 (Karnataka)

31. Dr. Vipin Prakash Thapliyal
Director
Central Pulp & Paper Research Institute
Post Box 174, Paper Mill Road
Himmat Nagar
Saharanpur – 247001 (Uttar Pradesh)

32. Dr. N.B. Brindavanam
506, Fame's Brindavanam Apartments
2-131/2, Yendada
Visakhapatnam – 530 045 (Andhra Pradesh)

33. Dr. S. Murugesan, IFS
Director
Institute of Forests Genetics and Tree Breeding
Post Box No. 1031, HPO - R.S. Puram
Coimbatore-641002 (Tamil Nadu)

34. Dr. M.P. Singh, IFS
Director
Institute of Wood Science and Technology
PO Malleswaram
Forest Research Laboratory
Bengaluru-560003 (Karnataka)

35. Dr. G. Rajeshwar Rao
Director
Tropical Forest Research Institute
P.O. Regional Forest Research Centre
Mandla Road
Jabalpur – 482001 (Madhya Pradesh)

36. Shri M.R. Baloch, IFS
Director
Arid Forest Research Institute
P.O. Krishi Mandi
New Pali Road
Jodhpur-342008(Rajasthan)

37. Shri Arun Singh Rawat, IFS
Director
Forest Research Institute
P.O. New Forest
Dehradun – 248006 (Uttarakhand)

38. Dr. R.S.C. Jayaraj, IFS
Director
Rain Forest Research Institute
Post Box No. 133
Deovan, AT Road (East)
Jorhat – 785001 (Assam)

39. Dr. Nitin Kulkarni
Director
Institute of Forest Productivity
Main Road, Hinoo
Ranchi-835303 (Jharkhand)

40. Dr. S.S. Samant
Director
Himalayan Forest Research Institute
Conifer campus, Panthaghati
Shimla-171009 (Himachal Pradhesh)

41. Dr. D. Jayaprashad IFS
Director, IFB
Institute of Forest Biodiversity
Dulapally, Kompally (SO)
Hyderabad – 500100 (Telengana)

42. Shri Omkar Singh, IFS
Director
Indira Gandhi National Forest Academy
P.O. New Forest
Dehradun – 248006 (Uttarakhand)

43. Dr. V.K. Bahuguna, IFS
Former Director General, ICFRE
281, Phase – I, Vasant Vihar
Dehradun – 248 001 (Uttarakhand)

44. Dr. S.K. Khanduri, IFS
Ex-PCCF Kerala,
409, Nilaya Hills,
Haridwar Bye-Pass Road,
Dehradun – 248 001 (Uttarakhand)

45. Dr. Nitin Pandit
Director
Ashoka Trust for Research in Ecology and Environment
Bengaluru (Main) Royal Enclave
Srirampura, Jakkur Post
Bengaluru – 560 064 (Karnataka)

46. Shri Kalyan Singh Rawat
Maiti Sadan
Village and P.O. Nathuawala
Raipur – 248 008
Dehradun (Uttarakhand)

47. Dr. Suresh Chandra Pant, IFS (Retd.)
Plot No. 727/A, Sector – 8 - C
Gandhi Nagar, Gujarat – 382 007

48. Dr. Ashwani Kumar, IFS
Former Director General, ICFRE
312, Pratap Road Cross, Clement Town,
P.O. Subhash Nagar,
Dehradun-248002

49. Shri R.P. Agarwalla, IFS
Former PCCF and Chief Wildlife Warden
Government of Assam
21 B, Hatisila, Kharghuli
Dr. Bhupen Hazarika Path
Guwahati – 781 004
House No. 1052, Sector 40,
Gurgaon – 122 002

50. Shri Umendra Dutt
Kheti Virasat Mission
R.V. Shanti Nagar
Jaitu, Faridkot – 151202 (Punjab)

51. Shri Arun Singh Rawat, IFS
Director General
Indian Council of Forestry Research and Education
P.O. New Forest
Dehradun – 248006 (Uttarakhand)

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2019-20

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Indira Paryavaran Bhawan,
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New Delhi – 110 003

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Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi – 110 003

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Deputy Inspector General Forest (RT)
Ministry of Environment, Forest & Climate Change,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi – 110 003.

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Ministry of Environment, Forest & Climate Change,
Indira Paryavaran Bhawan,
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New Delhi – 110 003

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Council of Scientific and Industrial Research,
2, Rafi Marg, Anusandhan Bhawan,
New Delhi

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University Grants Commission,
Bahadur Shah Zafar Marg,
New Delhi

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Director,
Wildlife Institute of India,
Chandrabani, Clement Town,
Dehra Dun

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Indian Institute of Forest Management,
Nehru Nagar,
Bhopal – 462 003 (M.P.)

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Director,
Indira Gandhi National Forest Academy,
P.O. New Forest,
Dehra Dun – 248006

12. Dr. Subhash Ashutosh, IFS

Director General,
Forest Survey of India,
Kaulagarh Road,
Dehra Dun

13. Dr. Shekhar C. Mande

The Secretary to the Government of India,
Department of Science and Technology,
Technology Bhawan,
New Mehrouli Road,
Delhi

14. Dr. S.C. Gairola, IFS
Director General,
Indian Council of Forestry
Research and Education,
Dehra Dun

15. Prof. Tankeshwar Kumar
Vice Chancellor
Guru Jambheshwar University of Science & Technology,
Hisar – 125001 Haryana

16. Dr. Parvinder Kaushal
Vice Chancellor
Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni
Solan – 173230 (Himachal Pradesh)

17. Dr. B.P. Thapliyal
Director
Central Pulp & Paper Research Institute
Post Box 174, Paper Mill Road
Himmat Nagar
Saharanpur – 247001 (Uttar Pradesh)

18. Shri J.K. Mohanty, IFS
Principal Chief Conservator of Forests & HoFF,
Madhya Pradesh
Ist Floor, Satpura Bhavan
Bhopal – 482003 (Madhya Pradesh)

19. Dr. Sanjay Kumar, IFS
Principal Chief Conservator of Forests & HoFF
Jharkhand
Van Bhawan
Doranda
Ranchi – 834002 (Jharkhand)

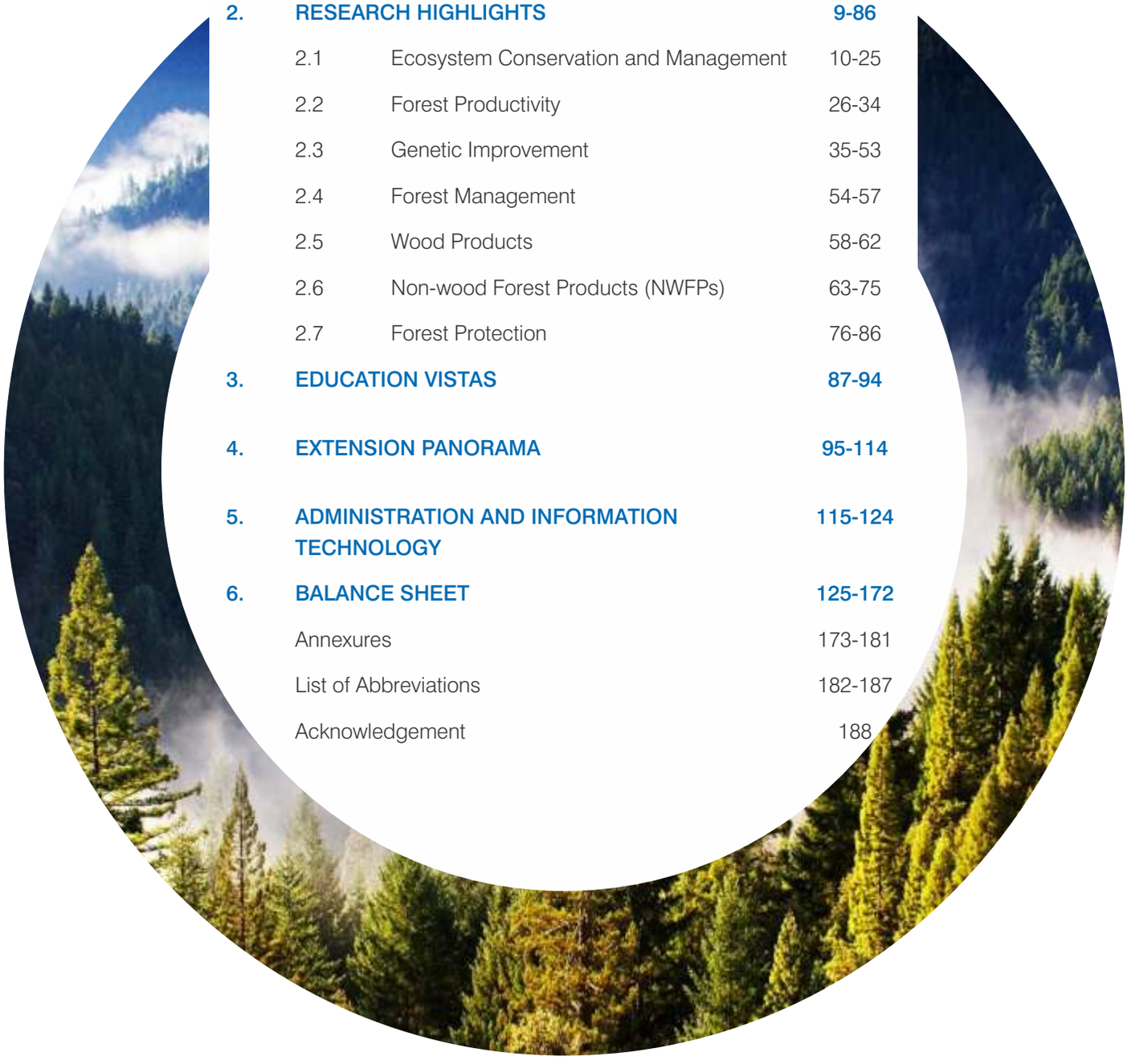
20. Shri. A.S. Rawat, IFS
Director
Forest Research Institute
P.O. New Forest
Dehradun – 248006 (Uttarakhand)

21. Dr. S. Murgesan
Director
Institute of Forest Genetics and Tree Breeding
P.O. Box No. 1031,
H.P.O. – R. S. Puram
Coimbatore – 641002 (Tamil Nadu)

22. Dr. Genda Singh
Scientist G
Arid Forest Research Institute
Krishi Upaz Mandi
New Pali Road
Jodhpur – 342008 (Rajasthan)

23. Dr. K.K. Pandey
Scientist G
Institute of Wood Science and Technology
P.O. Malleshweram
Bengaluru – 560003 (Karnataka)

CONTENTS



OVERVIEW

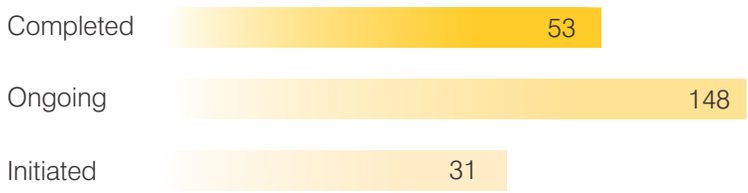
OVERVIEW

Indian Council of Forestry Research and Education, Dehradun is mandated to conduct holistic research on forestry and provide solutions training with the emerging issues in the various sectors of national and global concerns. ICFRE conducts research on various aspects ranging from forest productivity, genetic improvement, biodiversity conservation, agroforestry, climate change, forest products, combating desertification, sustainable development, Silviculture, Ecology & Environment and extends the research outcomes from lab to land for the benefit of various stakeholders. The annual report of ICFRE gives a glimpse of the overall significant findings of the year is divided into 5 chapters namely Introduction, Research Highlights, Education Vistas, Extension Panorama and Administration & Information Technology. Balance sheet of the Council is the 6th chapter.

During the year 2019-20 ICFRE conducted the research on the following:

PROJECT

PLAN



EXTERNALLY AIDED

The overall allotted budget for the financial year 2019-20 was Rs. 230.00 Crore and expenditure was Rs. 239.38 Crore for ICFRE.

In addition to the above financial assistance for externally aided project the budget was Rs. 77.72 Crore.

Environment and Climate Change

Studies on carbon sequestration through afforestation at Rourkela Steel Plant, Odisha revealed that in the year 2019 carbon content in the total survived trees was 1,68,271 tonnes, with maximum in *Tectona grandis* followed by *Alstonia scholaris* and *Cassia siamea* trees.

An estimation of soil carbon stock in Betla National Park and Dalma Wildlife Sanctuary in Jharkhand revealed that the overall soil organic carbon-stock in Betla National Park was1.02 million tonnes while for Dalma Wildlife Sanctuary it was 1.35 million tonnes. Dalma Wildlife Sanctuary though smaller in area has 0.33 tonnes more soil organic carbon than Betla National Park. This is due to various Soil Moisture Conservation works being carried out in the DWLS, which also significantly contributed in more SMC instead of smaller area than BNP.

Promoting soil carbon sequestration is an effective strategy for reducing atmospheric CO_2 and improving soil quality. Carbon sequestration and Carbon dioxide emission from the soils under different forest covers in Uttarakhand were studied and results indicated that the decrease in soil organic carbon is due to intensive forest management, increased carbon mineralization led to higher carbon dioxide emission rate.

Participation in COP

ICFRE organized a side event on Restoration of Degraded Forest Lands and Combating Desertification at COP 14 on 13 September 2019. About 110 national and international delegates participated in the side event.

ICFRE organized a side event in collaboration with ICIMOD on 'Land Degradation Neutrality and REDD+ Readiness in India' at India Pavilion of Twenty Fifth Session of Conference of Parties (COP 25) of United Nations Framework Convention on Climate Change (UNFCCC) at Madrid (Spain) on 6 December 2019.

ICFRE participated in the exhibition at Thirteenth Session of the Conference of the Parties (COP-13) to the Convention on the Conservation of Migratory Species of Wild Animals held at Gandhi Nagar, Gujarat during 17-22 February 2020.

Biodiversity Conservation

Assessment, documentation, and characterization of lichen diversity in Tripura are underway. A total of 124 lichen species have been identified from Tripura so far. *Multiclavula mucida* is the new record of basidio-lichen for India.

Exploration and utilization of wild mushroom diversity in Mizoram resulted in documentation of 153 mushroom species. Out of 153 mushroom species, 103 species were reported for the first time from Mizoram whereas, 12 species have been reported for the first time from India.

Studies on diversity and host range of hymenopteran egg parasitoids from northern India i.e. Haryana, Uttar Pradesh and Uttarakhand are in progress. Twenty-six species have been identified, out of which three species, *Lathromeroidea deoriaensis, L. indica* and *Haeckeliania singularis* were new to science.

Five rare and endangered orchids of Mizoram were cultivated through tissue culture and 15,000 plants were reintroduced in wild for *in situ* conservation.

The People's Bio-Diversity Registers(PBRs) for 2 blocks namely Bamutia and Mohanpur were prepared and submitted to Tripura Biodiversity Board. PBRs of 21 Biodiversity Management Committees of Shimla has also been completed.

Sandalwood Beyond the Boundaries

Sandalwood plantations have been introduced in Gujrat and Rajasthan beyond the natural boundaries. Research to assess performance of pelletized sandal seeds in nursery and field was conducted. *Trichoderma viridae* was found a suitable bioinoculant for promoting propagation of sandalwood. *Pithecellobium dulce* was found the suitable host for sandal to be planted in dry areas.

Conservation of Medicinal Plants

Natural populations of *Litsea glutinosa* (Maida lakri) an endangered and threatened medicinal tree of North–West Himalayas were identified in Uttarakhand, Himachal Pradesh and Haryana and their database has been prepared for mapping. Propagation protocols have been developed and standardised.

Species distribution and regeneration studies of *Aegle marmelos, Albizia amara, Limonia acidissima, Sapindus emarginatus, Santalum album, Scheleichera oleosa, Strychnos nux-vomica, Syzigium cumini, Canarium strictum, Givotia rotelleriformis, Celastrus paniculata* and *Terminalia bellirica* at various altitudes in Kolli hills forests for conservation and restoration strategies for above species of Eastern Ghats were conducted. Enrichment planting of above species covering 9 ha was successfully completed in open forest areas with the support of TNFD.

Andrographis paniculata (Kalmegh) and *Bacopa monnieri* (Brahmi) are important medicinal herbs being used by pharmaceutical industries. Superior germplasm of Kalmegh and Brahmi having more active ingredients (andrographolide and bacoside respectively) have been identified for commercial cultivation. Post harvest technologies (drying, processing and storage) of Kalmegh and Brahmi have been standardized for quality herbal produce.

Phytochemical evaluation of *Habenaria edgeworthii* (Vriddhi) and *Habenaria intermedia* (Riddhi), the important Astavarg species revealed that *H. edgeworthii* and *H. intermedia* plants possess good antioxidant activity and thus could be a potential source of natural antioxidants

New Records

Costus igneus commonly known as spiral flag, also known as insulin plant is a member of Costaceae. It is a perennial, upright, spreading plant reaching about two feet tall, with spirally arranged leaves and attractive flowers. Pseudovivipary was observed for the first time in Costaceae (*Costus igneus*).

Severe disease outbreaks of Alternaria leaf spot on *A. excelsa* were recorded. This is the first report to confirm that *Alternaria alternata* is associated with leaf spot and blight disease of *A. excelsa* in India.

Garella ruficirra infesting young shoots of *Quercus lanata* in Kumaon region of Uttarakhand was reported for the first time.

Genetic Improvement

Distinctiveness, Uniformity and Stability (DUS) testing guidelines and establishment of Gene Bank is underway for forest tree species namely *Ailanthus excelsa*, and *Melia dubia*. Over 40 DUS characters were developed for *A. excelsa*. A draft guideline for DUS testing was developed for *T. grandis*.

Forest genetic diversity serves a number of fundamentally important functions. Six species viz. Burans, Thuner, Kharsu Oak, Bhojpatra, Kafal and Butter tree have been prioritized for molecular characterization and genetic diversity estimation. Shannon's diversity index ranged from 1.59 to 2.48.

The regions with high level of genetic diversity and private alleles are most suitable for conservation of the species.

A germplasm bank of 43 teak clones was established in an area of 1 acre at Panampally, Kerala.

Three multi-location clonal trials were established at Neyveli, Cuddalore; Kangeyam, Tiruppur and Melur, Madurai in Tamil Nadu for evaluation of promising clones of *Tamarindus indica* for higher fruit productivity.

Identified 6 high yielding clones of *Calophyllum inophyllum* with high oil yield for variety release.

Bamboo - the Green Gold

Awareness programmes were conducted on optimum utilization of bamboo and to convert waste bamboo into value added product in the form of bamboo charcoal briquette for promoting livelihood at Sardoka Engti Village and Rong Bong Ghat, Karbi Anglong district, Assam. A model facility centre (brick kiln) was established in Jilangso village of the district Karbi Anglong for bamboo charcoal production.

Bamboo lumbers were prepared using matured culms of four bamboo species. The lumber of all the species were tested for various physical and mechanical properties as per BIS. The mechanical properties of bamboo lumbers were better than teak. These bamboo based composites have potential to be used as an alternate to solid wood in structural and non-structural applications.

For the first time four species of bamboos, which are important for bamboo artisans for manufacturing of round bamboo novelty products, have been successfully kiln seasoned using dehumidifier kiln and vacuum kiln without drying degrades. The implementation of developed kiln seasoning method of bamboos will add value to round bamboo products for bamboo artisans in terms of uniform quality products.

Wood Products

Plantation timbers densities are lower than the traditional furniture and joinery timbers of India and are underutilized due to unsuitable properties needed for solid-wood industry. The density and other properties of the timber can be enhanced with the help of thermo-hygro-mechanical (THM) methods to make it suitable for higher end products like furniture, flooring etc. The THM treatment transforms wood into semi-solid state, after which 'die-tool' was used to compress and impose shapes and patterns simultaneously. Excellent results were obtained on *M. dubia* and *Eucalyptus* spp. on 'die-tool' imprinting.

Three low density wood species, viz., *Maesopsis eminii, Ailanthus excelsa* and *Melia dubia* were impregnated with two resins blended with different proportions of clay and silica nano particles using vacuum-pressure techniques. Density and strength parameters of all three woods were found to be improved by 15-25% and 30-55% after impregnation with resin-nanoparticle blends. Preliminary results indicated effectiveness of the nano impregnation for improving termite resistance of low durability timber.

Tribals' Traditional Healthcare

Documentation of eleven different species of insects of medical importance being used by tribals of Satpura plateau was done. 22 species of fungi were also collected from the area out of which six species were edible.

Ethnomedicinal studies of Chakma, Reang, Kuki, Tripuri, Halam, Garo, Kalai, Jamatia and Bhil tribes of Tripura was conducted. 481 medicinal plants and herbs to cure about 20-25 diseases/ailments have been identified. The process of treatment for each ailment, dosage and their mode of administration have been documented.

Empowering Tribal Communities with Green Technologies

Compost made using weed and flower wastes added into the decomposed coir pith increased the efficacy of the coir pith. An increment of 40-45% in growth of the vegetable seedlings was observed compared to the conventional potting mixture while using the compost. This technology was transferred to WSHGs of Irular tribes who inhabit in forest fringe villages in Coimbatore as alternate source of income for their livelihood.

Tree Rich Biobooster acted as an alternate potting mixture and enriched its nutrients and efficiency as promising potting media. Onsite demonstration was also performed to explain in detail about the application of TRB in agriculture and allied sectors to 120 tribal women belonging to various settlements inhabiting in the forest fringe villages of Coimbatore and Pollachi region.

A NTFP database was developed for connecting the Large-sized Adivasi Multipurpose Cooperative Societies (LAMPS) and decision maker of the Karnataka forest department.

Heritage Protection

Technical advice was rendered for conservation and management of Holy Bodhi tree at Bodhgaya, heritage Pipal tree at village Main Bellaganj.

Urban Forestry

Avenue trees along major roads of Chandigarh were surveyed and 219 sample trees out of 1800 tress were assessed on 34 biometric, pathological, entomological and physiological parameters. The general observation showed that the trees were mainly affected by pathological problems and many of the problems were species specific.

Assessment of Visitor Carrying Capacity

Visitor carrying capacity of Chembra peak, Banasuramala-Meenmuttyand Soojippara in South Wayanad Division, Kerala was assessed. The optimum number of visitors per day was recommended.

Biopesticides

Bacillus species isolated from soil samples of healthy *Casuarina* plantations was screened for its bio-control efficacy against various pathogens and the product was later released as 'Bio-Bacillin' (*Bacillus valezensis*) during Tree Growers Mela-2020 organized by IFGTB.

The biopesticide formulation "Simca BC (Bean of paradise)" has been developed using seed oil of *Simarouba glauca* based on the significant biopesticidal activity against the targeted insect pests of forestry and agriculture crops at laboratory, nursery and field level.

Hydrology

CIA study of Sutlej basin was completed by ICFRE. The study report has been accepted by the expert appraisal committee of MoEF&CC.

ICFRE has been entrusted by NAEB for "Preparation of Detailed Project Report (DPR) for Rejuvenation of Major Indian Rivers through Forestry Interventions" for 13 rivers namely Beas Brahmaputra, Cauvery, Chenab, Godavari, Jhelum, Krishna, Luni, Mahanadi, Narmada, Ravi, Sutlej Yamuna of the country. This is a flagship project of the MoEF&CC, New Delhi. During the year draft reports for Luni and Narmada rivers were finalised. Website of Detailed Project Report (DPR) for rejuvenation of major rivers in the country through forestry interventions has been developed. A web Application for the same was also developed.

Centre of Excellence

Hon'ble Prime Minister of India Shri Narendra Modi ji during Fourteenth Conference of Parties (COP-14) to UNCCD at Greater Noida, NCR on 9 September 2019 announced to set up a Centre of Excellence at ICFRE to promote South-South cooperation to develop scientific approach and facilitate induction of technology on land degradation issues.

Forestry Education

ICFRE is playing pivotal role in the field of forestry education. At the FRI deemed to be University masters degree courses are being run in 04 disciplines. Research is also being pursued by the students for Ph.D. degrees. 25 Research Scholars have been registered for Ph.D. and a total of 41 Ph.D. degrees have been awarded. 274 trainings were organised to educate 12853 stakeholders including researchers, scientists, students, officials etc.

Green Skill Development Programme (GSDP)

ICFRE is conducting trainings under Green Skill Development Programme (GSDP) of MoEF&CC under ENVIS scheme. During the year 2019-20, 15 trainings were conducted for 286 participants out of which FRI-ENVIS conducted 12 trainings for 222 participants across the ICFRE institutes while IFGTB-ENVIS conducted 3 trainings for 64 participants.

Consultancies

ICFRE extended scientific consultancy services on various environmental aspects during the year for preparation of reclamation and rehabilitation plans for iron ore mines, monitoring and evaluation of catchment area treatment plans and afforestation plans, cumulative environmental impact assessment of hydroelectric projects in Sutlej river basin, environmental performance evaluation, indexing and environmental audit of coal mines, biodiversity assessment studies with respect to coal and iron ore mines for different stakeholders in the country. The stakeholders included Karnataka State Official Authority, Tehri Hydro Development Corporation India Ltd, NTPC Ltd Noida, MoEF&CC GoI, New Delhi, Coal India Limited, Kolkata, National Mineral Development Corporation Ltd, Hyderabad, Singreni Collieries Company Ltd., Kothagudem, Chhattisgarh Forest Department, Raipur and Department of Forest and Environment, Bhubaneswar.

Enhancing the Outreach

Dissemination of technologies developed by the Council to the intended target groups including farmers, SFDs, entrepreneurs, industries, rural poor and unemployed youth is a continuous process through various extension activities / programmes. This year ICFRE organized 191 Symposia, seminars, workshops etc. in which 9798 persons participated. Under Van Vigyan Kendras, 62 trainings were carried out for 4760 participants including farmers, SFD personnel and other stakeholders.

Prakriti

Prakriti, a scientist–student connect programme, is operational with Kendriya Vidyalaya Sangathan (KVS) and Navodaya Vidyalaya Samiti (NVS) through all ICFRE institutes across the country. During the year, over 25,000 students and teachers from 232 KVs, 38 JNVs and 151 other schools and colleges situated in different parts of the country have been educated/awared through various programmes spreading over 259 days.

Tree Growers Mela

IFGTB, Coimbatore organized Industrial Tree Growers Mela on 22 October 2019 at Jayankondam, Ariyalur in collaboration with Tamil Nadu Newsprint & Papers Limited (TNPL), Karur. About 450 tree growers/farmers from Tamil Nadu participated in the Mela. A two days "Tree Growers Mela" was organized at IFGTB, Coimbatore on 10 and 11 March 2020 in which 1000 tree growers, farmers, etc. participated.

HFRI, Shimla in collaboration with Agriculture and Forest Department, Leh organized a Kisan Mela at Leh on 6 September 2019, in which more than 135 people including farmers, foresters, NGOs etc. participated.

CYCUS-a Farmer's Friendly Mobile App

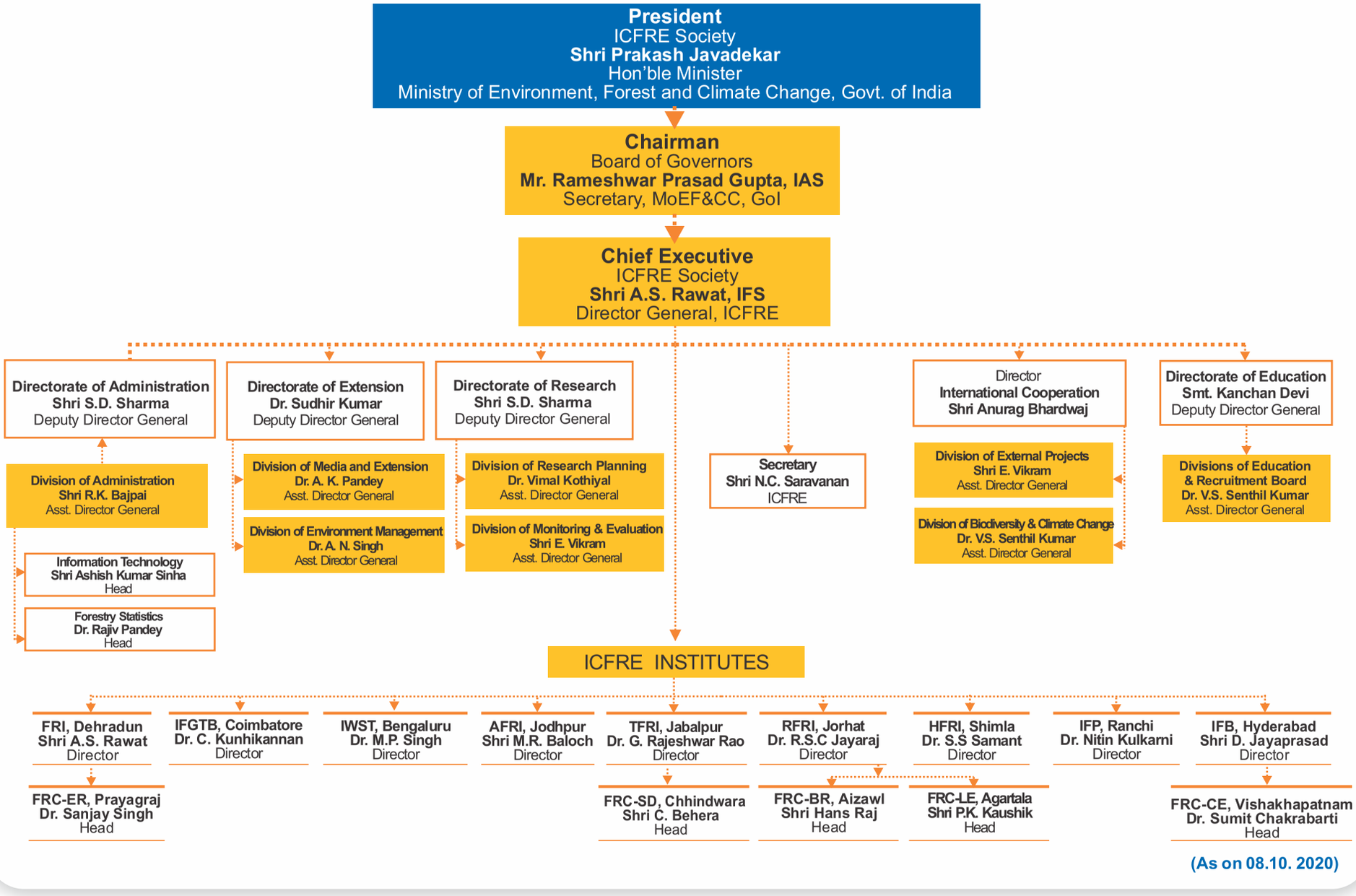
A farmer's friendly mobile app was released on 22 October 2019 in the Tree Growers Mela. In this App only 5% of sampling needs to be done for estimation of yield of standing crop. This mobile app is now available in Google Play Store as "CYCUS" – which stands for Casuarina Yield Calculating Utility Software.

Collaborations

To expand its outreach, ICFRE entered in active cooperation with other organizations like International Union of Forest Research Organizations (IUFRO), Vienna; National Institute for Entrepreneurship and Small Business Development (NIESBUD), Noida; G.B. Pant National Institute of Himalayan Environment (NIHE), Almora; Indian School of Business (ISB), Hyderabad etc. through Memoranda of Understanding.

New bilingual websites of ICFRE were redeveloped as per the Guidelines of Indian Government websites (GIGW).

ORGANIZATIONAL STRUCTURE OF ICFRE SOCIETY



(As on 08.10. 2020)

1 CHAPTER

INTRODUCTION

INTRODUCTION

Indian Council of Forestry Research and Education (ICFRE) is an autonomous organization under the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India with 9 research institutes located at Bengaluru, Coimbatore, Dehradun, Hyderabad, Jabalpur, Jodhpur, Jorhat, Ranchi and Shimla and 5 research centres located at Agartala, Aizawl, Chhindwara, Prayagraj and Visakhapatnam. The Hon'ble Union Minister of Environment, Forest and Climate Change is the President of ICFRE society and the Director General is its Chief Executive. The General Body is the supreme authority of the ICFRE, headed by the Union Minister, Environment, Forest and Climate Change, Government of India. Its members consist of serving and retired officers from various state governments, educational institutes, and scientific organizations.

ICFRE, an apex body in the national forestry research system has been undertaking holistic development of forestry research through need-based planning covering all aspects of forestry.

57th Board of Governors Meeting

The 57th meeting of the Board of Governors (BoG) of ICFRE was held under the chairmanship of the Secretary, MoEF&CC on 16.12.2019 in the Board Room of Forest Research Institute, Dehradun.

DG, ICFRE briefed the members on the salient achievements of the council during the past one year. The agenda items were then discussed *ad seriatim*.

The Board approved the draft Annual Report of ICFRE for the year 2018-19 and also the Audited Annual Accounts for the year 2018-19.

Chairman, BoG while highlighting the contributions of the Council expressed confidence that the Council will serve as a knowledge base for the Ministry and urged to guide forestry innovation in the country, especially on the relationship of people and forests.

He also emphasized on the extension of the research activities by strengthening the VVKs and to develop partnerships with leading industries for adoption and upscaling of the technologies developed.

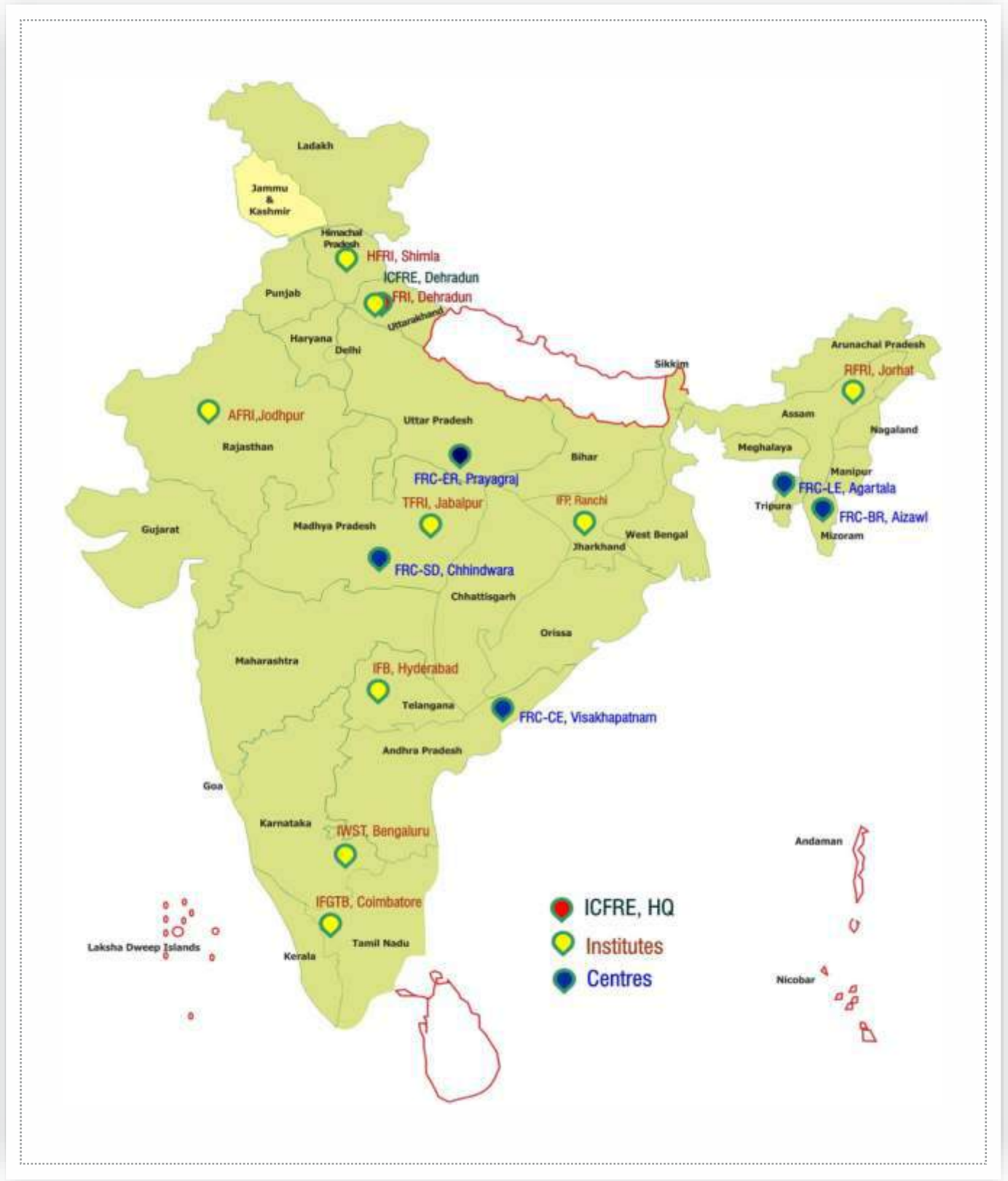
Vision

To achieve long-term ecological stability, sustainable development and economic security through conservation and scientific management of forest ecosystems.

Mission

To generate, advance and disseminate scientific knowledge and technologies for ecological security, improved productivity, livelihoods enhancement and sustainable use of forest resources through forestry research and education.

ICFRE - NATIONAL PRESENCE



Professional Support

ICFRE has extended collaboration with a number of national and international organizations to achieve greater outreach and cooperation through MoUs including following:

ICFRE with

- International Union of Forest Research Organizations (IUFRO), Vienna signed on 07 February 2020
- Indian School of Business (ISB), Hyderabad signed on December, 2019
- National Institute for Entrepreneurship and Small Business Development (NIESBUD), Noida signed on 14 November 2019
- G.B. Pant National Institute of Himalayan Environment (GBPNIHE), Almora on 19 October 2019
- Chinese Academy of Forestry (CAF), China
- Coal India Ltd.

FRI, Dehradun with

- M/s Tirupati Earth & Project Works Pvt. Ltd.
- ICAR-Indian Institute of Soil and Water Conservation (IISWC), Dehradun

Signing of MoU with IISWC, Dehradun

TFRI, Jabalpur with

- NABARD, Bhopal
- Orient Paper Mills, Amlai

AFRI, Jodhpur with

- CAZRI, Jodhpur

MoU on Luni River DPR being signed by Sh. M.R. Baloch, IFS, Director AFRI and Dr. O.P. Yadav, Director CAZRI, Jodhpur

IFGTB, Coimbatore with

- Telangana State Forest College & Research Institute, Hyderabad
- Tamil Nadu Forest Plantation Corporation (TAFCORN)
- College of Forestry, Ponnampet
- Tirupur City Municipal Corporation

IWST, Bengaluru with

- Maharashtra Bamboo Development Board (MBDB), Nagpur
- Sandalwood Society of India
- Hitachi India Pvt. Ltd.
- Spectrus Sustainable Solutions Private Limited
- Karnataka Forest Department

IFB, Hyderabad with

- Andhra Pradesh State Biodiversity Development Board.
- NBRI, Lucknow; University of Hyderabad, Hyderabad; S.V. University, Tirupati and BIOTRIM, Tirupati

New Collaborations in Pipeline

ICFRE with

- State Forest Departments with ICFRE Institutes
- National Institute of Hydrology (NIH), Roorkee
- Beijing Forestry University (BFU), Beijing
- Forestry and Environment Research, Development and Innovation Agency (FOERDIA), Indonesia
- Brazilian Forest Services (BFS), Brazil
- Kasetsart University (KU), Thailand
- Botanical Survey of India (BSI), Kolkata
- Wildlife Institute of India (WII), Dehradun
- International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
- Swedish Forest Agency (SFA), Sweden

Regional Research Conferences (RRCs)

Regional Research Conferences (RRCs) organized by various ICFRE institutes in 2019-20 are as follows:

RRCs organized in 2019-20

Sl.No.	Date	Conference	Location	Organizing institute
1	03 June 2019	Forestry Needs of Northern Indian states	Lucknow	FRI, Dehradun
2	17July 2019	Regional Research Conference	Hyderabad	IFB, Hyderabad
3	23 Aug 2019	Regional Research Conference (Central and Western Zones)	Jabalpur	TFRI, Jabalpur
4	04 Nov 2019	Regional Research Conference: North eastern region	Guwahati	RFRI, Jorhat
5	20 Nov 2019	Management of fragile ecosystems in climate change scenario	Coimbatore	IFGTB, Coimbatore

Visit of Dignitaries

- U.S. Ambassador to India Mr. Kenneth I. Juster with other US Embassy officials visited FRI, Dehradun on 1 May 2019.
- Shri. R. Kamalakannan, Hon'ble Minister for Agriculture & Farmers Welfare, Education & DRDA, Govt. of Puducherry visited IFGTB on 15 July 2019.
- International Union for Conservation of Nature (IUCN) President Mr. Zhang Xinsheng visited FRI, Dehradun on 14 November 2019.
- His Highness Sultan of Kedah, Malaysia visited FRI, Dehradun on 19 November 2019.
- Shri S. Niranjan Reddy, Hon'ble Minister for Agriculture, Telangana visited IFB, Hyderabad on 18 December 2019.

Mr. Zhang Xinsheng President of International Union for Conservation of Nature (IUCN) visited FRI, Dehradun

U.S. Ambassador to India Mr. Kenneth I. Juster visited FRI, Dehradun

2 CHAPTER

RESEARCH HIGHLIGHTS

2.1 ECOSYSTEM CONSERVATION AND MANAGEMENT

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	13	23	08
Externally Aided	12	29	19

2.1.1 Climate Change

Effect of altitude and seasons on soil respiration, bacterial communities and enzyme activities in Uttarakhand (FRI)

Soil samples were collected at different altitudes (500 to >1,500m amsl) from different forest types of Uttarakhand. Soil respiration rate declined during dry summer season (April–June) and increased rapidly during the rainy season (July–September); moderate fluxes were recorded during other months. Significant difference was observed in soil respiration rate seasonally but not among different forest types. It was observed that the microbial status of mixed forest and oak forest soil was better than other forest types. The bacterial population decreased during winter season in all the forest types. Major species of bacteria isolated were *Azotobacter* sp., *Azospirillum* sp., *Pseudomonas putida, Clostridium* sp., *Klebsiella* sp., *Bacillus* sp., *Staphylococcus* sp., *Streptococcus* sp. Significant variation in soil enzyme activities which decreased with increasing soil depth in all the forests was also recorded; dehydrogenase and phosphatase enzymes were overall higher in rainy season.

Predicting climatically suitable future habitats for the range-restricted Himalayan bird using species distribution modeling approach (FRI)

The study was carried out to predict the impact of climate change on current and future habitat suitability

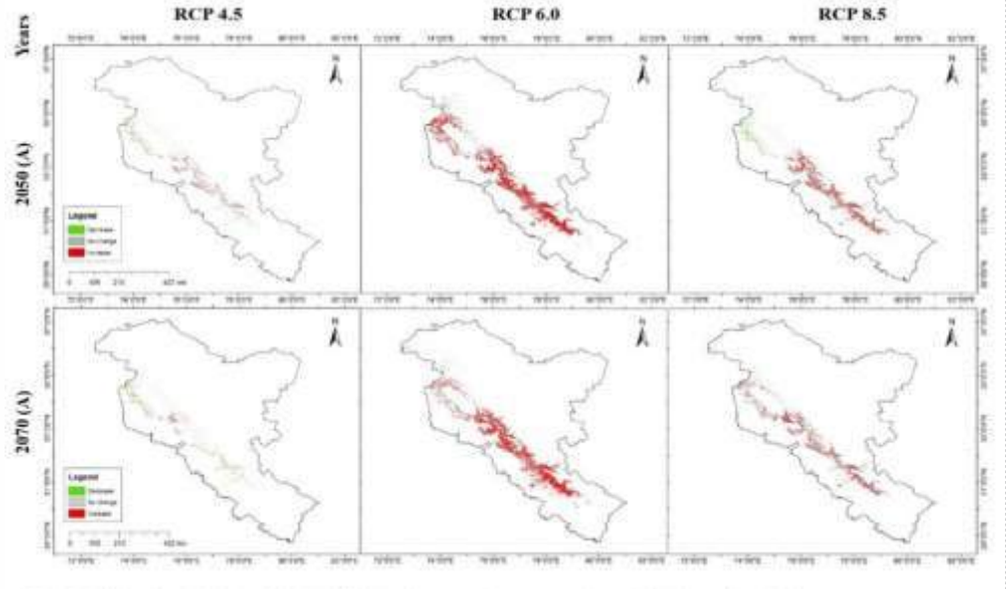


Figure: Prediction of suitable future habitat of Western Tragopan (*Tragopan melanocephalus*) in various RCPs

of Himalayan range-restricted bird species viz., *Catreus wallichii, Tragopan melanocephalus* and *Sitta leucopsis* in the UT of Jammu &Kashmir, and the western Himalayan states Himachal Pradesh and Uttarakhand. Modeling of habitats suitability in current as well as future climatic scenarios of IPCC represented by representative concentration pathways (RCPs) viz. RCP 4.5, RCP 6.0 and RCP 8.0 were assessed for the year 2050 and 2070. The results showed that the habitat of *Tragopan melanocephalus* would shift towards higher elevations in eastern regions by expanding ~25 to 55% habitat area under different RCPs.

Carbon sequestration through afforestation at Rourkela Steel Plant, Odisha (TFRI)

Assessment of carbon stocks and annual carbon sequestration was carried out in 42.12 lakh trees of different species planted during the years 1958 to 2014 covering 1,013 ha area at Rourkela Steel Plant, Odisha. Results indicated an annual increase of 5.46 t/ha in carbon stocks from 144.28 t/ha to 166.11 t/ha during four years period, increase in average girth at breast height of trees to 8.37 cm and carbon content per tree to 11.84 kg and decrease in the number of trees in the plantations with an annual mortality rate of 0.84%. In the year 2019, carbon content in the total survived trees was calculated to be 1,68,271 MT, with maximum in *Tectona grandis* followed by *Alstonia scholaris* and *Cassia siamea* trees.

Carbon sequestration potential of existing land-use systems in Lahaul Valley, Himachal Pradesh (HFRI)

The study was conducted for Deodar, Kail and Juniper forest, Poplar plantation, pure agriculture, agri-silviculture, and agri-horticulture land-use systems of Lahaul valley. The biomass and carbon trend across different land use systems recorded was Kail forest (594.45 tha^{1})>Deodar forest (468.94 tha^{-1}) > Poplar plantation (219.21tha^{-1}) >Juniper forest (207.12tha^{-1})>agri-silviculture system (78.95 tha^{-1})>agri-horticulture system (64.37 tha^{-1})> agriculture system (7.980 tha^{-1}). Similar trends were observed in the biomass carbon stock. However, the soil carbon stock under various land use systems was: Juniper forest (77.39 tha^{-1}) >pure agriculture system (74.88 tha^{-1}) >Kail Forest (69.23 tha^{-1}) >Poplar plantation (67.20tha^{-1})> agri-silviculture system (60.98 tha^{-1})>agri-horticulture system (57.85 tha^{1})>Deodar forest (50.39 tha^{-1}).

Estimation of soil carbon stock in Betla National Park and Dalma Wildlife Sanctuary in Jharkhand (IFP)

Highest soil organic carbon was recorded under *Holoptelea integrifolia* dominated forests (25.05 tha^{-1}) while the lowest (7.9 tha^{-1}) was recorded in *Buchanania lanzan* dominated forests in Betla National Park. Similarly, in Dalma Wildlife Sanctuary the maximum soil organic carbon stock was recorded under *Gmelina arborea* dominated forests (53.3tha^{-1}) and minimum under *Albizzia lebbeck* dominated forests (22.7 tha^{-1}). The overall soil organic carbon-stock in Betla National Park and Dalma Wildlife Sanctuary area were estimated to be 1.02 million tonnes and 1.35 million tonnes, respectively. Dalma Wildlife Sanctuary - though smaller in area - has 0.33 million tonnes more soil organic carbon than Betla National Park.

Phyto-diversity and carbon stock assessment of trees outside forests in Assam using remote sensing and GIS (RFRI)

Common tree species recorded outside the forest in Barak valley of Assam are *Albizia procera, Albizia saman, Areca catechu, Artocarpus heterophyllus, Cocos nucifera, Hevea brasiliensis, Lagerstroemia speciosa, Mangifera indica, Neolamarckia cadamba* and *Senna siamea*. In the home gardens of Central Brahmaputra Valley Zone, *A. catechu, A. procera, M. indica* and *Tectona grandis* are the preferred species while in lower Brahmaputra valley zone *A. catechu, A. heterophyllus* and *Gmelina arborea* are also planted with *M. indicaand T. grandis*. In patch vegetation, *L. speciosa, Shorea robusta, G. arborea* and *T. grandis* were the most common species. Average tree biomass carbon was 83.52 tha^{-1} for tea gardens, 122.65 tha^{-1} for home gardens, 128.54 tha^{-1} for patch vegetation, 137.61 tha^{-1} for plantation and 196.71 $tha^{-1}$for roadside trees.

Carbon sequestration and Carbon dioxide emission from the soils under different forest covers in Uttarakhand (FRI)

Average values of preliminary data recorded from different forest covers/types so far revealed higher CO_2 emissions in sal vegetation (3.14 μmol $CO_2m^{-2}sec^{-1}$) as compared to chirpine vegetation (2.98 μmol $CO_2m^{-2}sec^{-1}$). These average higher values of carbon dioxide emission in sal vegetation correspond to the average higher soil temperature 20.28^{0}C and soil moisture 28.61%. Soil organic carbon in chirpine vegetation ranged from 0.97 to 5.5% and in sal vegetation ranged from 0.54 to 2.713%. The decrease in soil organic carbon due to intensive forest management, increased carbon mineralization led to higher carbon dioxide emission rate. Promoting soil carbon sequestration is an effective strategy for reducing atmospheric CO_2 and improving soil quality.

2.1.2
Ecology& Environment

Ecological studies in alpine pastures of district Shimla, Himachal Pradesh (HFRI)

Floristic, phyto-sociological and biomass studies were carried out in Hatu and Chansel alpine pastures during pre-monsoon, monsoon and winter seasons. During pre-monsoon season, at Hatu and Chansel pastures number of plant species found were 56 and 74 with dominance of *Anemone tetrasepala* (Badiratni) & *Potentilla atrosanguinea* (Bajradanti), respectively. The value of Diversity Index for Hatu and Chansel was 3.16 and 3.50, respectively. The value for above ground and below ground biomass at Hatu was 2.42 t/ha and 4.88 t/ha whereas at Chansel value was 2.60 t/ha and 5.85 t/ha, respectively.

Alpine pasture Chansel

Caltha palustris

During monsoon season, at Hatu and Chansel pasture number of plant species were 64 and 100, with dominance of *Senecio graciflorus* (Graceful senecio) and *Anaphalis contorta* (Bukiphool), respectively. The value of Diversity Index for Hatu and Chansel was 3.42 and 3.69, respectively. The value for above ground and below ground biomass at Hatu was 3.24 t/ha and 6.18 t/ha, whereas at Chansel the value was 3.48 t/ha and 6.26 t/ha, respectively.

Jurinea dolomiaea

During winter season, number of plant species at Hatu and Chansel pasture were 40 and 42 with dominance of *S. graciflorus* and *P. atrosanguinea,* respectively. The value of Diversity Index for Hatu and Chansel was 3.27 and 3.32, respectively. The value for above ground and below ground biomass at Hatu was 1.57 t/ha and 3.10 t/ha whereas at Chansel value was 1.36 t/ha and 3.16 t/ha, respectively.

Reclamation of coal mined land of North Eastern coalfields, Assam through soil amendment and revegetation with native plant species using integrated biological approach(RFRI)

A demonstration model for Eco-restoration of Mine overburden dump was established at Tikak Colliery, Margherita (Assam). Seedlings of 36 native plant species were planted in Tikak Colliery Over Burden Dump. In addition, *Melocanna baccifera, Bambusa multiplex, Thysanolaena maxima* and *Vetiveria zizanoides* were also planted. Seed balls of *Crotalaria striata, Thysanolaena maxima* and *Dicranopteris linearis* were sown in the three-tier model of plantation.

Studies on natural regeneration, diversity, and distribution of soil seed banks and their relationship with above-ground vegetation in the watershed of sacred Khecheopalri Lake of Sikkim (RFRI)

A total of 173 plant species were documented. Among different forest communities, species richness followed an order of mixed broadleaf (169 species) >swamp (58 species) >*Alnus nepalensis* forest (43 species)> *Cryptomeria japonica* plantation (35 species). Similarly, in terms of diversity indices, broad leaved mixed forest was the most diverse community while the least diverse was *Cryptomeria japonica* plantation. A total of 56 plant species were documented from the germination experiment of soil seed bank. The species richness in the soil seed bank followed an order of Mixed Broadleaf Forest (52 species) >*Alnus nepalensis* Forest (26 species)>Swamp/Bog (24 species)>*Cryptomeria japonica* plantation (19 species). Highest seed density (seeds m^{-2}) was recorded in Swamp/Bog (63,325) while the lowest density was recorded in *Alnus nepalensis* Forest (10,374).Of the recorded 98 tree species, regeneration of 29 % was good, 32% fair, 22% species were not regenerating while 3% species were immigrants or new in forest of KPL.

Biodiversity, regeneration and life history feedback of forest communities in response to canopy openings under selection-cum-improvement felling system(TFRI)

Impact of canopy opening on population structure and community composition under selection-cum-improvement (SCI) felling system was studied to assess its influences on floral diversity and regeneration. Three compartments each in different forest types (*Shorea robusta* – Sal; *Tectona grandis* – Teak; Mixed Deciduous) were selected and 90 permanent quadrats of 0.1 ha were laid out. Pre-felling and post-felling data on species diversity and regeneration was collected in these plots. Fortyone tree species were recorded to be regenerating in SCI site, of which 20 species were represented in the canopy of the forest. *Anogeissus latifolia*, a characteristic deciduous tree, was found to be dominant among the regeneration at SCI site. A total of 27 tree species in the understorey were recorded to be regenerating in control site and, unlike SCI sites, these sites were not dominated by a single species.

Understanding plant-water relations to annual weather fluctuations in dominant forest tree species in Madhya Pradesh (TFRI)

Sap flow pattern assessed over two years period for three seasons (summer, rainy and post-monsoon) in two girth classes (10-30 cm and 30-60 cm) of teak revealed that stems with lower girth class had high sap flow compared to that of higher girth class, indicating the variability in water potential. The rate of flow (flux) was observed to be higher in the heartwood and lesser in the sap wood for lower girth class, while it was the reverse for stem with higher girth class. Sap flows were stable before rainfall but started to fluctuate after rainfall. The effect of climate change on forests is one of the emerging concerns across the world. Such studies on tree water relationship can be used to track how trees and forests respond to changes in the climate.

Sap flow meter installation on *Tectona grandis* tree

Assessment of hydrological services imparted by forests of Kempty watershed (Mussoorie) (FRI)

The maximum discharge (0.061m^3/s) of the stream was measured during July and August 2019, the period of maximum rainfall in the study area(1,005 mm and 1,249 mm during July and August, respectively). The CO_2 emission at the elevation of 1,700 m, 1,800m, and 1,900 m for North, East, and South aspects were recorded. Maximum CO_2 emission (121 t/ha/year) was recorded at 1,800 m elevation for East facing whereas it was minimum (54 t/ha/year) for North facing at this elevation. Overall, average CO_2 emission of this watershed was observed 95 t/ha/year.

Studies on restoration and species recovery in a red listed (globally near threatened) mangrove *Ceriops decandra* (Griff.) Ding Hou (IFGTB)

Ceriops decandra is a landward under-shrub yellow mangrove species belonging to the family Rhizophoraceae. The study comprehended some of the anthropogenic stresses for localized extinction of *C. decandra* in Tamil Nadu across three locations (Pichavaram, Muthupettai and Kizhavanjore).

Ceriops decandra propagules in post fertilization developmental stages

Anthropogeny-induced habitat fragmentation seems to be major reason for local extinction in Kizhavanjore (10°79'N to 79°84'E). Species recovery can be performed through controlled pollination as the target species suffers pollinator limitation. Vegetative propagation is also being attempted in the target species.

Ceriops decandra functional male plant-bud and propagule abortions

2.1.3
Biodiversity

Improving the traditional homestead to a viable agro-forestry system for biodiversity conservation and inclusive growth of Khampti tribe of Namsai district, Arunachal Pradesh (RFRI)

Socioe-conomic surveys were conducted in five villages of Khampti tribes of Namsai district of Arunachal Pradesh. The plant species preferred by the local communities for agroforestry were *Acacia catechu* (Khair), *Areca catechu* (Tamul), *Aquilaria malaccensis*(Agar), *Ananus comosus* (Mati Kothal), *Albizia chinensis* (Shaw), *A. lucidor* (Moj), *Averrhoa carambola* (Kordoi), *Baccaurea ramiflora* (Leteku), *Citrus aurantifolia* (Kajinemu), *C. limon*(Komola), *Dalbergia sissoo* (Sisu), *Cinnamomum zeylenicum* (Dalcheni), *Lawsonia inermis* (Jetuka), *Piper betle* (Pan), *P. nigrum* (Jaluk), *Sapindus mukorossoi* (Manishal), *Phyllantus emblica* (Amlakhi), *Zizyphus mauritiana* (Aplebogori), *Zingiber officinalis* (Ada), *Curcuma longa* (Halodhi) and *Schumannianthus dichotomos* (Patidoi)

Socio-economic survey at Old Mohong Village, Lekang (Mahadevpur) Circle, Namsai district, Arunachal Pradesh

Molecular characterization of selected medicinal plants of Uttarakhand (FRI)

Aconitum heterophyllum, Aconitum balfourii, Dactylorhiza hatagirea, Paris polyphylla and *Saussurea costusare* threatened medicinal plant species of Indian Himalayan region with declining status demanding urgent conservation. Taxonomically authenticated plant samples of these selected species were collected from various parts of Uttarakhand and different genetic populations were identified using molecular markers (ISSR markers). Short section of DNA from specific genes (unique Barcode sequences) was sequenced and database has been developed for all selected species and their populations. This database will be useful as future reference to identify these species from tiny amounts of DNA material.

Collection of *Aconitum balfourii* samples

Laying of Transect in Sunderdunga (Bageshwar), Uttarakhand

Conservation of *Litsea glutinosa* – an endangered and threatened medicinal tree of North-West Himalayas (FRI)

Natural populations of *Litsea glutinosa* (Maida lakri) were identified in Uttarakhand, Himachal Pradesh and Haryana and their database has been prepared for mapping. Seed production was found very low due to heavy lopping of species for fodder. Fruits were collected in September – October and seeds were extracted manually. Seeds were treated with Bavistin @ 0.2% before sowing. Seed germination was completed in six weeks with 30.04 % germination. However, seeds treated with gibberellin (500 ppm) showed 41.48 % germination. Cuttings obtained from juvenile plants having 10-15 cm length with 4-5 nodes and 0.80 cm to 1.00 cm thickness were planted in vermiculite medium under the mist chamber at 25 - 35°C with 70% RH which gave 43 % rooting.

Assessment of plant biodiversity of Silent Valley Buffer zone(IFGTB)

Reconnaissance Surveys were done in different locations in the buffer zone and adjacent areas of Silent Valley National Park. More than 1,850 specimens were collected, 1,388 herbarium sheets were prepared and 560 species were identified. 30 species were recorded as threatened as per the IUCN Red List. Two species viz., *Dianella ensifolia* (L.) Redouté and *Euonymus crenulatus* Wall. ex Wight & Arn. were recorded as a new report to the flora of Palakkad district, Kerala.

Studies on maturation and viability of seeds of five important tropical species: *Adina cordifolia, Mitragyna parviflora, Lannea coromandelica, Ougeinia oojeinensis* and *Anogeissus acuminata* for effective collection and seed storage (TFRI)

Studies revealed that *L. coromandelica* seeds have physiological dormancy which can be avoided by premature collection. Seeds of *A. accuminata* had very low germination (2-5%). Seeds of all the species were categorized as orthodox species. It was determined that viability of *A. cordifolia, M. parviflora* and *L. coromandelica* seeds can be maintained upto one year at ambient temperature if stored at 3-5% moisture content. Viability of *O. oojeinensis* can be maintained for two years if stored at low temperatures (15°C to -20°C) at 3-5% moisture.

Study of flora and fauna of Raj Bhawans of Rajasthan (AFRI)

At Raj Bhawan Jaipur, 205 plant species belonging to 63 families and 156 genera (68 trees, 87 shrubs, 16 climbers, 29 herbs, 14 grasses,2 sedge species) were reported. At Raj Bhawan Mount Abu, 293 plant species belonging to 70 families and 214 genera (59 tree species, 70 shrub species, 27 climbers, 94 herbaceous species, 36 grass species, 5 sedge species and two ferns) were recorded. Seventy-eight species were common to both the Raj Bhavan areas.

Assessment, documentation and characterization of lichen diversity in Tripura (RFRI)

A total of 124 lichen species have been identified from Tripura. Low lying areas of altitudinal range 0-500 m are predominantly characterized by crustose lichen communities with genera such as *Caloplaca, Chrysothrix, Cryptothecia, Glyphis, Graphis, Pertusaria, Pyrenula* etc. Genera such as *Arthonia, Bacidia, Buellia, Bulbothrix, Caloplaca, Cladonia, Coccocarpia, Collema, Dirinaria, Flavoparmelia, Haematomma, Heterodermia, Lecanora, Leptogium, Letroutia, Parmotrema, Pyxine,* etc. are of common occurrence in the altitudinal range of 500-1000 m. *Cryptothecia striata* was one of the most abundant crustose lichens of Tripura occurring on tree bark and leaves, iron poles, cement walls, etc. *Dirinaria aegialia* is another dominant sub-foliose species. Leaves of under-storey plants in thick forests were occupied by follicolous lichens such as *Strigula elegans, Calopadia* etc. *Multiclavula mucida* is the new record of basidio-lichen for India.

Exploration and utilization of wild mushroom diversity in Mizoram (RFRI)

153 mushroom species (including 47 edible and 10 non-edible) belonging to 16 orders, 41 families and 58 genera were documented. Total 103 mushroom species were reported for the first time from Mizoram whereas, 12 species have been reported for the first time from India.

Cookeina tricholoma

Calvatia booniana

Assessment of floristic diversity in Tundah Wildlife Sanctuary of district Chamba, Himachal Pradesh for its long-term ecological monitoring (HFRI)

View of Tundah Wildlife Sanctuary, Chamba (HP)

233 plant species belonging to 176 genera and 76 families were recorded in the sanctuary. The dominant families were Asteraceae, Apiaceae, Fabaceae, Lamiaceae, Rosaceae, Geraniaceae, Polygonaceae, Pinaceae, Ranunculaceae and Acanthaceae. The maximum species were recorded in Lamba pahad (145), followed by Dughi Dhar (132), Tarun Dhar (128), Tandi Dhar (125), Thanala Forest (123), Janu Dhar (117), Mumber Dhar (116), Chharola Forest (105) and Liyundi Dhar (75). Out of 113 medicinal plants recorded, 20 species fall in threatened category. The ethnobotanical study in 14 villages in and around the sanctuary documented 107 plant species used for different purposes.

Rhododendron lepidotum

Bergenia ciliata

Assessment of vegetation in Kibber Wildlife Sanctuary, district Lahaul-Spiti, Himachal Pradesh (HFRI)

116 plant species including 9 species of shrubs and 107 species herbs were recorded in 12 selected sites in the sanctuary. The species showed contiguous distribution pattern. Asteraceae was recorded as dominant family followed by Fabaceae and Rosaceae. *Caragana versicolor* was the dominant community. Out of 107 herbs, four species i.e. *Arnebia euchroma* (Ratanjot), *Bergenia stracheyi* (Pashanbhed, Paatherchatta), *Physochlaena praealta* (Langthang) and *Rhodiola heterodonta* (Churupa) were found threatened in the sanctuary. The status of Rheum *spiciforme* (Lachhu) is near threatened.

Study site Racholakmo

Studies on diversity and host range of hymenopteran egg parasitoids from northern India (Haryana, Uttar Pradesh and Uttarakhand) (FRI)

345 samples of insect fauna were collected from Haryana, Uttar Pradesh and Uttarakhand. 26 species have been identified, out of which three species i.e. *Lathromeroidea deoriaensis, L. indica* and *Haeckeliania singularis* are new to science.

Out of 236 samples of insect eggs, parasitoids have emerged from eleven samples. Parasitoids include *Trissolcus* sp., *Telenomus* sp., *Euderus* sp., *Ooencyrtus* sp. and *Trissolcus* sp.

Digitization and enrichment of National Forest Insect Collection (NFIC) of Forest Research Institute Phase-II (minute insects) (FRI)

Digitization of 1,200 reference species of the orders Coleoptera, Diptera, Hemiptera, Hymenoptera, and Lepidoptera of NFIC has been completed. 50 types of Bethylidae, Chrysididae, Drynididae and Formicidae which were considered lost as per taxonomic literature were rediscovered. All the types were revised taxonomically with their detailed photographs.

Butterflies associated with different forest types/sub-types in Uttarakhand (FRI)

Information on 220 species of butterflies in 23 forest sub-types of Uttarakhand was recorded. The study revealed the occurrence and association of the scarce lilac-fork *Lethe dura gammiei* with woolly-leaved oak *Quercus lanata* forest in the Kumaon region previously known from Sikkim eastwards. The occurrence of the rare Mountain Tortoise shell *Aglais rizana* from sub-alpine patch in Badrinath-Mana area of upper Garhwal was recorded after a gap of 100 years in Garhwal. Dark sapphire, *Heliophorus indicus* generally found in North-East India was recorded along the12/C1e Moist Temperate Deciduous Forest edge in Kedarnath Wildlife Sanctuary in Garhwal Himalaya.

The Scarce Lilacfork, *Lethe dura gammiei* (Lepidoptera: Nymphalidae: Satyrinae)

Diversity study of pteromalid (Hymenoptera: Pteromalidae) parasitoids of northern India with special emphasis on bioefficacy of some selected parasitoids(FRI)

24 species of pteromalid parasitoids of northern India were collected and identified, viz. *Anisopteromalus calandrae, Cephaleta chinensis, Dinarmus basalis, Eupristina* sp., *Eupristina vitricellata, Euneura* sp., *Halticoptera* sp., *Merismomorpha* sp., *Metastenus* sp., *Pachycrepoideus* sp., *Philotrypesis caricae, Propicroscytus mirificus, Propicroscytus* sp., *Ptromalus metalicus, Pteromalus puparum, Scutellista cyanea, Stictomischus* sp., *Syntomopus* sp., *Syntomopus* sp., *Sycophilodes* sp., *Theocolax elegans, Trichomalopsis travacorensis, Trichomalopsis* sp. and *Walkarella* sp.

Walkerella microcarpae

Ptromalus puparum

Propicroscytus mirificus

Taxonomic study of Tettigoniidae (Orthoptera) of India (Under All India Co-ordinated project on Taxonomy (AICOPTAX) (FRI)

North India

Surveys were conducted for collection of tettigoniids in the states of Uttarakhand, Uttar Pradesh, Haryana and Punjab. About 300 specimens were collected out of which 21 species were identified. Seven species viz.,*Conocephalus (Anisoptera) melaenus, Euconocephalus incertus, Hexacentrus major, Hexacentrus unicolor, Neoconocephalus retusus, Phaneroptera nana* and *Sathrophyllia rugosa* were recorded for the first time from northern India.

Tettigoniids collection in a forest near Joshimath, Uttarakhand

Specimens of Tettigoniids collected during tours of Uttarakhand

In grasslands, *Conocephalus maculatus* was the most abundant species while in scrub forests *Himertula kinneari* was the most frequently found species. *Mecopoda elongata* was the noisiest species in the wet tropical and sub temperate forests.

South India - IFGTB, Coimbatore

Tettigoniid faunal surveys were carried out in different habitats under 30 different agro-climatic zones in southern India. Thirty three species of tettigonids under 5 different sub-families viz., Phaneropterinae, Conocephalinae, Hexacentrinae, Mecopodinae and Meconematinae from Tamil Nadu were collected. Sixteen species from 11 genera from Karnataka have also been collected. Collected specimens were identified upto species level. Maximum diversity was observed in forest lands of Karnataka, Tamil Nadu and Kerala viz., 53.6%, 52.9%, and 44.7%, respectively. Minimum diversity was recorded in wastelands of Kerala, Tamil Nadu, and Karnataka i.e.,3.1%,1.8% &1.6%, respectively.

Taxonomic evaluation of Orthoptera (short horn grasshopper, katydids, crickets) was conducted in diverse habitats under 7agroclimatic zones of Tamil Nadu. 116 species of Orthoptera belonging to 59 genera under 22 sub-families were recorded. Two species new to science viz., *Trigonocorypaha thenensis* and *Trigonocorypha ponmanea* collected from forests in Theni and Coimbatore, respectively have been described.

Central India - TFRI, Jabalpur

Surveys were conducted in 9 agro-climatic zones: plains (Balaghat), northern hill zone (Mandla, Nivas), Kymore plateau and Satpura hills (Jabalpur, Katni, Seoni, Kundam), Vindhyan plateau (Sagar, Damoh), central Narmada valley (Narsinghpur, Hoshangabad), Satpura plateau (Chhindwara, Betul), Nimar valley (Khandwa, Khargone, Barwani) from Madhya Pradesh; Chhattisgarh plains (Bilaspur, Durg, Raipur) from Chhattisgarh and moderate rainfall zone (Nagpur and Gondia) from Maharashtra in five different habitats (agriculture land, barren land, grasslands, forest and plantations). A total of 401 insect specimens of family Tettigoniidae belonging to 21 species were collected and identified.

North East India - RFRI, Jorhat

Different agro-climatatic zones of North-eastern region were surveyed and different species of tettigoniids were collected, preserved and identified. A total of 20 species of tettigoniids was recorded. Out of the 20 species, 15 species were identified viz., *Ducetia japonica, Conocephalus maculatus Pheneroptera gracilies, Euconocephalus incertus, Hexacentrus unicolor, Linea dentata, Trigonocorypha unicolor, Conocephalus posticus, C. strictus, Neoconocephalus* sp., *Phyllozelus siccus, Sanaa impeiralis, Holochlora paradoxa, Phaneroptera falcata* and *Phaneroptera nana* etc.

Cecidology and nursery establishment of *Pistacia integerrima* for exploring of in-situ leaf gall production(FRI)

Studies were undertaken on the gall (Kakadsinghi) formation by the aphid *Baizongia pistaciae* and its intensity on *Pistacia integerrima* trees from April to October at the sites near Sayia (Chakrata). Mature winter migrants emerged from these galls reared for laying of Apterous virginoparae. Alates in the laboratory laid maximum of 12-16 nymphs. Apterous virginoparae were released on the raised alternate host plants during the first week of December. Three generations of Apterous virginoparae on roots of alternate host plant (December-March) were reared. Rearing of the aphid was completed and alate sexupare (spring alates) emerged from 15 March onwards. Sexupare lay 14-16 sexuals; with female : male ratio of almost 1:1.

Studies on taxonomy and host range of larval parasitoids, *Apanteles* spp. (Hymenoptera: Braconidae) from Uttarakhand and Haryana (FRI)

Eight species of *Apanteles: A. creatonoti, A. hyblaeae, A. nilamburensis, A. ruidus, A. calycinae, A. prodeniae, Apanteles neonephoptericis* sp. Nov. (reared from *Eutectona machaeralis*) and *A. phytometrae* have been identified. From rearing samples of larvae/cocoons, *Apanteles calycinae* emerged from shisham defoliator, *Plecoptera reflexa* and *Apanteles* nr. *ruidus* emerged from teak defoliator, *Hyblaea puera. Apanteles ruidus* also emerged from teak skeletonizer, *E. machaeralis*. Laboratory testing of *Apanteles ruidus* has been carried out against teak skeletonizer, *E. machaeralis* and shisham defoliator *Plecoptera reflexa*.

Apanteles ruidus

Apanteles cocoons on Hyblaea puera larva

Biodiversity, Habitat Association and GIS mapping of noctuid moths (Noctuidae: Lepidoptera) of chirpine forest of Jammu Province (Jammu & Kashmir) India (HFRI)

Sixty five species of noctuid moths collected from the chirpine forests of J & K Union Territory belonging to 46 genera in 17 families were identified on the basis of their genital structure. Database of noctuid moths was prepared with their taxonomical details and habitat distribution along with good quality images. The trend or changes in distribution pattern of noctuid moth species on the basis of biotic and abiotic factors was observed.

Auchmis inextricata (Adult)

A. inextricata (Male Genitalia)

A. inextricata (Ductus ejaculatorius)

Asota caricae (Adult)

Asota caricae (Tiger moth) (Male Genitalia)

A. caricae (Ductus ejaculatorius)

2.1.4

Forest Botany

Revision of Osmaston's Forest Flora for Kumaon for conservation and sustainable utilization (FRI)

Random sites of Nainital and Haldwani Forest Divisions were surveyed and data was collected on different taxonomical aspects. Taxonomical-cum-pictorial descriptions of 120 plant species were recorded. Local names, uses and nomenclature of recorded species were updated.

Haldina cordifolia

Ilex dipyrena

Falconeria insignis

Revision of Kanjilal's Forest Flora of the Chakrata, Dehradun and Saharanpur Forest Divisions, Uttar Pradesh for conservation and sustainable utilization (FRI)

Random sites of Chakrata Forest Division, Saharanpur Forest Division, and Kalsi Soil Conservation Division were surveyed, and data collected on different taxonomical aspects. Taxonomical-cum- pictorial descriptions of 119 plant species were recorded. Local names, uses and nomenclature of recorded species were updated.

2.1.5

Tribal and Traditional Knowledge System

Processing and value addition of Terminalias (IFGTB)

A survey was conducted in all 7 sub-ranges of the Coimbatore Forest Division in which 13 villages were identified where Terminalia NTFPs are being collected by the tribals belonging to the Irula community. Survey revealed that 25% of the people from these villages are involved in NTFP collection. Market survey was also conducted of 14 wholesale and retail raw drug dealers in and around Coimbatore district. The rate at which the myrobalans were procured from the tribals/contractors ranged from Rs. 30-80 per kg, whereas the selling price ranged between Rs. 40 to 150 per kg.

Biodiversity of Satpura agro-climatic region with special reference to insect and fungi dependencies of tribals (TFRI)

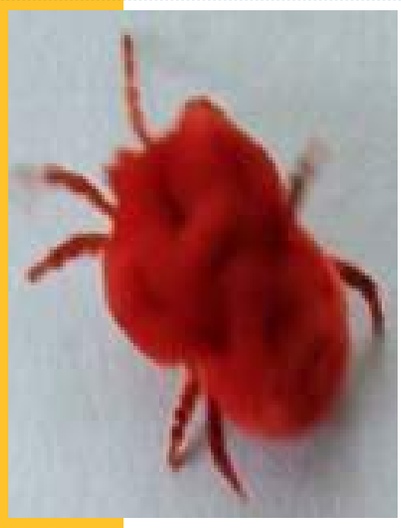
104 insects belonging to 36 families of the three orders Lepidoptera (20), Coleoptera (11) and Hymenoptera (05)

have been documented from Satpura plateau region of Madhya Pradesh. Diversity index (Shannon-Wiener) in East Chhindwara showed higher (2.986) diversity status of insect species. Documentation of 11 different species of insects: *Polistes carolina* (Tataiya), *Trombidium grandissimum* (Bir Bahuti), *Oecophylla smaragdina* (Lal chinti), *Apis dorsata* (Madhumakkhi), *Hieroglyphs banian* (Chidda), *Microtermes obesi* (Dimak), *Pachliopta aristolochiae* (Common rose), *Bombax mori* (Kosa kida), *Sceliphron* spp. (Mud Wasp), *Catharsius molossus* (Gober kida) of medicinal importance being used by tribals of Satpura plateau was done.

Twenty two species of fungi were collected from study area out of which 6 species viz., *Termatomyces* sp., *Sparassis* crispa, *Pleurotus* sp., *Lantinus* sp., *Agaricus campestris* and *Volvariella volvacea* were edible.

Termatomyces sp.

Caterpillars of *Pachliopta aristolochiae*



Trombidium grandissimum

Mylabris pustulata

Medicinal Plants and Herbs: Study on its uses amongst the tribal communities of Tripura(RFRI)

Documentation was carried out of 481 medicinal plants and herbs used by Chakma, Reang, Kuki, Tripuri, Halam, Garo, Kalai, Jamatia and Bhil tribes. Different crude formulations of medicinal plants and herbs used by tribals to cure about 20-25 diseases/ailments have been identified and documented. The process of treatment for each ailment, dosage and mode of administration have been documented for 9 tribal groups from 5 districts covering 4 forest divisions of Tripura.

Traditional Tribal Medicine Practices among the Tribes of Tripura (RFRI)

About 50 important medicinal plants and herbs used by Halam & Kuki communities in Khowai district of Tripura were documented. More than 20 diseases/ailments are treated using crude formulations prepared in the form of liquid tonic/extracts, tablets and pastes/ macerates from medicinal plants and herbs.

Preparation of People's Biodiversity Register for different blocks in Tripura (RFRI)

The People's Bio-Diversity Registers for 2 blocks namely Bamutia and Mohanpur were prepared and submitted to Tripura Biodiversity Board.

Documentation of the traditional ecological knowledge (TEK) and quantification of medicinal plants used by the Karbi tribe of Karbi Anglong hill district of Assam (RFRI)

Different traditional plant pest traps - *Celosia argentea, Chromolaena odorata, Bambusa tulda*; different fish gears made of *Bambusa tulda, B. balcooa* and piscicidal plants like *Polygonum glabrum, Catunaregum spinosa* and *Zanthoxylum* sp. were documented through surveys. *Clerodendrum viscosum, Scoparia dulcis, Croton persimilis, Lygodium* sp. were identified which are used in preparation of rice cake – an important ingredient of Karbi local liquor. Sorensen Similarity Index was used to compare the similarity in the use of similar medicinal plant species by Karbi and other four tribes of Assam, namely Dimasa, Boro, Mishing and Sonowal Kachari. The coefficient of similarity was found highest in Dimasa and Karbi tribe.

Important ingredients of Rice Cake which are used in making Karbi local liquor: Hor-alang/Hor-arak

Important piscicidal plants used by Karbis in fishing: the leaves/fruits/barks are threshed/crushed/pound & released in the steam to stupefy the fishes

2.2 FOREST PRODUCTIVITY

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	01	14	00
Externally Aided	05	12	03

2.2.1 Silviculture

Establishment of a Bamboo High Tech Nursery at Coimbatore (IFGTB)

Around 50,000 certified quality planting stock of bamboo have been maintained in the newly established Bamboo High Tech Nursery at Forest Campus, Coimbatore with the objective of making it available to different stake holders involved in bamboo cultivation.

Soil carbon sequestration potential in preservation plots in wet evergreen and moist deciduous forests in Central Western Ghats of Karnataka (IWST)

Assessment of carbon stocks and carbon storage in relation to size fractions of soil in preservation plots in central Western Ghats, adjoining agricultural and degraded lands was carried out. The study indicated that change of land use from permanent preservation plots to agriculture and then to degraded land could induce a sequential acidification and reduction in surface organic carbon through sheet erosion. Subsequent reduction in carbon sequestration potential in both the forest types, irrespective of the locations, resulting in an overall reduction in land quality was also observed.

Spatio-temporal landuse patterns at rural-urban interface and the relationship between green areas and biophysical features (IWST)

Diversity indices show high species diversity in urban domain than in rural and rural-urban interface. The reduction in tree species over time changed their density and frequency with slight rearrangement and few additions in tree species. The Importance Value Index (IVI) showed dominance of ornamental tree species in urban areas and religious/multi-purpose tree species in rural areas and at rural-urban interface. The Air Pollution Tolerance Index (APTI) showed that the tree species along the northern and southern transects are sensitive to air pollution with constant increase in surface temperature. Normalized difference vegetation index (NDVI) denoted the overall decline in tree vegetation indicating the necessity to protect, conserve and increase the existing green spaces along the gradient.

Study on ecophysiology of seed germination and seedling survival for restoration of natural regeneration of two threatened species of Central India (TFRI)

Viability of seeds of *Dalbergia latifolia* and *Litsea glutinosa* collected from Mandla district and Chhindwara district varied from 55-100% and 90-100%, respectively. Germination of the seeds of both the species was not affected by light and therefore these could be germinated in open or dense forests. *D. latifolia* seeds germinated at 20-35^{0}C. Fresh seeds of *L.glutinosa* were found to be characterized by physiological dormancy, which was broken naturally during rains resulting in 60-90% germination in field condition. Seeds of *D. latifolia* did not lose viability, when stored with 3-8% moisture content at any of the three temperature up to 18 months. Viability of *L. glutinosa* seeds stored with more than 10% moisture content at ambient temperature, was lost within one year of storage.

Conservation and restoration strategies for traded trees of Eastern Ghats (IFGTB)

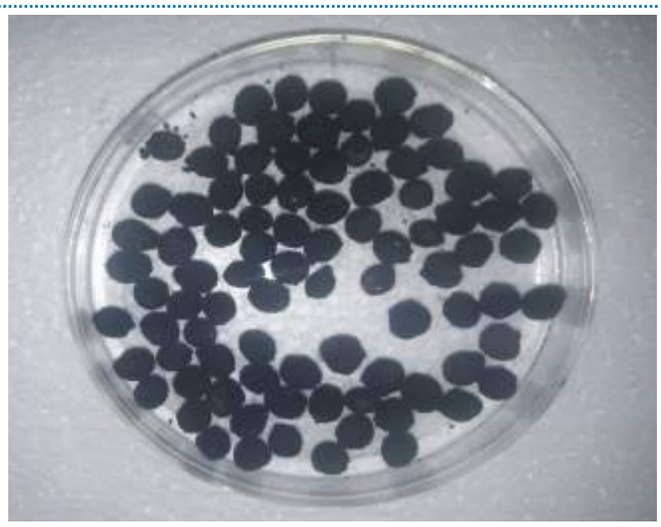
Identified seed sources, collected fruits, standardized seed handling and nursery practices for species such as *Aegle marmelos, Albizia amara, Limonia acidissima, Sapindus emarginatus, Santalum album, Schleichera oleosa, Strychnos nux-vomica, Syzigium cumini, Canarium strictum, Givotia rotlleriformis, Celastrus paniculata* and *Terminalia bellirica*.

Species distribution and regeneration studies of selected species were conducted at various altitudes in Kolli Hills forests. 60 sample plots were laid out - 25 in Kolli hills, 17 in Pachamalai, 5 in Solaimathi and 13 in Puliancholai viz. 291 species falling under 81 families were recorded in the four sites. Enrichment planting of selected species covering 9 ha was successfully completed in open forest areas with the support of TNFD at all the sites in three different altitudinal ranges - 901 msl and above, 401-900 msl and 201-400 msl. The GPS co-ordinates of the planting sites were recorded.

Enrichment planting at Kolli Hills

Research to assess performance of pelletized sandal seeds in nursery and field on comparative performance assessment of pelletized, non-pelletized and planted seedlings in the field (IFGTB)

Mature fruits of *Santalum album* were collected from four sources namely, Marayoor (Kerala), Bengaluru (Karnataka), Tirupati (Andhra Pradesh) and Coimbatore (Tamil Nadu). Germination and seedling vigour tests were conducted and Kerala seed source was identified to be superior to other sources. Seed grading of sandal was standardized and it was found that seeds retained in 6.7 mm sieve give better germination. Sandal seed invigoration was carried out by moisture rehydration and drying technique on 6 months old sandal seeds. Among various treatments, incubating at 45°C for 1 hour followed by 24 hours pretreatment with 500 ppm GA3 gave very high germination.



Pelleted seeds of Sandal

Among various seed pelleting compositions, GA3 (500 ppm for 24 hours)+ PVP (1 g in 10 ml water) + Charcoal (2 g/ 100 seeds) gave good results and *Trichoderma viride* was found suitable bioinoculant. The suitable host for Sandal to be planted in dry areas was identified as *Pithecellobium dulce*. Sandal propagation can be promoted by pelleting methods and using suitable host. The pelleted seeds are made available for sale to farmers and forest departments.

Seed source and plantation site matching for canal bund planting and homesteads in Tamil Nadu (IFGTB)

Natural populations of teak were quantified for their reproductive fitness and success. Provenances from both wet and moist locations were sampled. In the Eastern Ghats, populations from Kurubuthipallam & Thimbam and in Western Ghats populations from Topslip, Mudhumalai, Kalakkad and Mundanthurai were studied. There was no significant difference in the flowering, fruiting and seed parameters among the populations, except that the Western Ghats populations showed rapid germination (within 7-9 days) while it was extended to 21-28 days in the Eastern Ghats collections. DNA studies were conducted using RAPD markers, wherein it was observed that the Tamil Nadu populations were distinct in comparison to the central Indian teak populations. It is traceable that the teak grown in the Delta region and most farmsteads is genetically closely related. Deploying seeds that were products of selfing had inadvertently led to selection of precocious flowering. Hence, it is recommended to infuse resources from wild into the existing nurseries and other propagule outlets in the canal bank teak growing areas. Three trials have been established with the State Forest Research Institute in different eco-climatic locations of Tamil Nadu.

Poor seed filling in teak fruits of Kalakkad

A Population Progenitor trees estimated over 400 years analysed reproductive fitness and sucess at Mundanthurai Tiger Reserve

2.2.2

Social Forestry, Agro-forestry/ Farm Forestry

Evaluation of existing Sandalwood (*Santalum album*) plantations, development of agroforestry trials and capacity building to promote its cultivation in Gujarat and Rajasthan (AFRI)

Agroforestry trials with horticulture/silvicultural crops such as *Citrus limon* (lemon), *Punica granatum* (pomegranate), *Annona reticulata* (custard apple), *Emblica officinalis* (Aonla), *Casuarina equisetifolia* (Casuarina) and *Santalum album* (sandalwood) plantations were established at Anand Agriculture University, Anand, VVK field at Rajkot in Gujarat and at Jaipur National University, Jaipur in Rajasthan.

Sandal wood with lemon and Casuarina at Anand Agriculture University

Sandalwood with Aonla at Jaipur National University

One year old plantations of Santalum album in Gujarat and Rajasthan

Development of *Bauhinia variegata* (Kachnar), *Grewia optiva* (Bhimal) and *Anthocephalus cadamba* (Kadam) based agro-forestry models on farmers' land under rainfed conditions in Uttarakhand (FRI)

Agro-forestry models by intercropping millets and sugarcane with *Bauhinia variegata* (Kachnar), *Grewia optiva* (Bhimal) and *Anthocephalus cadamba* (Kadam)at spacing of 6mx6m and 6mx8m,were established on farmers land in Uttarakhand. It was found that *A. cadamba* stood first in spacing of 6mx8m with a height of 300.67cm and girth 19.18 cm followed by *G. optiva* of height 292.45cm and *B. variegata* of height 285.67cm, but in girth performance *B. variegata* (17.0cm) was found better than *G. optiva* (15.72 cm). On the other hand, *B. variegata* and *G. optiva* were somewhat slow in growth but both are suitable fodder species for same area. Agricultural crops were found performing better and found suitable (Wheat, Maize, Millet for fodder) and Sugarcane in both rabi and kharif season at both the sites. In kharif, Millet yield (300q/ha) was found better in 6mx8m spacing under *A. cadamba* as compared to yield of 290.0q/ha in 6mx6m spacing at site-I. In rabi, Wheat yield (39.5q/ha) was also found maximum in 6mx6m spacing under *B. variegata* as compared to yield (39.0q/ha) under *G. optiva* in 6mx8m spacing at site-I. At site-II sugarcane yield (469.7q/ha) was found maximum in 6m x8m spacing under *B. variegata* as compared to yield (463.7q/ha) in 6m x6m spacing.

Kadam with millets (fodder) at Dhaluwala Majbata (Haridwar) Site-I

Kadam with Sugarcane at Dhaluwala Kalan (Haridwar) Site-II

Livelihood improvement through sustainable utilization of *Grewia optiva* (Bhimal) in Uttarakhand (FRI)

Fibre was extracted from *Grewia optiva* bark using cow dung, urea and thio-urea. Application of 1% urea in water reduced retting time of the fibre by 77.5% (approximate 69 days) compared to the traditional method requiring retting time of 90 days. Saponin content in the leaves of *G. optiva* was found ranging from 40-48%.

Evaluation of windbreaks for enhancing water use efficiency, crop productivity and climate change resilience in farmlands in semi-arid regions of Tamil Nadu (IFGTB)

The efficacy of Casuarina clones in enhancing water use efficiency through soil moisture retention and agriculture crop productivity in the farm fields was assessed. Windbreaks were more effective in reducing water loss through evapo-transpiration. Suitability of seedling as well as clonal origin trees of *Casuarina junghuhniana* (Junglisaru) as windbreak was assessed in terms of their root architecture at farm field in Idigarai. The study showed that despite lack of tap root in trees of clonal origin, many 1st order and 2nd order roots developed into a tap-root like structure by growing vertically downwards as anchoring roots. This leads to the conclusion that clonal origin trees of *C. junghuhniana* are as good as windbreaks of seedling origin for having anchoring roots to withstand wind throw.

Developing of lateral roots in to a tap-root like structure as anchoring roots in windbreak clones of *Casuarina junghuhniana*

Agro-forestry interventions and conservation of tree genetic resources of *Acacia leucophloea* in traditional 'Korangadu' Silvi-pasture system towards fodder security (IFGTB)

Seedlings raised from 60 selected CPTs of *Acacia leucophloea* have been planted at two locations in Palladam and Thrippur districts of Tamil Nadu. A field trial has been established with half-sib progenies of the selected CPTs at field research station in Thuvarankuruchi. The progenies of selected CPTs were evaluated for variation in growth and biomass production at nursery stage for three consecutive years. The results showed huge variation in germination percentage, which ranged from 2% in half-sib family no. 24 to 71% in half-sib family no. 2. Biomass production was also highest in half-sib family No. 2, while least biomass production was recorded in half-sib family No. 28. Further, the progenies of these selected CPTs have also been planted in three locations in Palladam, Thrippur and in Field Research Station of IFGTB in Thuvarankuruchi, Tamil Nadu.

Greater growth and biomass recorded in progenies of half-sib family No.2

Lesser growth and biomass recorded in progenies of half-sib family No.28.

Preparation of Volume and Yield Table for Indigenous Tree Species in Tamil Nadu (IFGTB)

Volume and yield tables for 90 trees from 30 plantations of *Melia dubia* across Tamil Nadu have been prepared and their biomass sampling has been done.

Comparative study on growth, wood quality and financial returns of teak managed under different agroforestry practices in Karnataka (IWST)

Growth, wood quality and financial returns of 24-25 years old teak grown under three agroforestry systems in Karnataka viz., intensively managed block (Bim), unmanaged block (Bum) and partially managed line (Lpm) plantations were evaluated. Teak grown under Bim and Lpm exhibited significantly higher growth rate compared to Bum. However, heartwood percentage, wood density and bending properties were higher in Bum. Overall, wood quality of Bum was superior to Lpm and Bim. However, teak grown from these three systems exhibited lower values of wood quality parameters compared to forest teak. Bim may be chosen due to higher total volume and moderate properties giving higher financial returns. It is recommended to delay the harvesting of Lpm for a few years to acquire higher biomass and mechanical maturity.

Development of *Gmelina arborea* based agro-forestry system in M.P. (TFRI)

Medicinal plants namely *Asparagus racemosus* (Satavar), *Curcuma longa* (Haldi), *Zingiber officinale* (Ginger), and *Piper beetle* (Betel Vine) were intercropped with *Gmelina arborea*. Estimation of major nutrients (N, P, K, Ca, Mg) in soil showed increased amount of nitrogen in the intercrop soil (35 kg ha^{-1}) as compared to the sole crop soil (30 kg ha^{-1}). Intercropping did not show significant difference in the content of active ingredients of the medicinal plants.

A view of agroforestry system established at TFRI, Jabalpur

Impact Assessment of Agroforestry systems existing in farmers' fields of Madhya Pradesh (TFRI)

Multi-staged sampling procedure was adopted for the study which included selection of districts, blocks, villages and farmers. 100 farmers from 10 villages of each district were selected. Interaction with farmers (who adopted agroforestry landuse system) was done and data was collected on the basis of questionnaire. In the seven blocks of Seoni district, only 10 % farmers (mainly large and marginal) of four blocks have adopted Palash and Eucalyptus-based agroforestry system followed by Mango and Orange based Horti-agri system (8%) and Arjun on field bunds (6%). In Hoshangabad district, 15% farmers (mainly large farmers having more than 5 ha landholding) adopted teak-based Silvi-agri system, 8% Mango-based system, 4% Aonla-based, 3% Bamboo-based and 1% Anar-based system.

This study showed that the farmers who had adopted Agroforestry system on their farm field, benefitted due to increased income by 25 - 30 %. Out of the total sampled farmers, majority have indicated agroforestry a source of additional income. The income generated by the teak-based AF system is maximum (28% after 20 years of its plantation) followed by Eucalyptus-based AF system (25%), fruit-based system (Aonla, Mango, Orange, Guava),while some farmers went in for bund plantation, getting indirect income in terms of fuelwood and leaf as fodder. Farmers who had adopted bamboo on their field bunds, were utilizing its benefits only as fencing material, staking for climber crops, and other household articles. Other factors of Agroforestry as pointed out by the farmers are tree as an source for emergency cash (20%), supplemental employment (15%), fuelwood and fodder (12%) and soil conservation (5%).

Aonla based agroforestry system in farmer's field at Seoni (M.P.)

T. arjuna based agroforestry system existing in farmer's field at Seoni (M.P.)

Study on crop yield, soil fertility and gum production in *Acacia senegal* based traditional agro-forestry system in arid region of Rajasthan (AFRI)

Sample plots of *Acacia senegal* with tree densities: 10-20, 20-30 and 30-40 trees/ha were laid out at nine sites on farm land in Jodhpur, Barmer and Nagaur districts of Rajasthan. Maximum height (7.60 m) and DBH (22.9 cm) was recorded at tree density 20-30 trees/ha as compared to others. Reduction in crop yield was maximum (58.12 %) at 30-40 trees/ha and minimum (53.71 %) at 10-20 trees/ha. Crop yield reduction was higher (61.6%) near tree trunk (1 m distance from tree trunk) than respective sole crop whereas reduction was also higher (57%) near tree trunk as compared to canopy edge of tree density. Cost of cultivation recorded through interaction with the farmers and its economic return was calculated. Economic returns were highest for pearl millet crop (Rs. 62,933/ha) under irrigated condition followed by un-irrigated pearl millet (Rs.15,542/ha). However, economic returns of mothbean-based agroforestry was found lowest (Rs.1,165/ha) in kharif season. In rabi season, economic returns were higher (Rs. 22,663– 60,316/ha) in cumin-based agroforestry system as compared to mustard-based agroforestry system (Rs.2,770/ha) under irrigated conditions. Injection of ethophon in *A. senegal* trees was found to enhance gum production from 0.10 kg to 2.00 kg per tree.

Acacia senegal grows naturally and scattered with age ranging between 20-70 years, with varying diameter classes. Gum yield was 100-2,000 g /tree in 10-20 cm dbh, 90-450 g/tree in 21-30 cm dbh and 100-670 g /tree in 31-41 cm dbh class, showing inverse relationship ($R^2 = 0.38$; $p < 0.05$) with dbh of the trees.

Community dependency on Oak forests for fodder and comparative analysis of different Oak species of Himachal Himalaya for nutritive value and leaf biomass production (HFRI)

Data collected through questionnaires in various forest divisions of Himachal Pradesh revealed that stall fed populations of livestock are currently higher than 10 years ago, indicating reduction in grazing pressure. Community dependency on oak fodder was maximum in winter season. The study revealed most people were practicing light lopping as compared to moderate or heavy lopping in oak species. Near cities, communities were found over-exploiting oak resources due to ever increasing milk demand in urban population and overall less availability of green fodder. The nutritive analysis of Ban, Bani, Mohru, Kharsu and Brey Oak revealed that with increase in altitude, the values of crude fat and crude protein increased in Ban oak and Mohru oak. Oak leaf samples collected from northern aspect recorded maximum nutrient content and also maximum crude protein during spring season. Heavy lopping or lopping twice a year resulted in subsequent decline in production of fodder as compared to yearly lopping.

Intensive organic farming system based on Paddy+Bach (*Acorus calamus*), trees and fish in Agro-forestry system (IFB)

An Intensive Organic Farming System based on Paddy +Bach (*Acorus calamus*) with trees and fish in agro-forestry has been developed in Andhra Pradesh for the year 2019-20 with financial assistance from Andhra Pradesh Medicinal and Aromatics Plant Board (APMAPB). An area of 10 acres has beencovered by providing planting material free of cost to willing farmers. Farmers are preferring to plant *A. calamus* in high density 50,000 propagules/acre alone or with fish; the latter is fetching more returns so they migrated to fish farming from this system as large farmers did not prefer labour intensive models. Farmers have obtained yield of 20-30 quintals dry Acorus rhizomes per acre, the current market price of which is approximately Rs 7,000 per quintal. While buy back arrangements were made for sale of their produce, farmers are free to sell the produce in open market too if they get better price.

Farmers collecting the Acorus roots

Dependency on silvi-pastoral systems for fodder in Banalgi, Solan

Survey and evaluation of Silvi-pastoral systems in Himachal Pradesh and their role in sustaining community livelihood (HFRI)

Field data on distribution of tree species and other vegetation including grasses, forbs and shrubs recorded from three different sites (1 ha area each) of Lothal, (Chamba), Jarashi (Shimla) and Ghiaghi (Kullu). Community dependency on silvi-pastoral systems for fodder, fuel, medicine, etc. were recorded from Lothal, Chamba, Ghiaghi (Kullu) and Muling (Lahaul-Spiti). It was found that in Lothal (Chamba) locals are dependent on *Grewia optiva* (Beul) whereas in Ghiaghi (Kullu) locals are highly dependent on *Quercus floribunda* (Mohru) for tree fodder. Documented economic evaluation, census and livestock data provided by locals, Panchayat secretary/ Revenue officials/ Animal husbandry officials of selected villages.

Establishment of community fodder banks in forest fringe villages in Uttarakhand and Himachal Pradesh (HFRI)

Some native and non-native fodder plant species have been evaluated for their nutritional composition (i.e., proteins, carbohydrates, fats, fibre, ash content, etc.).Fencing and high density plantation of species namely, *Grewia optiva* (Beul), *Bauhinia variegata* (Kachnar), *Leucaena leucocephala* (Leucaena), *Morus alba* (Sehtut) and *Celtis australis* (Khirik) at three randomly selected demonstration sites viz.,Padli (4,200 ft), Rano (4,100 ft) and Maraog (924 ft) have been established.

2.2.3

Forest Soils & Land Reclamation

Identification and characterization of important bacterial groups from salt affected soils of Haryana and Punjab (FRI)

Soil samples from salt-affected sites under different landuses in Muktsar and Bhatinda in Punjab and Fatehabad and Kaithal in Haryana were collected from pre-determined depths of 0-30, 30-60, 60-90 cm during pre- and post-monsoon seasons. Soil bacteria were isolated from the collected soil samples and characterized as *Streptococcus* sp., *Bacillus* sp., *Staphylococcus* sp., *Klebsiella* sp., *Enterobacter* sp., *Clostridium* sp., *Rhizobium* sp., *Azospirillum* sp., *Escherichia coli*, *Pseudomonas* sp .Most of the isolates were rod shaped and some were cocci. Of these isolates, 62% were Gram positive while 38% were Gram negative. Gram's staining showed that 0-30 cm depth is occupied by majority of Gram negative bacteria in Haryana. There is significant difference in the bacterial population and majority are Gram positive at 30-60 cm depth. Majority of the soils studied fall in the category of lower organic matter and medium status of available nitrogen ranging from 0.0005 to 0.02 %, phosphorus level ranged from 0.0004 to 0.01%, thus indicating poor soil fertility status.

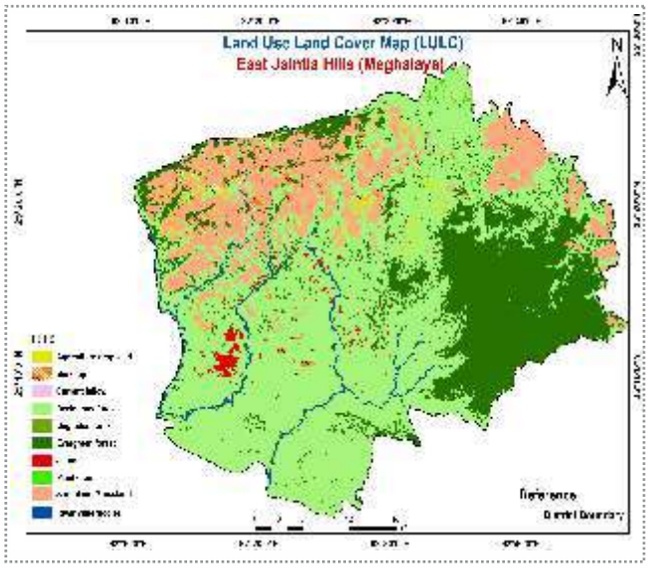
Soil nutrient pool and microbial studies under different forest types in Uttarakhand Himalayas for sustainable management (FRI)

Bulk density (BD) distribution in the soil profile studied, showed increase with respect to soil depth in all different

forest types and varied from 1.05g/cm^3 to 1.28g/cm^3. The water holding capacity (WHC) recorded a decrease with increase in soil depths in all forest types and it varied at different soil depths. Organic carbon (OC) associated with the soil of high altitudes forest types from FT-4 to FT-7 was higher than at lower altitudes FT-1 to FT-3. Irrespective of altitudes, organic carbon content decreased with soil depth while the soil available nitrogen (N) decreased down the profile with increasing soil depth in all forest types.

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

Partitioning of biomass in stem, branches and leaves was 68.36%, 29.04% and 2.59% in case of *Eucalyptus camaldulensis* and 28.08%, 67.50% and 4.42% in case of *Acacia tortilis*, respectively. The increase in total biomass favoured increasingly higher biomass allocation towards stem in *E. camaldulensis* and in branches in *A. tortilis*. Total dry biomasses of both the species have been observed significantly related with their girth at breast height by a power equation.



LULC Map of Garo Hills district

Modelling soil carbon dynamics and land use cover change in Meghalaya (RFRI)

LULC mapping was done in different districts of Meghalaya, using the maximum likelihood supervised classification of LISS-III satellite imagery. The maximum area under forest cover was observed in Jaintia hill district (2,547.65 km^2), which is almost similar to FSI estimate of 2,537.89 km^2. Comparing data of 2010 with that of 2020,increment of soil organic carbon under different land uses, showed that maximum increase was noticed in forests (0.23 t C ha^{-1}yr^{-1}), followed by coffee plantations (0.11 t C ha^{-1}yr^{-1}) and tea gardens (0.09 t C ha^{-1}yr^{-1}), while rubber plantations have the lowest increments of 0.06 t C ha^{-1}yr^{-1}. The soil organic carbon (SOC) stock in pine forests of East Khashi hills district ranged from 40.68 to 72.24 t C ha^{-1}. The value of carbon stock in the forest soils of Jaintia hills is in the range of 54.48 to 79.06 t Cha^{-1}.

Pineapple garden

Development and optimization of biochar enriched super-compost from forest necromass for enhanced soil carbon sequestration(RFRI)

Biochar enriched super-compost has been developed containing 65-68% carbon and 1.12-1.20% nitrogen. The biochar enriched super-compost was found to increase soil C in the range of 11.48-47.61%.

2.3 GENETIC IMPROVEMENT

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	13	47	08
Externally Aided	06	25	09

2.3.1

Conservation of Forest Genetic Resources

National Programme for Conservation and Development of Forest Genetic Resources: Pilot project on 'Creation of Centre of Excellence on Forest Genetic Resources (CoFGR)' (FRI)

This programme is being implemented in Uttarakhand on a pilot scale to create 'Centre of Excellence on Forest Genetic Resources (CoFGR)' at FRI, Dehradun.

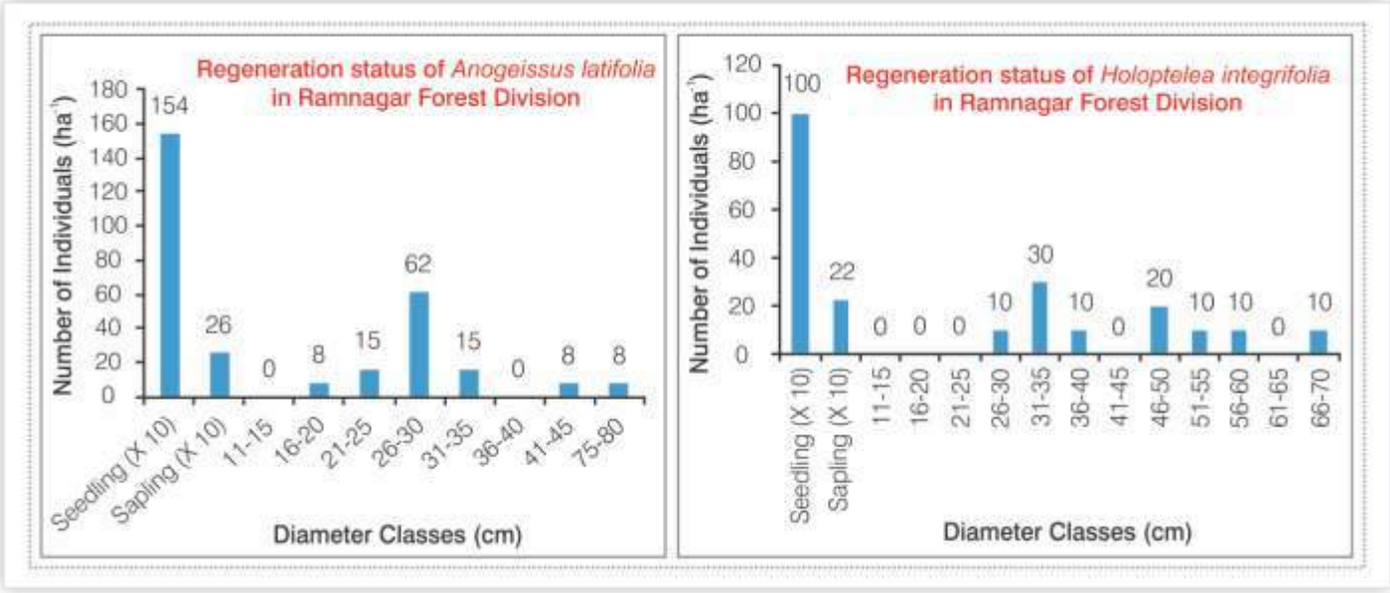
A. FGR Documentation

Upgradation and digitization of DD herbarium

DD herbarium is the biggest in Asia and has been recently converted into a state of art herbarium of forest species. Digital Herbarium Specimen Database has been created for better access and long-term safeguard of valuable herbarium specimens. This year more than 17,000 herbarium specimens were digitized and entered into the database.

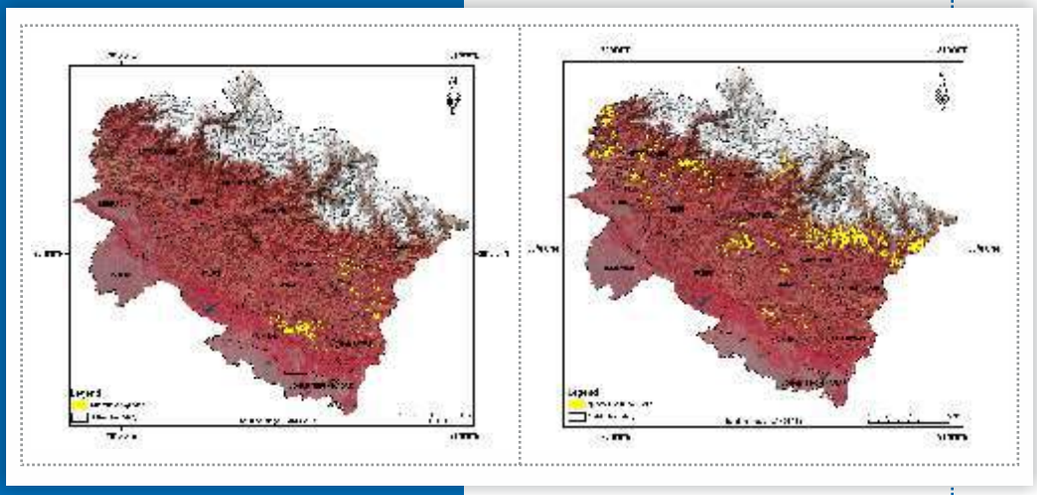
Documentation of Forest Genetic Resources (FGR) diversity

250 species of FGR of Uttarakhand have been shortlisted and are being documented for their diversity, regeneration and population structure. Intensive field survey of all districts of Uttarakhand has been carried out for ground verification of species and their populations.



Development of Eco-distribution maps

Eco-distribution maps of five FGR species (***Betula utilis, Juglans regia, Quercus semecarpifolia, Q. lanuginosa*** and ***Taxus baccata***) were prepared and updated with latest geo-spatial modelling tools Arc GIS and ERDAS Imagine software, besides using Maxent species distribution model. LANDSAT-8 Satellite image of Uttarakhand was also prepared for mapping.



Eco-distribution maps of *Quercus semecarpifolia* and *Q. lanuginosa*

Fraxinus micrantha

Oroxylum indicum

Aegle marmelos

Toona ciliata

Quarterly germination of the prioritized FGR species

FGR Seed and Germplasm storage

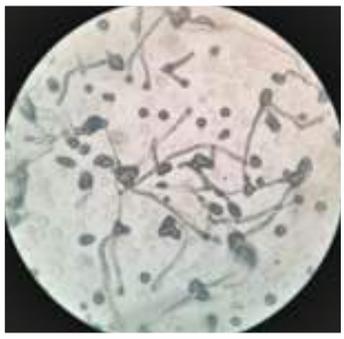
Seeds were collected from demarcated populations of forestry species. Well processed, cleaned, desiccated, initial viability determined seed samples of 20 forestry species along with passport data were deposited for long term storage (-18°C) in the Gene bank of NBPGR, New Delhi for their long-term conservation. The stored seeds were monitored quarterly for their viability.

In-vitro storage of FGR species

In-vitro storage protocols for germplasm of very high conservation concern have been standardized and ***in-vitro*** regeneration

In vitro multiplication of ***Taxus contorta*** shoots

protocols for three selected FGR species have been developed. Pollens of ***Heteropanax fragrans, Oroxylum indicum, Diploknema butyracea, Sterculia colorata, Butea pellita, Rauwolfia serpentina*** and ***Cratevaadan sonii*** are being maintained in liquid nitrogen with periodic viability tests.



Pollen tubes germinating

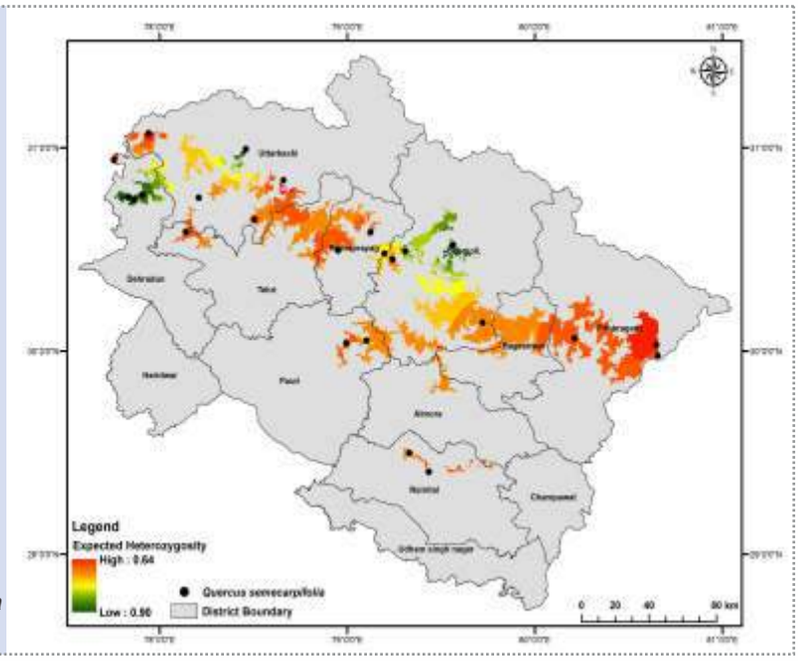
Anther with pollens

Floral buds of *B. pellita*

Viability testing of stored pollen of ***Butea pellita***

Estimation of genetic diversity hotspots for conservation

Forest genetic diversity, both inter-specific and intra-specific, serves a number of fundamentally important functions. Six species viz., ***Rhododendron arboreum*** (Burans), ***Taxus wallichiana*** (Thuner), ***Quercus semecarpifolia*** (Kharsu oak), ***Betula utilis*** (Bhojpatra), ***Myrica esculenta*** (Kafal), ***Diploknema butyreacea*** (butter tree) have been prioritized for molecular characterization and genetic diversity estimation. Alleleic pattern and gene diversity across 24 populations in ***Q. semecarpifolia*** was completed. Expected heterozygosity in populations of ***Q. semecarpifolia*** ranged from 0.64 to 0.89 which was highest in Karandam Bugyal. Shannon's diversity index ranged from 1.59 (Yamunotri) to 2.48 (Bhukkitop). The regions with high level of genetic diversity and private alleles are most suitable for conservation of the species.



Genetic diversity hotspots of *Quercus semecrpifolia*

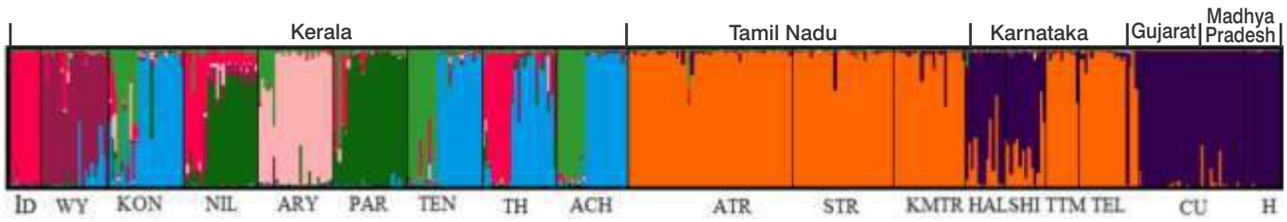
Establishment of field gene banks of FGRs for conservation

In-situ and *ex-situ* conservation measures for FGRs species in the form of conservation reserves and field gene banks are being developed. Nursery techniques of five priority species viz., ***Cinnamomum tamala, Diploknema butyracea, Myrica esculanta, Rhododendron arboreum*** and ***Taxus wallichiana*** have been standardized and planting stocks being raised for field gene banks.

Documentation of population demography and genetic structure of teak for developing sustainable conservation strategies and resource management (IFGTB)

Teak natural populations from South to Central India were selected to study the extent of genetic variation and local adaptive potential using genome wide SSR markers. Bottleneck effect along with genetic drift and local adaptation have played a crucial role in designing the genetic structure of these populations, separating

them into three genecological zones namely Kerala, Tamil Nadu-Karnataka and Karnataka-Central India (Gujarat and Madhya Pradesh). Information on genetic variability, genetic structure, allelic richness, private and unique adaptive alleles of teak populations showed the presence of population specific diversity and revealed the basis of local adaptations. Significant association of genetic structure to environmental factors, temperature and precipitation was detected using linked neutral loci (SSR loci IFGTB285 and IFGTB479b). Population genetic structure of natural teak populations is influenced by isolation by distance (IBD) and isolation by environment (IBE); specifically, the longitude showed greater correlation than latitude. Niche modelling identified Central Indian populations to be more vulnerable to climate change and probable shift in the distribution pattern of the species in the ensuing years.



K=8

Population structure of Teak natural populations

Characterization of the hill bamboo species (ringal) of the North-Western Himalayas for their conservation and genetic improvement (FRI and HFRI)

Four hill bamboo (ringal) species commonly found in Uttarakhand Himalaya namely, ***Arundinaria falcata*** (Gol ringal), ***Thamnocalamus falconeri*** (Dev ringal), ***T. spathiflorus*** (Thamringal) and ***Sinarundinaria anceps*** (Jhumra ringal) were studied for their distribution and characterization. Novel species-specific 48polymorphic SSR were identified after PCR validation of 106 SSRs. Cross amplification study revealed good level of transferability (51 primers were amplified in ***S. anceps***, 44 in ***T. falconeri***, 29 in ***T. spathiflorus***) but exhibited very low level of polymorphism (10 in ***S. anceps***, 13 in ***T. falconeri***, 4 in ***T. spathiflorus***). For molecular taxonomic study, 11chloroplast regions were screened in the target species and four of these namely, rbcL, matK, rps16_trnQ, and psbK-I showed positive amplification. The regions were amplified, purified and sequence was derived from PCR products. Sequence data was analysed for DNA polymorphism and phylogenetic analysis. It was observed that all four chloroplast regions were highly conserved across the target bamboo species but matK locus successfully resolved four target species. Also, species-specific nucleotides have been identified and validated across

Micro-propagation of rare and endangered species of Orchids of Mizoram and re-introduction in wild (RFRI)

Five rare and endangered orchids of Mizoram, viz., *Dendrobium primulinum, D. transparens, Cymbidium aloifolium, Vanda coerulea, Aerides odorata* were cultivated through tissue culture and 15,000 plants were re-introduced in the wild for ***in-situ*** conservation.

Orchid tissue culture plantlet

In situ conservation of wild orchid by reintroduction

Conservation and evaluation of bamboo genetic resources of North East India (RFRI)

Bamboo being a most sustainable future source of raw material as it is high yielding and fast-growing,desirable phenotypes of 15 different commercially important bamboos were selected from Assam, Nagaland and Manipur. 453 accessions of 15 species of bamboo were collected and assembled in the germplasm bank of Rain Forest Research Institute, Jorhat.

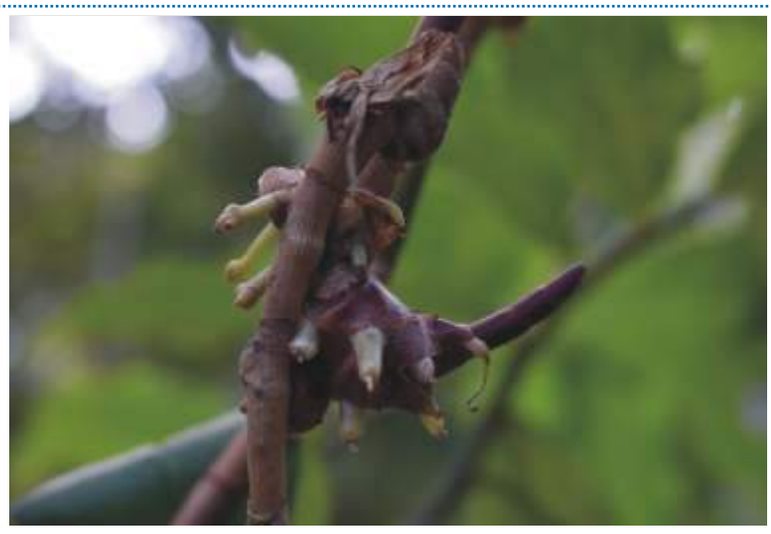
Different forms of *Paris polyphylla* collected from different community forests, Kohima at elevation 1449-1701 m

Exploration, identification of genetic resources and strategies for sustainable management of *Paris polyphylla* in Arunachal Pradesh, Manipur, Mizoram and Nagaland in North East India(RFRI)

Populations of ***Paris polyphylla*** were explored from Lower Dibang valley of Arunachal Pradesh, Kohima and Mukokchung districts of Nagaland, and Champhai district of Mizoram. Four different forms of the species were identified from the surveyed area. Awareness generation programmes were carried out in 9 fringe villages for its sustainable management.

Creation of North-East Indian Zingiberales biodiversity garden (Gene Bank) in RFRI, Assam

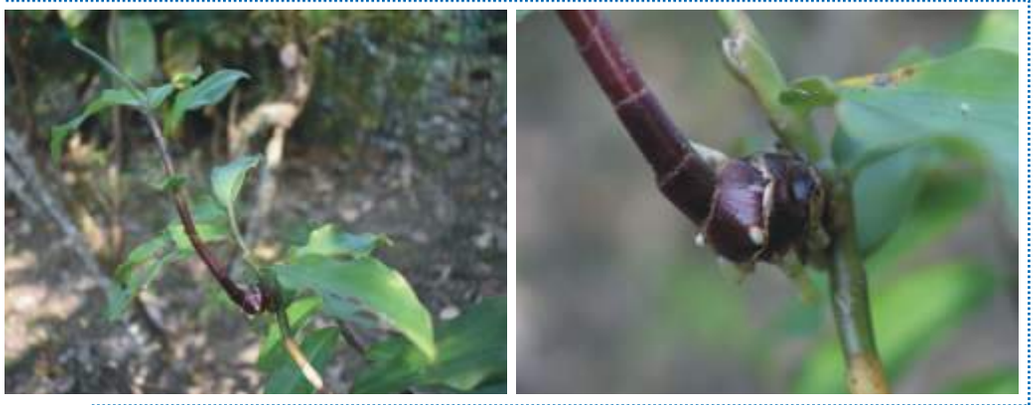
Sixty plant species specimens including ***Zingiber, Curcuma, Hedychium, Alpinia, Globba, Kaempferia, Canna, Cheilocostus,***



Pseudovivipary in *C. igneus Nok*

Inflorescence in *Costus igneus Nok*

Costus, Etlingera, Schummanianthus, Phrynium, Musa and *Ensete* have been collected and planted. The morphological, phenological and ecological data have also been collected. Pseudovivipary was observed for the first time in Costaceae (*Costus igneus*).



Pseudovivipary in *C. igneus* Nok

Conservation of RET species of Chhattisgarh – *Plumbago zeylanica* and *Celastrus paniculatus*–and production of quality planting material (TFRI)

Plumbago zeylanica (Chitrak) and ***Celastrus paniculatus*** (Malkaganii) were collected from Chhattisgarh (Dhamtari, Khairagarh, Kondagaon and Baster). Propagation of both species through cuttings treated with 200 ppm IBA was attempted. Micropropagation of both the species was done through nodal segments inoculated on MS medium containing 1mgl^{-1} BA, after surface sterilization. Sprouting was obtained after 15 days and 2-3 shoots were formed in both species. Shoot cultures of ***Celastrus paniculatus*** were maintained on MS medium supplemented with 1mgl^{-1} BA and cultures of ***Plumbago zeylanica*** were maintained on MS medium supplemented with 1mgl^{-1} BA, 0.5mgl^{-1} IBA and 2 mgl^{-1} Adenine sulphate.

Planting material of ***Plumbago zeylanica*** and ***Celastrus paniculatus*** in GTI nursery

Recovery programme for *Syzygium alternifolium*-an endangered species from Eastern Ghats(IFB)

Field surveys were taken up in 14 forest ranges and natural populations of ***Syzygium alternifolium*** and leaf samples were collected from 8 populations for genetic analysis. Seed germplasm was collected from 7 populations and nursery was raised. About 600 seedlings are being maintained for establishing gene conservation stands.

Nursery of ***Syzygium alternifolium***

Germplasm assemblage of *Dalbergia* spp.-its characterization and evaluation (IFGTB)

Under this programme, 92 phenotypically superior trees of *Dalbergia* spp. were selected across Tamil Nadu and Kerala. Forty four superior trees were cloned and planted at Varavoor area of Thrissur Forest Division, Kerala and molecular and chemical variation studies are in progress.

Adaptive diversity in sandalwood populations (sandanam) (IFGTB)

The project aimed to understand the adaptive potential of Indian sandalwood, *Santalum album* using the strategy of landscape genomics. The natural populations in Karnataka (Chickmagalur, Mandagadde and Mysore), Tamil Nadu (Chitteri, Javadi hills, Bargur, KMTR), Kerala (Marayoor, Agali), Odisha (Koraput) and Madhya Pradesh (Seoni) were assessed and variation in foliar traits and essential oil content was recorded. A species distribution model of sandalwood was developed and the MaxEnt model revealed that precipitation of driest month (44.5%) and maximum temperature of warmest month (11.5%) significantly contributed to species distribution.

2.3.2

Tree Improvement

Selection and screening of germplasm of *Acacia nilotica* L. (Babul) to improve productivity in Tamil Nadu (IFGTB)

Comparison tree method was used for selecting 50 candidate plus trees (CPTs) of *Acacia nilotica* from 30 districts and the passport data was recorded. Seeds from 50 CPTs were collected and seedlings were raised for establishment of progeny trials at different locations.

Genetic Improvement of *Swietenia macrophylla* King. for higher productivity (IFGTB)

Forty candidate plus trees (CPTs) of *Swietenia macrophylla* were selected from 25 populations in Tamil Nadu and Kerala. Wood anatomical and dendrological studies of 30 CPTs has been completed. Average bark thickness (2.9± 2.1 mm) and heartwood percentage (89±3) was found to be good. A progeny trial of 40 families in randomized block design (RBD) has been raised for plus tree selection.

Evaluation of promising clones of *Tamarindus indica* L. for higher fruit productivity(IFGTB)

Tamarindus indica (tamarind imli) groves of Tamil Nadu were surveyed and 30 CPTs were selected and passport and phenology data was collected.135 accessions with high sucrose content (sweet tamarind) and anthocyan in pigment (red tamarind) assembled in different germplasm banks and clonal orchards were evaluated for biometric, vegetative and reproductive characters. Around 2,000 grafts were produced from 20 outstanding clones of tamarind and vegetative multiplication garden was established in Forest Campus, Coimbatore and three multi-location clonal trials were established at Neyveli, Cuddalore (Dist.), Kangeyam, Tiruppur (Dist.) and Melur, Madurai (Dist.) in Tamil Nadu. Clonal demonstration trials were also established in farmers' fields located at Kollegal (Karnataka), Pattukottai. Thalavaipettai, Erode (Tamil Nadu) and Rajkot (Gujarat).

Testing of new set of provenances of *Acacia mangium* and estimation of genetic gain from first and second generation seed orchards(IFGTB)

The project was initiated during 2016 in collaboration with the Australian Tree Seed Centre (ATSC), CSIRO. Seeds of 14 natural provenances of *Acacia mangium* obtained from ATSC Australia and two seed lots from the existing seed orchards established by IFGTB were used for establishing multi location trials. International Provenance Trials were established at Ramnagar, Karwar (Dist.) Shaklespur, Hasan in Karnataka and Silapather, Dhemaji and Kokhrajar in Assam.

Development of descriptors and DUS testing guidelines for indigenous forest tree species (*Tectona grandis* and *Melia dubia*) and establishment of Field Gene Bank(IFGTB)

For developing DUS test guidelines for teak (*Tectona grandis*), visits were made to Seed Production Area (SPA), Clonal Seed Orchards and Permanent Preservation Plot (PPP), Germplasm banks in Kerala, Tamil Nadu and Maharashtra. An image data base was developed using the National Germplasm Bank for Teak established by Maharashtra State Forest Department at Chandrapur. This germplasm bank has about 160 clones assembled from 10 teak growing states. A draft guideline for DUS testing was developed. A germplasm bank for 43 clones of Teak was established in an area of 1 acre at Panampally, Kerala.

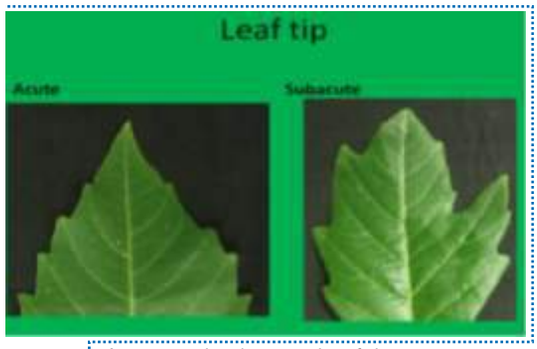
DUS Centre on Casuarina and Eucalyptus(IFGTB)

DUS testing for six clones of Casuarina and one clone of Eucalyptus has been completed. The reference collection of candidate and example varieties of the two species has been assembled and maintained in the DUS Centre. Annual

recording of descriptors of the assembled varieties was done. Registration Certificates will be issued by the Authority for the seven clones which will protect the IPR for the new planting material in favour of ICFRE. In Eucalyptus, field visits were made to Thiyagadurgam and Salem for observing DUS characters in all the reference clones of Eucalyptus. The database on the DUS characters for about 24 clones was updated.

Development of descriptors and DUS testing guidelines for *Ailanthus excelsa* Roxb. and establishment of Gene Bank (IFGTB)

DUS descriptors for ***Ailanthus*** excelsa have been developed and the testing guidelines have been prescribed. All the colours have been finalized with RHS colour chart (the standard reference for recording plant colours). Accordingly, bark colour has been finalized as Greyish white, Grey and Yellowish grey, etc. Stem Scar is an another distinct character with two shapes, namely heart shaped and elliptic shaped in three different sizes:(1.9 cm), medium (2.5) and long (>3.2 cm), as a measured observation of group of plants. Leaf Characters, such as Leaf tip: Acute and subacute, and Leaf lamina: symmetrical and asymmetrical have been described. There are three types of stipules, which have been described as cadcucous, deciduous and persistent in ***A. excelsa*** as among the important features as descriptors.



Acute and subacute Leaf tips

Symmetrical and asymmetrical

Development of DUS Descriptors for Red Sanders (*Pterocarpus santalinus* L.f.) and Indian sandalwood (*Santalum album L.*) and documentation of Indigenous (Traditional) Knowledge regarding these species (IFGTB)

Natural populations of ***Santalum album*** (sandalwood) in Marayoor and Sathiyamangalam and farmers' plantations at Palladam and Pudukottai were surveyed and variability in morphological characters of leaf, fruits, seeds and bark were studied in 20 trees selected at random. The leaf samples were collected for further assessment using image analyser. Based on the population assessment, 17 characters were found to have discrimination potential.

Variation in Sandal flower colour

In case of Red Sanders (***Pterocarpus santalinus*** L.f.), plantations at Chennai, Lingamalai (Tamil Nadu), Kattilakuzhi and Aranamkuzhi, Trivandrum (Kerala) was studied for various tree characters like tree form, bark color, texture, leaf size, petiole characters, shape, color, base, apex and margin. Ten characters were observed to have discrimination potential.

Screening of international germplasm of *Casuarina equisetifolia* for enhancing productivity and rural livelihood in Tamil Nadu (IFGTB)

In the International provenance trials of Casuarina equisetifolia at three sites, Thuvarankurichy, Neyveli and Gudalur near Chennai in Tamil Nadu, observations recorded after three and a half years of age suggest fastest growing provenance was found to be 18586 of China. The following provenances were found at par with it: 18144 Kenya, Mixed Seed lot India, 18298 Thailand, 18355 Benin, and Palacherla A India. 18122 EGYPT was at the bottom position. These provenance trials will serve as store house for genetic variability and further breeding programmes. The trials are being used to develop quality seeds.

Evaluation of *Gmelina arborea* genetic resources for productivity enhancement and wood properties(IFGTB)

The clonal trial was evaluated for growth superiority and tolerance to pest and disease. The most productive 10 clones of ***Gmelina arborea*** were shortlisted. Mini-cutting technique for vegetative multiplication was developed for large scale multiplication.

Selection and multi-location testing of *Gmelina arborea* clones for growth, form and wood traits (IFGTB)

Extensive survey was carried out and 45 CPTs of ***Gmelina arborea*** were selected on the basis of growth superiority, clear bole and pest and disease resistance. Quantified variations in wood density, fibre length, lumen diameter and fibre angle of selected CPTs were studied. Clonal multiplication techniques for large scale multiplication were standardized and variation in rooting and shooting parameter of different clones was studied. Collaborative multi-location clonal trials of ***G. arborea*** were established at Forest Research Centre, Lingamalai, Tiruchirappalli and at various farmers' fields.

Genetic improvement of *Melia dubia* (Malavepu) (IFGTB)

Provenance resource stands, progeny trials and seed orchards of ***Melia dubia*** were established and evaluation trials were carried out. Pest and disease problems of the species in nursery and natural plantations have been identified and control measures developed. Clonal propagation technology for ***M. dubia*** has been developed and a Vegetative Multiplication Garden established, from which clones are being vegetatively propagated for clonal trials. A Field Gene Bank is being maintained in the Vegetative Propagation Complex.

Assessment of *Calophyllum inophyllum* clones for oil yield and site specificity(IFGTB)

Calophyllum inophyllum tree cultivation will provide alternate source of TBO for both medicinal use and as biofuel. Four multi-location clonal trials and 01 progeny trial were raised and high yielding germplasm was cloned vegetatively. One demonstration trial in farmer's field in Veerananpalayam near Kangeyam was established. Six high yielding clones of ***C. inoplyllum*** have been identified for variety release.

Evaluation and popularization of *Neolamarckia cadamba* in Tamil Nadu and Kerala (IFGTB)

A clonal trial of ***Neolamarckia cadamba*** was raised in IFGTB research centre, at Neyveli (Tamil Nadu) in September 2019. One progeny trial raised during 2012-13 in IFGTB research centre – Gudalur, Maramalainagar, Chennai was converted into seed orchard during February 2020.Technology for quality seedling production has been developed.

Evaluation of Second Generation *Eucalyptus camaldulensis* clones for higher productivity (IFGTB)

A clonal trial of second generation ***Eucalyptus camaldulensis*** clones was raised in research centres at Gudalur –Maraimalai Nagar, Chennai (Tamil Nadu) and one Clonal assemblage-cum-Clonal trial has been established at Panampally (Kerala). Growth data of second generation ***Eucalyptus camaldulensis*** clones for three trials was recorded.

Assessment of variability for growth, heartwood colour and wood quality traits of different populations of *Pterocarpus santalinus* (Red sanders) in Karnataka (IWST)

Significant variation was found in growth traits, heartwood content and time of heartwood formation within tree and between trees in ***Pterocarpus santalinus*** (Red sanders) in Karnataka. Heartwood was not developed in trees whose girth was less than 50 cm with age between 32 to 47 years old plantations. Poor site plantations had better wood quality than that of plantations in good sites. Acoustic tool (Fakopp Stress wave timer) may be used for selection of superior genotypes for tree improvement.

Assessment of variability in growth, heartwood colour, oil yield and chemical profiling of Indian *Santalum album* (Sandalwood) in Kerala (IWST)

A survey was done in 7 ***Santalum album*** (sandal) reserves viz., NSR-I, II, NSR-I (Vested), SR-52, KSR-I & II, VSR-I and II in Marayoor. Passport data and growth data were collected for selected trees. Heartwood content, colour and oil extraction was done for 225 samples and were ranked based on the observations.

Development of value chain for bamboos for mass multiplication, popularization in farmers' fields and industrial linkages in Central India (TFRI)

Linkages are being developed among institute, farmers and wood-based industries (Orient Paper Mills) on a tripartite model. Propagation and multiplication of selected improved clumps of various bamboo species through macro- and micro-propagation was achieved. Field trials of eight different bamboo species (***Bambusa tulda, B. bambos, B. nutans, B. vulgaris var. green, B. vulgaris var. yellow, B. balcooa, Dendrocalamus strictus*** and ***D. asper***) was established at Chingrola district of Umaria, Madhya Pradesh.

Selection of plus trees of *Tectona grandis* (Teak), raising progeny trials and establishing germplasm bank(TFRI)

A total of 114 CPTs (Madhya Pradesh-58, Chhattisgarh-30, Odisha-11, Maharashtra-15) of teak have been selected. A progeny trial was established representing seedlings from teak CPTs/PTs of four central Indian states.

Selection of pest and disease free CPTs of *Gmelina arborea* and production of clonal planting material(TFRI)

Survey was carried out in 11 sites of Madhya Pradesh, and 48 CPTs of ***Gmelina arborea*** were been selected. Experiments were carried out on vegetative propagation studies using semi-hardwood cuttings. Maximum rooting of cuttings was obtained with treatment of 500 ppm IBA.

Rooting in semi hardwood cuttings of selected trees in ***Gmelina arborea***

Evaluation of progeny trials of *Tectona grandis* and production of improved planting stock resistant to defoliator and leaf skeletonizer (TFRI)

Trees of three progeny trials of ***Tectona grandis*** (teak) established at Moiyanalla, Seoni and Chandrapur were assessed for damage caused by teak leaf defoliator (***Hyblaea puera***) and leaf skeletonizer (***Eutectona machaeralis***) for three years. Morphological parameters like total height (m), clean bole height (m), gbh (cm), crown height (m) and crown diameter (m) of the trees was recorded. Status of leaf flushing, flowering and fruiting was also observed.

Laboratory bioassays were carried out for feeding behaviour of defoliator and skeletonizer. Data of damage caused by leaf defoliator and leaf skeletonizer in the progeny trials was analysed. ***In-vitro*** cultures of selected families were established through nodal segments and through shoots -both multiplied on MS medium supplemented 2.22μM BA and 1.16μM kinetin. Rooting was obtained in cuttings treated with 800 ppm IBA.

Guiling study site

Identification, Ecological Assessment for Selection and Screening of Superior, Insect-Pest Resistant Clones of *Salix* for their Cultivation, Production Trends and Conservation in the Cold Deserts of Himachal Pradesh and Jammu & Kashmir (HFRI)

Cold desert tree species ***(Salix)*** in areas bordering Tibet, local willow species in upstream of Kaza, Pin Valley, Lingti Valley, Tabo upstream to Schling and Tabo downstream were surveyed. Desirable genotypes of the species were selected and planting stock was collected. It was observed that intra-specific hybridization is very common and

seems to be an important factor for variability.

Soil analysis of these sites revealed that soil moisture, soil pH, bulk density, organic carbon (%) and EC (μs) ranged from 1.21 to 4.35, 7.8 to 8.2, 1.18 to 1.42 mg/m^3, 0.71 to 2.20 and 0.21 to 0.34 μs, respectively. Available nitrogen, available phosphorous and available potassium ranged from 130.20 to 164.20 kg/ ha, 28.10 to 44.50 kg/ha and 203.50 to 332.50 kg/ha, respectively. Soil Organic Carbon ranged from 1.02-1.59%. Nitrogen ranged from 43.90 to112.89 kg/ha.

Locations of Salix in natural zone

Two insects; ***Aculops tetanothrix*** (Willow budgall mite) and ***Pontanias*** pp. (Willow Sawfly) on Salix species were recorded.

Cerura vinula (Moth larva)

Cavariella ageopodii (Aphid)

Collection, Conservation and Evaluation of *Melia dubia* Germplasm from North-Bengal, Odisha hills and other parts of India for identification and release of superior clones(IFP)

A total of 88 different accessions of ***Melia dubia*** were collected from different parts of the country including North India, South India and eastern India are being raised in a germplasm bank at the institute for its first time introduction in Bihar and Jharkhand. Multilocation field trials of superior phenotypes have been established at 3 different locations viz.,1 in Bihar and 2 in Jharkhand.

Productivity improvement in *Pterocarpus santalinus* L.f., through mass selection and selective breeding(IFB)

Comparison/check tree method was used in selecting ***Pterocarpus santalinus*** plus trees from plantations. Twenty two candidate plus trees have been selected and half-sib progenies of 18CPTs are being raised in nursery. Rooting and callusing response was found to be slightly better in air layering experiments in vermiculite compared to coir pith. Use of vermiculite as substrate in combination with NAA (2-Napthalene-acetic acid at 1000 ppm) yielded the maximum (70%) rooting.

Vermiculite media with NAA (1000 ppm)

All India Coordinated Project on Genetic Improvement of *Melia dubia*

FRI, Dehradun

Some selected genotypes of ***Melia dubia*** were found suitable for paper manufacturing with an average pulp yield of 51.31 %. However, while the species had exceptional variability for pulping, it varied significantly from genotype to genotype. Majority of genotypes (FRI/MD/104, 028, 075 and 76) were also found to be excellent raw material for quality plywood manufacturing. The principal component analysis for growth and wood parameters revealed that wood parameters contribute substantially higher over growth parameters towards total variability.

RFRI, Jorhat

Sixty CPTs of ***M. dubia*** were identified from different geographical regions of Northeast India. Out of these, 28 accessions were used to raise 3 progeny trials at Silapathar Goalpara and Parbatjhora Forest Division, Kokrajhar district, Assam. Morphological characterization in the progeny trial revealed variations in bark, drupe and stone. Mini-cutting technique was initiated using different concentrations of IBA and sprouting was observed. Micropropagation technique has been optimized. ***In-vitro*** cultures initiated successfully from nodal cuttings. The rooted propagules hardened successfully in vermiculite in mist chamber and were transferred to soil. Rooting experiment was conducted and maximum 62% rooting was observed at 200 ppm IBA solution.

Genetic improvement of *Azadirachta indica* for developing high oil and azadirachtin yielding varieties (FRI)

The collection of leaves of different progenies of ***Azadirachta indica*** from field trails as well as germplasm bank was been carried out and the leaves stored at –80 ºC in laboratory for further molecular analysis. The process of identification and (or) development of unique SSR primers has also been initiated. The concentration of fatty oil and azadirachtin varied considerably with respect to agro-climatic and ecological zones, varietal and genetic factors. The average maximum concentration of Aza-A, Aza-B, Nimbin and Salannin in neem oil have been found as 8,610, 7,319;19,237 and 39,840 ppm, respectively. Master cultures of various genotypes are being maintained at FRI, Dehradun.

Genetic improvement for productivity and insecticidal properties of *Polygonatum verticillatum* Linn.(FRI)

Gene bank of ***Polygonatum verticillatum*** was established at High Altitude Herbal Garden, Chakarata (Uttarakhand), consisting 140 genotypes selected from the entire growing range of the species in India (J&K, Himachal Pradesh, Uttarakhand & Sikkim). Genetic diversity & active principles among the genotypes were analyzed & found to vary significantly from region to region & genotype to genotype.

Study of structural dynamics and genetic improvement of *Grevillea robusta* (Silver Oak) (FRI)

Field surveys were conducted regularly and data were recorded on spatial, morphological and phenological parameters of ***Grevillea robusta***. On the basis of these parameters, selection indices were used to select the CPTs from Haryana, Punjab and Uttarakhand. Genomic DNA of 200 samples belonging to different genotypes of Haryana, Punjab, Uttarakhand and Uttar Pradesh was extracted with precision and stored at -80^{0}C. 120 SSR primers were designed from sequenced data, out of which 11 showed polymorphism. Multi-location progeny trials have been raised in 3 states i.e. Haryana, Uttarakhandand and Uttar Pradesh. Complete eco-distribution maps were prepared for Punjab, Haryana and Uttarakhand using Maxent modeling tool.

Deployment of eucalypts genotypes in the field and hybridity testing through molecular markers(FRI)

PCR primers designing for predicted SSRs analysis in eucalypts was completed. Leaf samples were collected from eucalypts trials to study genetic relatedness. The 4 polymorphic primers that got amplified products were visualized through qualitative assay (gel electrophoresis). Vegetative propagation was successful in genotype (1D) from branch cuttings of mature trees of eucalypts.

Selection and genetic evaluation of *Ailanthus excelsa* germplasm in northern India(FRI)

15 polymorphic SSR Primers have been validated for all 220 samples of genotypes of ***Ailanthus excelsa*** and these all are now ready for genotyping. A total of seven progeny trials have been established across locations in northern India. Recently, severe disease outbreaks of Alternaria leaf spot on ***A. excelsa*** were recorded. This is the first report to confirm that ***Alternaria alternata*** is associated with leaf spot and blight disease of ***Ailanthus excelsa*** in India.

Field evaluation of recombinants emanating from F1 and F2 generations of *Corymbia* (Syn. *Eucalyptus*) hybrid *C. citriodora* × *C. torelliana* for high productivity (FRI)

Inter-specific hybrids and recombinants were developed from ***Corymbia citriodora*** × ***C. torelliana*** and were selected and classified on morphological basis. Complete micro-propagation protocols were developed for 9 accessions and established in an evaluation trial as single tree plot design at three sites of Seonthi (Kurukshetra), Manakpur (Yamunanagar) and FRI Dehradun. Tissue culture cloned hybrids E-14 and E-2 were performing the best in growth and survival after one year of planting. Across all three sites, best growth after one year was observed in E-14 (ht 393.4 cm and dbh 27.9 mm) followed by E-2 (ht 300.2 cm and dbh19.7 mm).

Development of Seed Production Area and haploid plants in *Commiphora wightii* (Arnott)- A rare and threatened medicinal plant (AFRI)

142 genotypes, with minimum 100 seed yield were selected. A total of 61 genotypes which were common in all three parameters; black seed ratio, black seed weight and black seed germination percentage were further selected. After three months, findings on growth indicated that three genotypes namely C 501, C 516 and C 609 were superior. At present 7,700 ***Commiphora wightii*** germplasm are available in AFRI and out of these 714 are superior female progenies.

Cuttings of 25 superior female genotypes from Deesa, Gujarat were raised in AFRI mist chamber in February 2019. Rooting in 55.40% cuttings was observed after two months. It can also be treated as Genetic Resource of ***C. wightii*** (particularly extremely rare male plants) for future improvement and Breeding Programme.

A) Male and selected superior female ***Commiphora wightii*** (guggal) cuttings collected from Deesa,

B) Sprouting in male cuttings

C) Response in cuttings of 13 male genotypes

D) Response in cuttings of 25 superior female genotypes - Total 7697 plants

Studies on phenology, molecular analysis and wood properties of *Tecomella undulata* with respect to three flower colour morphotypes (AFRI)

Based on the survey of eight districts of Rajasthan (Nagaur, Sikar, Churu, Bikaner, Jalore, Jaisalmer, Barmer and Jodhpur), three morphotypes of ***Tecomella undulata*** were identified. It was observed that the percentage of orange colour morphotypes was more in comparison to yellow and red colour morphotypes. For phenological studies 90 trees (30 trees of each color) were marked at Bhadrajune, Jalore and phenological data like leaf size, pod size, flowering pattern and percentage was recorded among the three different flower colour morphotypes. For testing of mechanical and physical properties of wood among these morphotypes, 9 wood logs from Mohangarh, Jaisalmer were collected and supplied to FRI, Dehradun for wood quality analysis.

Various properties of wood tested indicated that red flower trees had higher specific gravity (0.67 g /cm^3), fibre stress elastic limit of 62.4 N/mm^2, Modulus of Rupture of 93.4 N/mm^2, Modulus of Elasticity of 7,830 N/mm^2, radial and tangential hardness of 7,578 N and 8,189, respectively and radial and tangential shear strength Parallel to grain as 11.2 N/mm^2 and 12.2 N/mm^2 as compared to other flower colour trees.

Marking, felling and transportation of nine logs of *Tecomella undulata* from Mohangarh, Jaisalmer to FRI, Dehradun

Multilocational clonal trials of Casuarina species for multiple end uses in Gujarat state(AFRI)

Survival rate and growth were measured in three trials (one in Rajkotand two in Bhavnagar-Hatab and Hebatpur) established with 30 outstanding clones of *Casuarina equisetifolia, C. junghuhniana* and their hybrids. One-year growth assessment revealed that CH 18, CH 22 and CH 25 clones are performing better in all the three locations. These clones belong to inter-specific hybrids between *C. equisetifolia* and *C. Junghuniana*. 98 %survival rate was observed in Rajkot (inland area) as compared to 25% in Hatab (sea coast) and Hebatpur (saline

Clonal plantation at Rajkot (inland area)

Clonal plantation at Hebatpur (Salt affected)

Genetic improvement of *Parkia roxburghii* (RFRI)

82 CPTs of *Parkia roxburghii* were selected from Manipur, Mizoram, Nagaland and Tripura. Vegetative propagation techniques through cuttings and air layering were standardized. IBA 500 ppm treatment for 30 minutes with suitable potting media i.e., sand, soil and FYM (1:1:1) was the best for propagation through cuttings. Vegetative propagation through air layering was successful with IBA 200ppm + moss + soil+ coconut husk. A total of 16 bacterial strains have been isolated from soil and preserved for further identification and development of Plant Growth Promoting Rhizobacteria (PGPR).

Vegetative propagation through stem cuttings

Vegetative propagation through Air layering

Isolation and pure culturing of different bacterial strains

Genetic improvement and conservation of Chironji (*Buchnania cochinchinensis* Lour) in central and eastern India (IFP)

210 CPTs of *Buchnania cochinchinensis* have been selected in 15 districts of Jharkhand and in one district of West Bengal and passport data have been recorded for the selected CPTs. Seeds from 20 selected CPTs were collected and seed length, seed width and 100 seed weight were recorded. Seed oil content estimation was carried out. Pre-sowing treatment has been standardized. On the basis of phenotypical assessment, maximum phenotypical good trees were found in Latehar district followed by East Singhbhum of Jharkhand. Preliminary results show that provenance Batkha Kahapa, Chhindwara is promising.

Evaluation of the existing seed stands and seed production areas (SPA) of major forest trees under the Forest Directorate, West Bengal (IFP)

Evaluation of existing seed stands in the three Silviculture Divisions of West Bengal were carried out. Of the 202, 194 seed stands have been evaluated based on area, isolation zone, tree density, tree age, growth, health etc. Inferior trees owing to retarded growth, crooked stem form, attack by pest and diseases or damage by cyclone have also been demarcated. These trees are proposed for culling in future for better seed production. Silvicultural practices such as weeding, cleaning and pruning are suggested to be undertaken for better accessibility to the seed stands.

2.3.4 Vegetative Propagation

Propagation of improved bamboo clumps

About 20,000 plants of the selected improved bamboo clumps have been produced vegetatively for their propagation and dissemination. FRI, Dehradun transferred 13 superior clumps of ***D. strictus*** (10 clumps) and ***D. somdevai*** (3 clump) to Uttarakhand State Bamboo Mission through Material Transfer Agreement (MTA). About 1,000 superior plants were provided to HFRI, Shimla for development of demonstration plantation/bamboo nursery. TFRI, Jabalpur transferred 2 superior clumps, one each of ***Bambusa tulda*** and ***B. bambos*** to Telangana State Bamboo Mission through MTA. RFRI, Jorhat supplied superior planting material to IFGTB Coimbatore on MTA.

Stock of Multiplied Superior Clumps ready for transfer at FRI, Dehradun

Maintenance of Rhizome bank at RFRI Jorhat

Studies on improving adventitious rooting in *Dalbergia latifolia* Roxb. and field performance of its rooted plantlets (TFRI)

Branch wood cuttings of ***Dalbergia latifolia*** with basal dip treatment of 5mM IAA + 1mM boric acid for a period of 20 hrs planted during the month of April-May resulted in 26% adventitious rooting. Field performance of cuttings raised plants is better than seedlings raised plants.

2.3.5

Biotechnology

Evaluation of germplasm and transcriptome studies in eucalypts for water logging and salinity(FRI)

To address the problem of waterlogging and salinity in Bathinda, Faridkot, Ferozepur, Muktsar and Sangrur districts of Punjab, clones of eucalyptus are being screened for water logging and bio-drainage applications. In first screening based on nursery experiments and physiological parameters, 88 clones were screened, out of which 11tolerant clones and 11 susceptible clones were identified. These will be used for field trials and controlled transcriptome analysis.

Network Project on Marker-Assisted Selection in Eucalyptus (Thaila maram) (IFGTB)

Genome-wide association analysis was conducted and single nucleotide polymorphism (SNPs) was identified for different wood property traits in *Eucalyptus*, explaining up to 20.49% of phenotypic variance. Additionally, water stress tolerant clones were cataloged and drought indices for screening *Eucalyptus* clones in nursery condition were developed. A set of chromosome-specific polymorphic SSRs were identified to enhance the mapping of eucalypts genome. Potential markers identified to explore the possibilities of marker assisted selection/breeding in eucalypts. A combination of drought indices for screening *Eucalyptus* clones for water stress response in nursery condition was identified. Multiple trait selection indices for wood property traits and abiotic stress tolerance were also developed.

In vitro production of secondary metabolites from tree species(IFGTB)

Protocols for hairy root culture have been developed for tree species in which roots are the major source of medicinal extractives. Tissue culture protocols for *Aegle marmelos* (Bael), *Oroxylum indicum* (Syonkha), *Gmelina arborea* (Ghamari) have been successfully established. Hairy root transformation protocols were developed for these three species.

Single Nucleotide Polymorphism (SNP) marker discovery to resolve *Bambusa tulda-longispiculata-nutans-teres* complex in bamboo taxonomy(IFP)

Transferability of around 400 EST-SSR from rice has been evaluated to find 39 potential markers which include 5 for *Bambusa nutans*, 13 for *B. tulda*, 15 for *B. teres* and 3 for *B. longispiculata*. The cytoplasmic genes i.e. rbcl, matk and rpoc based markers were amplified in the genome of 9 genotypes of *B. nutans*, 7 genotypes of *B. tulda* and 1 genotype of *B. teres* and *B. longispiculata* each, respectively to sequence specific single band amplicons for detection of SNPs. 5 SNPs were obtained from matK gene of size 868 bp showed 1 SNP whereas rbcl and rpoCl gene of size 730 bp and 447 bp, respectively showed 2 SNPs each. Out of the 5 SNPs, three SNPs were predominantly present in *B. nutans* only and absent in *B. tulda.* This finding could be useful for taxonomical identification. *B. longispiculata* was found different from the other three species with respect to mat-K gene while *B. nutans* was different from others with respect to rbcl and rpo CL genes.

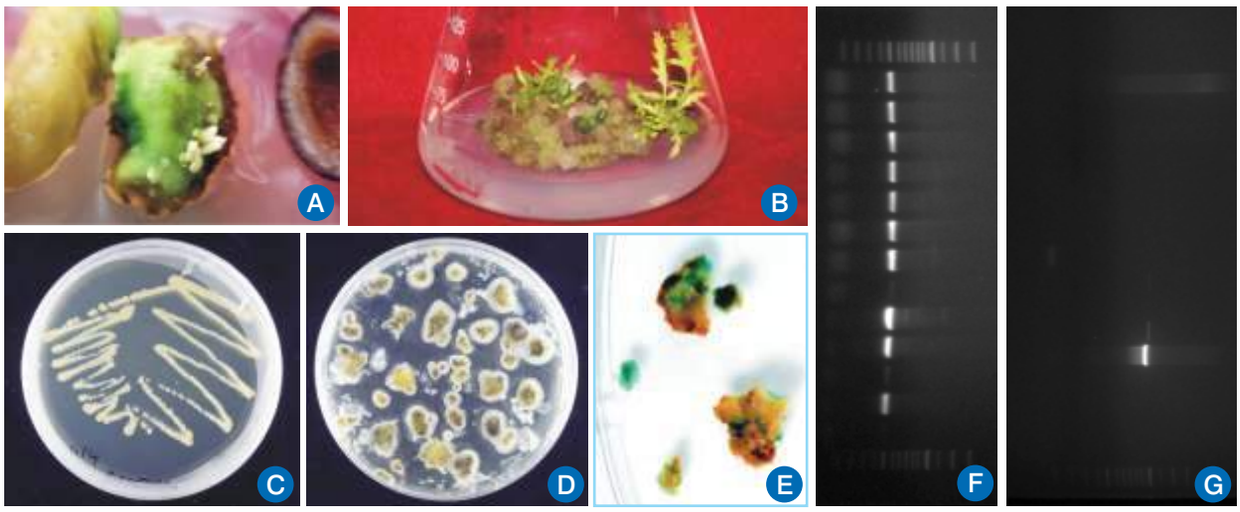
Studies on propagation of a valuable timber species, *Diospyros ebenum* J. Koenig ex Retz. through seeds and *in vitro* techniques(IWST)

Diospyros ebenum seedlings were collected and DNA extraction from leaf was standardized. *In vitro* culture establishment of *Diospyros* sp. callus was successfully initiated from leaf explants and shoots were induced from axillary buds of *D. ebenum*.

Genetic improvement of *Azadirachta indica* (neem) through transgene pyramiding for enhancement of cold endurance(AFRI)

LBA4404 strain of Agrobacterium was successfully transformed with the pCAMBIA1304 plasmid vector which contains genes for selectable marker - gusA and gfp. Neemcalli after 3 days of Agrobacterium co-cultivation on modified co-cultivation (MCCM) medium were incubated in X-Gluc solution at 37°C from a few minutes to overnight and scored for evidence and extent of GUS activity. Stable expression of beta-glucourinidase gene was observed as blue patches on callus surface and inside upon sectioning after over 12 weeks of co-cultivation, indicating positive transformation events and successful integration of the introduced (gusA) gene in neem genome. The efficiency of transformation has to be further optimized. Semi Quantitative Reverse Transcriptase-PCR (sqRT-PCR) was done using gusA gene primers and *nptII* gene primers and distinct bands were obtained corresponding to each of the two genes, giving molecular confirmation of the transformation success.

Neem Genetic Transformation



A. Somatic embryos in Neem; B. Shoot formation *in vitro* from neem callus; C. Agrobacterium culture maintenance; D. Agro-Neem cocultivation plate; E. GUS Positive callus of Neem; F. Expression of hpt-II gene introduced in Neem; G. Expression of GUS gene introduced in Neem callus.

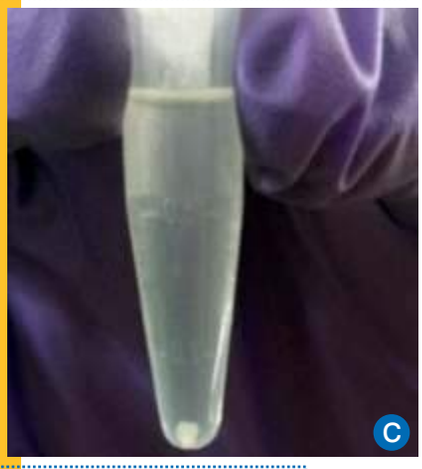
Cloning and characterization of salt tolerance conferring vacuolar Na+/h+ antiporter (nhx1) genes from *Prosopis juliflora* and *Salvadora persica* (AFRI)

Prosopis juliflora and ***Salvadora persica*** seeds were collected, procured, stored and seedlings have been grown on hydroponics system containing Hoagland medium supplemented with different NaCl concentrations for different durations. Plants were treated with various concentrations of NaCl (40mM, 100mM, 200mM, 300mM and 400mM) for different time periods - 1h, 3h, 6h, 12h, 24h, 36h, 72h and 7 days. RNA was extracted from leaves and roots from both species and quantified. cDNA has been prepared from the RNA and stored for future. The yield of RNA ranged between 0.5-0.75 mg per gram of fresh tissue and the absorption ratio (A260/A280) was 1.98 (close to ratio for pure RNA). Partial length isolation of Na+/H+ antiporter gene and its sequencing were done.

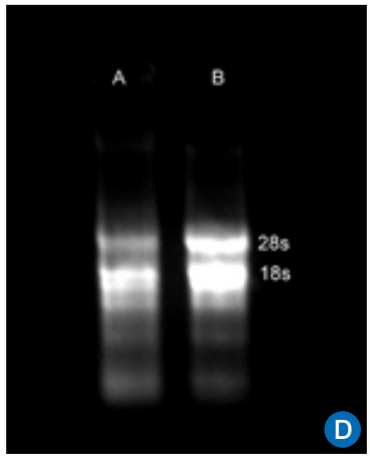
Gene Cloning of nhx1 gene from trees

A. *Salvadora persica* seedlings growing

B. RNA extraction protocol optimization step



C. RNA pallet at the bottom



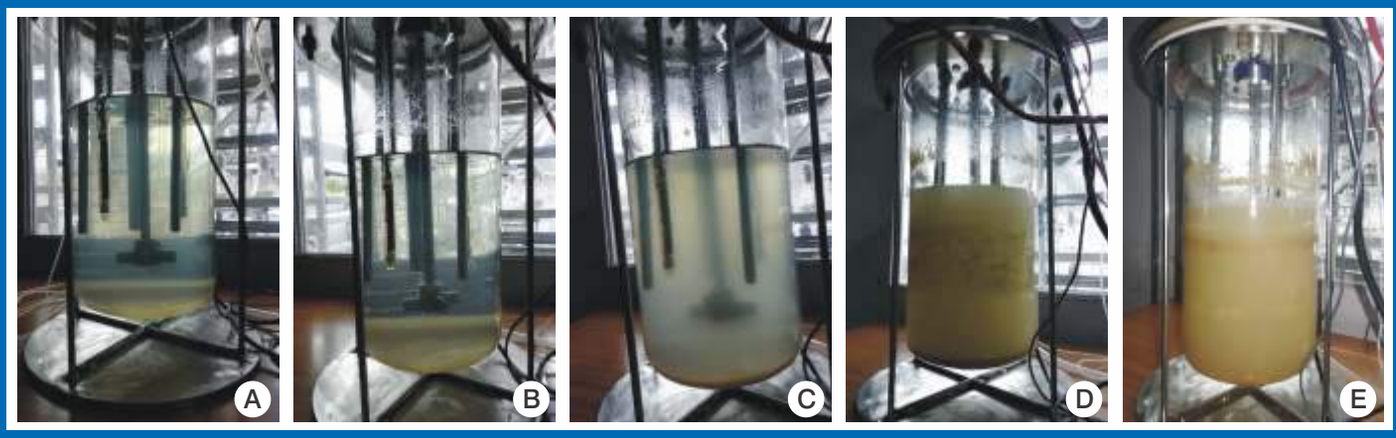
D. Denaturing Gel electrophoresis showing good RNA yield from *S. persica*.

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

Tissue culture studies were carried out in ***Schizostachyum dullooa***. Nodal segments were used for micropropagation. The best bud break was achieved on MS medium supplemented with 5.0 mg/l BAP. After 2 weeks, proliferated shoots were sub-cultured on fresh MS medium supplemented with cytokinin. ***In vitro*** shoot multiplication was achieved on MS medium supplemented with 2.5mg/l BAP. This bamboo is very recalcitrant for ***in vitro*** rooting as all the experiments conducted failed to produce ***in vitro*** rooting.

Non-destructive *in vitro* production of pharmacologically - active natural extract containing Guggulsterones – A potent cardio-protective and anti-cancer drug from *Commiphora wightii* (guggul) using Bioreactor (AFRI)

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



(A to E): Stages of biomass accumulation of guggul cell lines in the bioreactor over time at 1 week interval

Screening of DNA markers to distinguish male and female *Ailanthus excelsa* (Ardu) trees for higher biomass production (AFRI)

Genomic DNA was extracted from leaf samples of 80 ***Ailanthus excelsa*** trees (20 male and 20 female trees each from two locations of Gujarat and 30 (15 male and 15 female) ***A. excelsa*** trees leaves samples from Jodhpur. A total of 42 RAPD, 20 ISSR and 23 ScoT primers were screened for DNA amplification of the male and female trees. Out of these, only 13 RAPD, 6 ISSR and 6 SCoT primers were found to be polymorphic for all three sites. None of the RAPD, ISSR and ScoT primers showed private band which can clearly differentiate between two genders. Cost analysis of markers shows that morphological markers are 10 times cheaper than DNA marker. Morphological marker (leaf trichome) is the best, cost effective as well as highly reliable marker for gender identification in ***A. excelsa*** as yet.

2.4 FOREST MANAGEMENT

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	04	03	01
Externally Aided	05	06	04

2.4.1 Sustainable Forest Management (SFM)

Monitoring and Evaluation of PUN-CAMPA and GPM plantations of Punjab (FRI)

The monitoring and evaluation of plantations carried out in all the forest divisions of 4 circles by Punjab Forest Department under PUN-CAMPA was done. Monitoring and evaluation was done in 591 randomly selected sites with an area of 3,637.07 ha out of the total 1,193 sites.

Assessment of Visitor Carrying Capacity (IFGTB)

Visitor carrying capacity of Chembra peak, Banasuramala-Meenmutty and Soojippara in South Wayanad Division, Kerala was assessed based on the data collected through field inspection, interactions with officials/staff of forest department, other stakeholders of the ecotourism sites and local people. The assessment was done in terms of physical carrying capacity (PCC), real carrying capacity (RCC) and effective carrying capacity (ECC).

Chembra Peak, Wayanad (Kerala)

It was observed that the present management capacity of the area is optimum and it was recommended that 200 visitors may be allowed to visit the Chembra ecotourism site daily during the season, subject to the variation in limiting factors. It was also observed that the visitors entering the area were more for the year 2016-17 and it was above the present estimated level of carrying capacity.

Banasuramala-Meenmutty, Wayanad (Kerala)

The study recommended that 1,100 visitors may be allowed to visit the Banasuramala-Meenmutty ecotourism site on daily basis during the season, subject to the variation in limiting factors. The study found that the present management capacity of area is optimum.

Soojippara, Wayanad (Kerala)

It was suggested that 1,200 visitors may be allowed to visit the Soojippara ecotourism site daily during the season, subject to the variation in limiting factors. It was found that the present management capacity of area is optimum. It was observed that the number of visitors entering the area was high for the years 2010-11 to 2012-13, 2015-16 and 2016-2017.

Effect of management practices on wood quality of *Melia dubia* (IWST)

Various wood properties - anatomical, physical and mechanical - of ***Melia dubia*** were studied for evaluation of wood quality from managed and unmanaged plantations. ***M. dubia*** wood of managed plantation has not shown any significant difference in specific gravity and strength properties compared to unmanaged plantation. However, the timber from managed plantation is more dimensionally stable.

Studies on status of *Dalbergia latifolia* – high value Indian Rosewood in Karnataka and Kerala (IWST)

Information on population structure and regeneration status of ***Dalbergia latifolia*** was recorded during field survey in various forest divisions of Karnataka and two forest divisions of Kerala. The study revealed that in natural forests, regeneration was poor and only mature trees were present. In moist deciduous condition although seeds showed good germination and

seedling formation, but seedlings fail to reach the next stage i.e., saplings and poles, due to tough competition from herbaceous weeds, ground fire, insect-pest attack and trampling and browsing by wild animals, etc. Therefore, different girth class trees were missing in the study area.

Restoration of Orchid Flora of Makum coal field areas of Digboi Forest Division (RFRI)

Altogether 35 orchid species were identified along with their host plants from Lekhapani, Tinkupani, Saleki, Namphai Reserve Forest and Tipong RF and proposed RF areas near Makum coal field, Margherita (Assam). Out of the 35 species, 32 were epiphytic in nature and 3 were terrestrial. *In-vitro* seed culture of 10orchid species was used for mass multiplication.

Capacity building on bamboo treatment techniques for promotion of earthquake resilient housing and structures in hill regions of Tripura (RFRI)

Designs for fabrication of three types of equipment i.e., Boucherie apparatus, Boiling Tanks and VPI machine were finalized and these were fabricated for conducting training programmes and for treatment of bamboos for house construction. People-friendly course modules for different training programmes were developed. A participatory SWOT analysis was also conducted for exploring the feasibility and effectiveness of different treatments and their methods.

One VPI Bamboo treatment plant was installed at the micro-enterprise site at Barkathal and its operational procedure was demonstrated for hands-on training to the core group members. Construction of four bamboo houses at

Bamboo treatment

Promoting livelihood by bamboo charcoal production and briquetting among selected forest fringe villages of Karbi Anglong district, Assam (RFRI)

Awareness programmes were conducted on optimum utilization of bamboo and to convert waste bamboo into value added product in the form of bamboo charcoal briquette at Sardoka Engti Village and Rong Bong

Training programme at newly established facility centre

Ghat, Karbi Anglong district (Assam). Manual briquetter has been developed and 10 such briquetters were fabricated for bamboo charcoal briquette making. A model facility (brick kiln) centre was established in Jilangso village of Karbi Anglong for bamboo charcoal production.

Assessing the impact of pruning of *Diospyros melanoxylon* bushes on yield, quality and natural regeneration of tree species in Maharashtra (TFRI)

Regeneration pathways of ***Diospyros melanoxylon*** (Tendu) through its root suckers and seeds were studied in Gondia and Gadchiroli forest divisions of Maharashtra. Studies were conducted in quadrats having regularly pruned tendu bushes and unpruned tendu poles. The plots having more number of pruned bushes depicted higher regeneration and number of regenerated individuals through root suckers, as compared to the quadrats having un-pruned tendu poles. The number of individuals in tendu plots increased 1.39 times in a year and maximum increase occurred during post-monsoon period. Under nursery conditions, tendu seeds depicted 37% germination rate. Seed germination initiated from the 25th day and continued till 37th day of sowing, the germinated seedlings showing 94.12% survival on nursery beds.

Regeneration of tendu through root sucker

Studying regeneration status of tendu in Maharashtra

2.4.2

Forest Economics

Estimation of species-wise bamboo resources and assessment of their utilization pattern in Mokokchung district of Nagaland (RFRI)

56 sample plots were laid out and 190 households were surveyed for information on utilization pattern of bamboo. A total of 955 clumps had been recorded from13 bamboo species including *B. balcooa, B. pallida, B. tulda, Cephalostachyum capitatum, Dendrocalamus hamiltonii, D. sikkimensis, Oxytenanthera parvifolia, Teinostachyum dullooa,* etc. For enumeration and development of allometric equations,120 culms of *B. tulda* were harvested.

It was found that the average density (culms/ha) of *B. tulda* increased with age. However, it was interesting to note that very few culms of girth classes of 31-39 cm were observed, which indicates that in general this species does not exceed 39 cm in girth in the study area. The height (m) of *B. tuldatends* to increase with girth and age, where it ranged from 12.13-21.86 m. The moisture content (%) of culm, branch and leaf does not follow any regular pattern in different girth classes but overall, it decreases with age over the years.

2.4.3

Information and Communication Technology (ICT)

Development of database on Non-Timber Forest Produce (NTFP) in Karnataka (IWST)

NTFP database was developed for connecting the Large-sized Adivasi Multipurpose Cooperative Societies (LAMPS) and decision makers for Karnataka forest department.

Smart forest project on protocol standardization for microchip-based e-protection system for valuable trees Phase II (IWST)

Protocol for microchip-based e-protection system for valuable trees was standardized. Modified microchip and simcard-based gateway were assembled. Communication between the microchip and gate is under progress. Development of protocol for microchip-based e-protection system for sandalwood trees, for example, will help to conserve precious bio-resources of the country.

2.5 WOOD PRODUCTS

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	12	29	06
Externally Aided	03	07	00

2.5.1 Wood and other Lignocellulosic Composites

Biological degradation and weathering behaviour of wood-polymer composites (IWST)

Wood plastic composites were found susceptible to weathering degradation with change in colour during early stages of weathering followed by loss in mechanical strength on long term exposure to outside conditions. Among different fibre types, jute fibre reinforced composite exhibited maximum colour change. At low fibre content, the strength loss ranged from 10 to 13% in composites after 12 months of weathering. At higher fibre content (50%), the strength loss ranged from 13 to 18%. Weathering resulted in development of micro-voids on the surfaces of composite material. Though presence of coupling agent did not have any influence in colour change, it had a positive impact on mechanical properties.

Development of agro-fibre filled reinforced polypropylene composites (IWST)

Extensive studies on luffa, arecanut, lantana and jute-luffa reinforced polypropylene composites indicated the possibilities of using these fibres for making value added products. The composites were prepared with and without coupling agent at different fibree loading ranging from 20% to 50%. The coupling agent is critical in imparting superior mechanical strength to the composites, making them suitable for different products. Arecanut shell fibres and lantana are good options for bulk production of thermoplastic composites. Injection-moulded products can easily be made using these composites with fibre content upto 50%.

Development of bamboo lumber using different bamboo species and evaluating its utilization potential as alternate to solid wood lumber for different structural applications (IWST)

Bamboo lumbers (using laminated strips and crushed bamboo) were prepared using matured culms of *Dendrocalamus brandisii, Bambusa bambos, B. vulgaris, Guadua angustifolia*. The lumber of all the species were tested for various physical and mechanical properties as per BIS. The mechanical properties of bamboo lumbers were better than teak. These bamboo-based composites have potential to be used as an alternate to solid wood in structural and non-structural

Bamboo lumber using laminated strips and crushed bamboo

Cross Laminated Timber panels

Properties of cross laminated timber from plantation grown hardwoods (IWST)

Rubberwood and pine wood planks used for making Cross Laminated Timber (CLT) panels were segregated based on their stiffness class. The stiffness and air dry density of rubberwood varied from 6 to 12 GPa and 0.49 to 0.83 g/cc, respectively. In case of pinewood, stiffness was ranging from 3.35 to 10.5 GPa and density was in the range of 0.39 to 0.55 g/cc. CLT panels were prepared using epoxy and polyurethane-based adhesives and tested for their density and stiffness. The stiffness of CLT was in the range of 9-10 GPa in case of rubberwood and 6-7 GPa for pinewood. In order to compare the properties, glulams were also prepared with three layers. Density of glulam was very similar to CLT but dynamic modulus was nearly 15% higher. CLT, glulam and normal wood were subjected to moisture absorption and adsorption test. Water soaking tests revealed the suitability of polyurethane based adhesive for CLT.

2.5.2
Wood Processing

Development of organo-metallic complex of *Eucalyptus* spp. and *Lantana camara* extracts and its evaluation as semi-biopreservative(IWST)

Organo-metallic complexes of ***Eucalyptus*** spp. and ***Lantana camara*** were evaluated as a potential wood preservative. Extractives from bark, wood and leaves were prepared using different solvents (viz., hexane, acetone, alcohol and water) of varying polarity. ***Hevea brasiliensis*** (Rubberwood) samples were treated with extractives of the above species by pressure method and dipping method, and were exposed to field test to study the toxicity of different extractives. Results of the initial experiment showed that alcohol and water extract after sequential extraction was performing better compared to other two solvents. ***Eucalyptus*** bark and wood extractives are performing better as compared to leaf extract.

2.5.3

Value Addition and Utilization

Thermo-Hygro-Mechanical (THM) modification of plantation grown timbers for value addition(FRI)

Plantation timbers densities are lower than those of traditional furniture and joinery timbers of India. The density and other properties of the timber can be enhanced with the help of thermo-hygro-mechanical methods to make it suitable for higher end products like furniture, flooring, etc. The results of the present study indicate that the low-quality plantation grown timbers may completely be transformed into high quality timbers with increased density, mechanical properties, colour and texture. Thermo-Hygro-Mechanical (THM) treatment transforms wood into semi-solid state, after which 'die-tool' was used to compress and impose shapes and patterns simultaneously. Excellent results were obtained on *Melia dubia* and *Eucalyptus* spp. on 'die-tool' imprinting.

Raw wood of *M. dubia* and it is modified using Thrmo-Hygro-Mechanical process

'Die-tool' imprinted wood blocks using THM treatment

Value-addition of low density woods by producing nano-wood composites (NWC) with enhanced properties for high end applications (IWST)

Three low density wood species, viz., *Maesopsis eminii, Ailanthus excelsa* and *Melia dubia* were impregnated with two resins (phenol formaldehyde and melamine formaldehyde) blended with different proportions of clay and silica nano-particles using vacuum-pressure technique for improving their technologically important quality parameters. Density and strength parameters of all three woods were found to be improved by 15-25% and 30-55% after impregnation with resin-nano particle blends

compared to control. For evaluating bio-resistance, samples were exposed in graveyard and in the lab and regular observations are being taken. Preliminary results indicated effectiveness of the nano-impregnation for improving termite resistance of low durability timber.

Studies on role of nano-fillers in wood composites and finger-jointed solid wood(FRI)

In the continuing efforts to improve the working efficiency of finger joints of *Melia azedarach* sections using nano-clay addition into UF adhesive, experiments were conducted with eight different concentrations. It was observed that1% nano-clay of UF resin powder resulted in the highest bending strength of 51.1 N/mm^2 accounting for 60.7% enhancement in MoR without affecting the elasticity.

Performance of southern Yellow Pine (SYP) and imported teak samples treated with CCA, CCB and ZiBOC(FRI)

Southern Yellow Pine (SYP) and imported teak (*Tectona grandis*) samples treated with CCA, CCB and ZiBOC wood preservative were evaluated in prototype cooling tower. Results showed that mean weight loss (%) was maximum (30.5%) in untreated samples in SYP as compared to imported teak (22%),where as substantial protection was achieved after treatment with preservative in both the species.

Studies on the Radio Frequency Curing of adhesives in manufacturing of plywood (FRI)

Using Radio Frequency Curing technique plywood of poplar veneers and combi-ply of poplar and eucalypts veneers with different duration of pressing time and pressure levels using urea formaldehyde (UF) and phenol formaldehyde (PF) adhesives have been prepared and tested for their properties (MC, density, GSS in dry and wet conditions; MoR along and across the grain; MoE along and across the grain). The process parameters for the manufacturing of poplar plywood and combi-ply of poplar and eucalypts veneers have been optimized.

Seasoning studies on important species of bamboos for handicrafts using dehumidifier kiln and vacuum kiln(FRI)

For the first time, four species of bamboos - B. *tulda, B. nutans, B. vulgaris* and *Dendrocalamus giganteus*, which are important for bamboo artisans for manufacturing of round bamboo novelty products, have been successfully kiln seasoned without drying degrades. Samples of these species were seasoned in dehumidifier kiln and vacuum kiln separately, and data have been recorded. The results showed that these bamboo species can be successfully kiln seasoned (defect free) in vacuum as well as dehumidifier kilns, provided mature material of more than 4 years age was taken for seasoning. The round bamboo material up to 10m height from bottom of culms dries defect free in these two kilns. The implementation of developed kiln seasoning method of bamboos will add value to round bamboo products for bamboo artisans in terms of uniform quality products.

Bamboo samples inside vacuum kiln during seasoning

Bamboo samples inside dehumidifier kiln during seasoning

Thermal modification of bamboos for improving various properties and value-added applications (IWST)

Bamboo culms of three species, namely *Dendrocalamus stocksii, D. strictus* and *Thyrsostachys oliveri* were thermally modified at 160-220°C for different durations. Thermally modified bamboo showed uniform brownish surface, reduced EMC (by 50-60%) and enhanced dimensional stability (by 50-55%). Flexural stiffness (MoE) and compressive strength was found to be almost unaffected up to 200°C. However, flexural strength (MoR) of bamboos reduced by 15-40%, depending upon treatment temperature. Amount of hemicellulose and alpha-cellulose was found to be decreased, while proportion of lignin increased with heat treatment. Thermally modified bamboos have improved decay resistance against fungal decay but not much resistance against termites. A few composite boards were also produced successfully using crushed and strips of thermally modified bamboo. Thermally modified bamboos may be used for producing furniture, flooring tiles, bamboo boards and strip-based panel products.

Weathering of coatings on thermally modified wood(IWST)

The study establishes the role of heartwood extractives in the photo-stability of *Albizia lebbek* and *Acacia auriculiformis* wood. The extractive rich heartwood showed higher UV resistance as compared to sapwood and is species dependent. Thermal modification of heartwood further enhanced UV resistance due to the presence of photo-stable compounds generated during thermal modification. Thermally modified wood, particularly sapwood portion is susceptible to photo-degradation and can be controlled by application of coating containing UV absorber (benzotriazole). Hot oil treatment with Pongamia oil was found to be very effective for inducing weathering resistance to *Hevea brasiliensis* and *Melia dubia* wood. Therefore, wood treated with hot Pongamia oil can be used for outdoor applications. Thermal modification has no beneficial effect in enhancing service life of transparent PU coating.

Photo-stabilization of wood surfaces and coatings with nanoscale UV absorbers (IWST)

Study on wavelength sensitivity of photo-degradation of wood indicates high degradation of wood surfaces below 380nm. Dispersion of nano-particles in PU coatings significantly restricted the colour changes and photo-degradation of wood polymers. Preliminary results on comparison of inorganic and organic UV absorbers indicate superiority of inorganic nano-particles in providing UV and microbial resistance.

2.5.4
Wood Chemistry

Isolation, identification and evaluation of the chemical markers in *Pterocarpus santalinus L.* (Red Sanders) wood grown in different locations(IWST)

Extraction and fractionation protocols have been developed for polar and non-polar metabolites (phytochemicals) from *Pterocarpus santalinus* (Red Sanders) (RS) wood. Standardization of isolation protocol for non-polar compounds and sequential extraction and fractional of polar metabolites was carried out. Non-polar major compounds were characterized by NMR, mass and other techniques. Chromatographic (i.e., HPLC and HPLC-MS/MS) fingerprints of RS wood were developed and its evaluation in core samples of RS wood from different locations was carried out. In HPLC analysis, at least five major peaks were observed in all core samples irrespective of location and girth class.

2.5.5
Pulp and Paper

Study on utilization of cationic cellulose as strength additive for quality paper production(FRI)

Suitability of bagasse for the extraction of alpha cellulose and its modifications into other bio-products was studied. Reaction parameters for the modification of alpha cellulose into cationic cellulose were optimized. Optimum DS (0.66) has been achieved in cationic cellulose produced from bagasse alpha cellulose. Cationic cellulose used as a strength additive in paper making shows a positive impact on the burst index of paper. The results of the study revealed that highly substituted cationic cellulose could be a suitable alternative to cationic starch as a strength additive in case of virgin pulps and mixed grade pulps.

2.6 NON-WOOD FOREST PRODUCTS (NWFPs)

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	03	07	01
Externally Aided	05	30	05

2.6.1 Resource Development of NWFPs

Studies on agro-economics, market price spread and gap analysis in cultivation and processing of Senna and Isabgol in Jodhpur Division of Rajasthan (AFRI)

14 *Cassia angustifolia* (senna) processing industries in Jodhpur and Pali districts were surveyed to identify constraints in processing and marketing of senna (Sonamukhi) in Jodhpur division of Rajasthan. Findings of the study revealed that small farmers are compelled to sell their products to middleman at lower prices. Various constraints identified includes- unavailability of labour at the right time, lack of knowledge about post-harvest technology and problems associated with long term storage of leaves, monopoly of traders, mandi system regarding intake of senna leaves and pods at some places.

Collection & storage in farmers field in Pali district

Storage of Senna in APMC, Sojat

Processing of Senna in Industry

Bailing of Senna

Processing, Trading and Marketing of Senna in different districts of Rajasthan

Capacity building of VFPCs/SHGs through value addition of selected under-utilized NTFPs for enhanced livelihood opportunities in arid and semi-arid Rajasthan (AFRI)

Cutting and weighing of fruits

- **Value Addition of *Cordia gharaf* (fruits) and *Leptadenia reticulata* (pods):** Pickle and murabba were prepared from fruits of *C. gharaf* whereas pickle was prepared from pods of *L. reticulata*. No microbial growth was observed up to six months in products of *C. gharaf*. However, the pickle prepared from the pods of *L. reticulata* tasted bitter after three months.
- **Study on shelf life of Value-added products of fruits of *Diospyros melanoxylon* and *Feronia limonia* and pods of *Tamarindus indica*:** Pickle and murrabba were prepared from fruits of *F. limonia* and squash, chutni and jam were prepared from pods of *T. indica*. Jam and squash were prepared from fruits of *D. melanoxylon*. Studies on shelf life of value-added products revealed that there was consistency in taste and no change in colour was observed in all the products except *D. melanoxylon* after six months. Microbial growth in *D. melanoxylon* was also observed after a month.

Scooping out Shell

- **Capacity Building of VFPCs/SHGs through value addition of *Feronia limonia* (fruits):** Two training-cum-demonstration programs were organized on value addition of *F. limonia* (fruits) for SHGs of Jamboree and Surpagla village in which 40 members including SHG/VFPC members. The training may be helpful in providing employment opportunities to SHG members for livelihood support.

Standardization of inoculation technique for Agarwood formation in *Aquilaria malaccensis* Lamk. in Khasi and Garo Hills of Meghalaya (RFRI)

A total of 164 nos. of *A. malaccensis* trees were inoculated with fungal cultures in 4 districts of Meghalaya and successful induction of agarwood could be achieved at

Training programme on artificial inoculation of fungal culture in *Aqularia* trees at Dapokgre (West Garo Hills)

Goiragre (West Garo hills) and Kharkutta area of Meghalaya. Hands-on training on artificial inoculation of agarwood was imparted to the farmers of Dapokgre (West Garo Hills).

Formation of agarwood at Umsaw Reserve Forest (Ri-Bhoi)

Agar based Agroforestry with rabi season vegetables

Co-ordinated research programme on agar (*Aquilaria malaccensis* Lamk.) (RFRI)

A study on stem borer *Neurozerra conferta* revealed that it has 4 to 6 months life cycle. Further, insect was successfully reared on artificial diet and 1 fungus and 5 bacteria were found on gut microflora of *N. conferta*. Potato dextrose broth and powder formulation of fungal culture were also found effective in artificial inoculation of agarwood in *A. malaccensis*. In order to determine the effect of age of the tree on micropropagation, preliminary observations revealed that cuttings from trees of 5-6 years of age treated with 200 ppm IBA showed better sprouting.

Economic analysis of 1st year agar-based agroforestry model at Namti, Assam revealed that the concerned farmer had earned an additional Rs.15,000/- from the sale of seasonal vegetables as banana was planted as perennial intercrop in the field.

Plantation of banana rhizome at Namti Rearing of *Neurozerra conferta* on artificial diet

Propagation of improved bamboo clumps (RFRI)

Macro-proliferation through culm cuttings has been initiated in selected species of *Bambusa tulda, B. balcooa, B. nutans* and *Dendrocalamus hamiltonii* and through branch cuttings for *B. tulda, B. balcooa* and *B. nutans.*

Quality planting material of *B. tulda, B. balcooa* and *B. nutans* was produced through micro-propagation. These TC plantlets were further macro-proliferated in nursery to increase the number. Vermi-composting unit was also constructed to further enhance the efficiency of compost in the nurseries

Three field nurseries have been established. One nursery has been established with a novel idea of providing shade (50%) with bamboo strips to replace the agro-shade net which is made of HDPE. An improved technique of macro-proliferation has also been devised wherein separation of tillers was done without completely removing the soil from root zone. More than 25,000 plantlets have been raised.

Rooted propagules

Composting Unit

Nursery with 50% shade using bamboo

Population assessment of highly traded and high value endemic medicinal plant species in Himachal Pradesh(HFRI)

A study was carried out to assess the population of 11 highly traded and high value endemic medicinal plants viz., *Aconitum heterophyllum* (Atish), *Arnebia benthamii* (Ratanjot), *Fritillaria roylei* (Kakoli), *Gentiana kurroo* (Kadvi), *Paris*

Podophyllum hexandrum in natural habitat

polyphylla (Satva), *Podophyllum hexandrum* (Bankakri), *Polygonatum verticillatum* (Mahameda), *Polygonatum cirrhifolium* (Meda), *Rheum australe* (Archu, Rewandchini), *Rheum webbianum* (Archu,) and *Trillium govanianum* (Nagchhatri) from 54 sites in different geographical locations of Himachal Pradesh. Each site has been geo-referenced.

Programme support on elucidation of biosynthetic pathways and development of gene markers of high value endangered medicinal herbs of NW Himalayas (Phase II)(HFRI)

Field Gene Bank (FGB) of *Picrorhiza kurroa* (Kutki) with 79 accessions collected from different geographical locations of Himachal Pradesh and Uttarakhand is being maintained at Field Research Station, Brundhar, Kullu (H.P.). In order to carry out the biosynthetic studies, samples of Kutki were sent to Bennett University, Noida.

Evaluation of genetic superiority and stability of identified active ingredient content accessions of *Picrorhiza kurroa* Royle ex Benth. (Kutki, Kadu), *Valeriana jatamansi* Jones (Nihani, Mushkbala) and *Podophyllum hexandrum* Royle (Bankakri) through multi-location trials and promotion of their cultivation amongst rural communities(HFRI)

The morphological characterstic and biological yield of *P. kurroa, V. jatamansi* and *P. hexandrum* were evaluated in the multi-locational trials.The samples of five superior accessions of *P. kurroa, V. jatamansi* and *P. hexandrum* were harvested from the trials and analyzed for their active ingredients. Mass multiplication of these medicinal plants was done and planting material thus produced was supplied to various stakeholders.

During the third year of the project, biological yield of top five high a.i. content accessions of all the selected species from the multilocation trial (MLT) sites were harvested (5 plants each) to evaluate the genetic superiority and stability of high active ingredient content accessions. In case of *P. kurroa* at multilocation trial sites viz. Nichar, Kothi and Bhrundhar (Manali) the fresh biological yield (Roots and Leaves) ranged from 2.9 gm to 9.5 gm while dry wt. varied from 1.9 gm to 6.1 gm. In case of *V. jatamansi* at multi-location trial sites viz.,Shilly, Solan; Shillaru, Shimla and Brundhar, Manali the fresh wt. ranged from 7.9 gm to 14.8 gm while dry wt. varied from 2.2 gm to 4.4 gm. In case of *P. hexandrum* at multilocation trial sites fresh biological yield ranged from 4.0 gm to 15.7 gm while dry wt. varied from 1.6 gm to 7.8 gm.

FGB of *Picrorhiza kurroa* at FRS, Brundhar, Kullu

Multilocation trial of *Valeriana jatamansi*

Standardization of nursery and propagation methods of *Trillium govanianum* (Nagchhatri)(HFRI)

Field Gene Bank of Nagchhatri with 27 accessions has been established and being maintained at FRS, Brundhar, Kullu (H.P.). The biological yield of *Trillium govanianum* from natural habitat of different geographical locations of Himachal Pradesh was assessed. IBA 150 ppm have been found to be effective treatment for vegetative propagation of *T. govanianum*.

Standardization of nursery techniques for mass multiplication of *Polygonatum cirrhifolium* (Mahameda) and its extension among local communities (HFRI)

Seed germination trials of Mahameda was laid out during post-winter, pre-winter and winter season under polyhouse and in open nursery beds. Propagation trials were also carried out by planting rhizomes (>1,000 nos.) of Mahameda at various nurseries of the institute.

Rhizomes collected from various Mahameda sites

Rhizomes collected from various sites were also analyzed for its nutritional value. Maximum value of Protein (41.85 mg/g), Phenol (0.286 mg/g) and Reducing sugar (1.39%) recorded from Tower House (Nichar), Kinnaur; Yalinge-Nichar, Kinnaur and Kasol-Parvati, Kullu, respectively.

Survey, mapping, development of cultivation techniques, evaluation of selected germplasm and economics of Fritillaria roylei Hook.f. (Kakoli) an important plant of the Ashtavarga Group of Medicinal and Aromatic plants (HFRI)

Field surveys were conducted in Mural Danda, Chanshal, Kalaban (Shimla), Chhitkul (Kinnaur), Loharta, Ratirar forest, Sakeran, Dhelthach (Tirthan valley), Tahuk (Manikaran valley), Sach pass, Tandidhar (Chamba) and Kagaldhar (Lahaul-Spiti) and collected bulbs and seeds. Morphological variations in plants of *F. roylei* were recorded in field/laboratory. Seeds and bulbs were sown in Baragaon nursery, Shimla, FRS, Jagatsukh, Manali and Tahuk, Manikarn valley, Kullu in order to study the effect of time of seed/ bulb sowing, depth of sowing, spacing etc. on the germination and growth. In laboratory, 95% germination was recorded in seeds with stratification treatment given for 30 days.

Germinated seeds, germinating bulb and seedling of *F. roylei*

Conservation of *Stereospermum suaveolens* (Roxb.) DC. – A rare species in Madhya Pradesh (TFRI)

Populations of *Stereospermum suaveolens* (Patala) were identified in 10 different districts of Madhya Pradesh. GPS locations were recorded and mapping was done. Morphological characters were recorded to study the variability. Root bark samples were analyzed for its active chemical ingredient, triacontanol by HPTLC to find out the chemical variations among different populations. Seedlings were raised in the nursery for establishment of germplasm bank.

Stereospermum suaveolens tree

Pods of *Stereospermum suaveolens*

Seeds of *S. suaveolens*

Seedlings of *S.suaveolens* raised in the nursery

Germination of *C.orchioides* through apical bud

C. orchioides (Kali musli)

Investigation on variations and domestication of *Curculigo orchioides* Gaertn. (Kali Musli) in Madhya Pradesh (TFRI)

Tubers of *Curculigo orchioides* were collected from 11 Medicinal Plants Conservation Areas (MPCA) of Madhya Pradesh. Sprouting behavior of tubers was investigated by sowing the apical, distal and end parts. Absolute tubers were also sown in nursery beds to observe the sprouting behavior. Phytochemical evaluation of tubers is being carried out to find out the superior germplasms for mass multiplication and domestication.

2.6.2

Sustainable Harvesting and Management

Integrated approach for development of standard nursery techniques and value added products of some socio-economically important species of Madhya Pradesh (TFRI)

Survey was conducted for the collection of seeds of selected species viz., *Terminalia chebula* (Harra), *Madhuca indica* (Mahua), *Terminalia bellirica* (Baheda) and *Semecarpus anacardium* (Bhilwa). Morphological observations on fruit/seeds (fruit size, fruit colour and fruit weight) were recorded from collected fruits/seeds. Value added product i.e., biscuits were prepared by incorporation of *S. anacardium* (Bhilwa) fruit powder and consumer acceptability test for developed biscuit was also conducted. Herbal gel was also formulated from *S. anacardium* leaves.

Standardization of harvesting time and post harvesting techniques of *Helicteri sisora* (Marorphali) and *Mucuna pruriens* (Kaunch) (TFRI)

Processing techniques of *Helicteri sisora* (Marorphali) and *Mucuna pruriens* (Kaunch) fruits were standardized. Harvesting time of Marorphali and Kaunch fruits were optimized in terms of their active chemical ingredients. The month of January and February were found favourable for the harvesting of fruits of these species.

2.6.3

Chemistry of NWFPs, Value Addition and Utilization

Characterization and extraction of eco-friendly dyes from leaves and bark of *Eucalyptus, Melia* and *Casuarina* - their application in textile industry (IFGTB)

The leaves and barks of different clones of *Eucalyptus* spp., *Melia* spp. collected from Panampally Field Research Station and TNPL, Karur and were processed for the extraction of dye solution. The extracted dye solution was preliminary analysed for its phyto-constituents. Different natural mordants like beet root, onion peel, amaranth leaves, red cabbage, *Indigofera tinctoria* and myrobalan solely or in combination was used along with different mordanting methods and fixation of dye was tested on different fabrics. The dyeing was done on different fabrics like cotton, silk, wool and linen. The soymilk-pretreated fabric indicated the improved dye fixation and different shades of colors. Designed and fabricated pilot scale dye extractor can be used in small-scale industry.

Value addition and utilization of *Cassia tora* seeds (FRI)

Cassia tora is a potential source of galactomannan which may be used as an excellent polymeric material of commerce for a large number of industrial applications. Intriguingly, due to the presence of toxic constituents in the seeds and other disadvantages, it has limited applications. Therefore, green, economic and facile methods were developed for removal of anthraquinones from *C. tora* endosperm. The results were validated by HPLC analysis. Further, *C. tora* gum was chemically modified via carboxymethylation and quaternisation to prepare value added products.

Bioprospecting of *Pinus roxburghii* needles wax and other extractives (FRI)

Pinus roxburghii needles are the major cause of forest fires. In our quest for utilization of pine needles, fibre was isolated from pine needles by using different protocols in quantitative yield of 40% using facile and green process. Preliminary examinations revealed that fibres can be utilized for various purposes viz., fibre boards, composites with natural polymers, ropes and for other applications.

Bioprospecting of Essential oils (FRI)

An energy efficient field distillation unit was designed, fabricated and commissioned in farmer's field at Pasoli Village, Dehradun for the livelihood support to village communities growing essential oil bearing crops especially *Cymbopogon* species. The results on isolation of essential oils of *Eucalyptus* hybrid leaves and *Cymbopogon citratus* leaves indicated that yield of the oil is higher by adopting cohobation principle for extraction of essential oils.

Distillation unit

Value addition to guar gum and its byproducts(FRI)

Guar gum, a speciality product is widely used in various industries. The native gum demands derivatization for end use applications. Quaternization of guar gum was done by employing clean, cheap and semi-dry method for enhanced industrial applications. Further, cross linking of guar gum was done with epichlorohydrin to prepare viscosifiers.

Phytochemical examination, molecular characterization and propagation of *Illicium griffithii:* a medicinally important RET plant of North-East India for improving economic and conservation status (FRI)

Shikimic acid, a potent pharmaceutical intermediate and sole building block for antiviral drug Oseltamivir (Tamiflu) was screened in *Illicium griffithii* fruits, barks and leaves from different areas of North-East India. The highest amount of shikimic acid was found to be 19.82% in fruits of *Illicium griffithii*. The genotype has been suggested for propagation to collaborating institute i.e., North Eastern Hill University, Shillong.

Nutritional and quality evaluation of selected wild edible plants as a source of functional food (FRI)

Fruits of *Rhus parviflora* (Tungla), *Rubus ellipticus* (Hisalu) and *Ficus palmata* (Bedu) were investigated for nutrient composition and bioefficacy. The high values of essential nutrients and better antioxidant activity of the fruits revealed their potential utilization in the production of nutritionally rich products in the form of jam, jelly, juice, pickle, health drinks, etc. which may generate livelihood for rural people.

Utilization of forest biomass through value added application as source of natural dyes (FRI)

Cassia occidentalis and *Mimosa himalayana* were investigated for dye yield and dyeing characteristics with the aim of exploring new plant sources of natural dye. Based on the dye yield and their dyeing performance on silk, wool and cotton fabrics, the two hitherto unknown plants have been determined as promising source of natural dye.

Studies on phytochemical composition of *Osyris quadripartita* (FRI)

Osyris quadripartita was collected from Dehradun, Mussoorie and adjoining areas of Uttarakhand. Heartwood of *O. quadripartita* was found to contain 0.20% to 0.56%of volatile oil whose GC-MS compositional analysis led to the identification of major chemical constituents. The volatile oil obtained from the heartwood of *O. quadripartita* has resemblance with that of sandalwood oil. However, there was significant difference in the oil yield and concentration of major chemical constituents. Qualitative phytochemical analysis of different plant parts (wood, leaves and bark) was carried out. Phyto-constituents like total phenolic content, total flavonoid content, total terpenoid content and total alkaloid content were quantitatively determined in different plant parts. Antioxidant activity (FRAP, ABTS and DPPH) assay of essential oils and different plant parts of *O. quadripartita* and Sandalwood oil was carried out. *O. quadripartita* leaves and wood showed better anti-oxidant activity.

Enzymatic intervention for quality improvement of essential oil from *Cyperus scariosus* and *Zanthoxylum armatum* (FRI)

Biological evaluation of essential oil obtained from pre-treatment of the rhizomes of *C. scariosus* and the leaves of *Z. armatum* were carried out for anti-fungal, anti-bacterial, pesticidal and anti-depressant activity. The pre-treated extracts showed increase in anti-fungal activity against *Fusarium oxysporum* and *Rhizoctonia solani. In-vitro* antibacterial activity against *Pseudomonas* sp. showed enhanced antibacterial activity using pre-treated essential oil extract. Enhanced pesticidal activity was observed against test insect poplar defoliator, *Clostera* sp. Further, increase in anti-depressant activity was also observed in Wistar rats using pre-treated essential oil extract against control.

Chemical examination and value addition of edible mushroom *Astraeus hygrometricus* (FRI)

Astraeus hygrometricus is a wild edible mushroom. Its fruit bodies are sought after for their delicacy, earthy aroma and meaty flavour. However, the shelf life is short, which limits their utilization and marketability. Chemical examination of the fruit bodies for expanding their nutritional and medicinal benefits was undertaken. Overall, the mushroom proved its edibility in terms of taste and nutritional value and also reflected its therapeutic potential. Canning of the fruiting bodies in 20% brine solution containing 0.1% citric acid was found effective to enhance the shelf life of the fruiting bodies upto 360 days without affecting their colour, organoleptic properties and content of protein, carbohydrates and fat. Since this preservation method is simple and economical, local/tribal people can use it for augmenting their income.

Investigation on population biology, characterization and conservation of some high value threatened medicinal plants of North East region (FRI)

GC-MS assisted chemical profiling of the extracts isolated from rhizomes of 24 accessions of 9 populations of *Valeriana jatamansi* (Indian Valerian) collected from the North East region of India was completed. Constituents characterized were mono-, sesqui- and di-terpenoids, and aliphatic and aromatic hydrocarbons and their oxygenated derivatives. Based on the Hierarchical Cluster Analysis of the data and content of the marker constituents, two chemically superior populations (VAJ-09-DH and VAJ-09-KD) were identified, which are being maintained and propagated by the collaborating institute of NE region. One population of *Coptisteeta* (Mamira) found in Arunachal Pradesh was also characterized for its marker constituent-berberine in its rhizomes by HPLC analysis.

Bioactivity guided chemical examination of knotwood of Indian trees (FRI)

Knot woods are underutilized biomass of no commercial value. However, knot woods contain diverse group of chemicals, recovery of which could make the knot woods an important resource for utilization. Chemical composition of hexane extracts of knot woods of *Pinus roxburghii* (Chirpine), and *Mangifera indica* (Mango) determined using GC-MS revealed their potential for recovery of constituents for aroma applications. Three compounds from 5% aqueous acetone extract of the knot wood of *P. roxburghii* were isolated, purified by HPLC, and identified by NMR spectroscopy and mass spectrometry as 2,3-bis(4-hydroxy-3-methoxybenzyl) butan-1,4-diol,3-hydroxy-3,4-bis(4-hydroxy-3 methoxybenzyl) dihydrofuran-2(3H)-one and 3,4-bis(4-hydroxy-3-methoxybenzyl) dihydrofuran-2(3H)-one. These compounds showed notable antioxidant capacity in amperometric assay.

Identification of superior germplasm of *Andrographis paniculata* and *Bacopa monnieri* and its cultivation in farmers'/tribals' field for livelihood generation (FRI)

Andrographis paniculata (Kalmegh) and *Bacopa monnieri* (Brahmi) are important medicinal herbs being used by pharmaceutical industries. Superior germplasm of Kalmegh and Brahmi having more active ingredients (andrographolide and bacoside respectively) have been identified for commercial cultivation in farmers' field. The highest andrographolide content was found in Dhamtari, Chhattisgarh accession (3.12%). The

Andrographis paniculata (Kalmegh)

Bacopa monnieri (Brahmi)

highest bacoside A content (3.18%) was found in *B. monnieri* accession BM 21. Post-harvest technologies (drying, processing and storage) of Kalmegh and Brahmi have been standardized for quality herbal produce. Partial shade drying was found to be a superior method of drying for Kalmegh and Brahmi. Storage conditions with respect to storage containers and storage time for *A. paniculata* and *B. monnieri* were optimized. Jute bags with polythene lining were found to be the most suitable packaging material for Kalmegh and Brahmi. Results indicate that Kalmegh should not be stored for more than six months after harvest, whereas Brahmi should not be stored for more than 4 months of harvest. The cultivation of Kalmegh and Brahmi crops is remunerative and should be encouraged to be taken up in farmers' fields.

Phytochemical evaluation of *Habenaria edgeworthii* and *Habenaria intermedia*, the important Astavarg species (FRI)

The two targeted Astavarga species namely *Habenaria edgeworthii* (Vrihddi) and *H. intermedia* (Ridhhi), and their substitutes including *Dioscorea bulbifera, Asparagus filicinus, Dactylorhiza hatagirea* and *Sida acuta* were analyzed for their physico-chemical parameters (ash value, water soluble ash, acid insoluble ash etc.), qualitative phytochemical profiles and quantitative values of phytochemical parameters (total phenolics, total flavonoids, terpenoids, tannins, glycosides and alkaloids). The results of the analysis revealed a close resemblance amongst target Astavarga species and substitutes. Antioxidant activities of the two Astavarga species and substitutes using *in vitro* assay like 2,2-azinobis (3-ethylbenzothiazoline-6-sulphonic acid) radical scavenging (ABTS), 2,2-diphenyl-1-picrylhydrazyl radical scavenging (DPPH) were determined.The results revealed that *H. edgeworthii* and *H. intermedia* plants possess good antioxidant activity and thus could beapotential source of natural antioxidants.

Plants of *Habenaria intermedia*

Plants of *Habenaria edgeworthii*

Evaluation of phytochemicals from forest species- *Terminalia bellirica, Sapindus laurifolius, Acacia concinna, A. auriculiformis* and *Ziziphus mauritiana* for removal of chemical residues from edible produce (FRI)

For the removal of chemical residues from edible produce i.e., vegetables, efficacy of saponin isolates from *T. bellirica, S. laurifolius, A. concinna, A. auriculiformis* and *Z. mauritiana* were screened out. Formulations were prepared with

saponin isolates and physico-chemical properties i.e. pH, viscosity, wetting power, solid content and surface tension were also determined. The residue of chlorpyriphos was found below detectable limit in *S. mukrossi* treated samples. Washing with *A. concinna, T.bellirica, S. mukrossi, Z. mauritiana* and *A. auriculiformis* extracts 1%, 2.5% and 5% dilutions for 10 min was found effective. The shelf life of formulations was also determined.

Transfer of products/technology on bio booster to Irular tribes in forest fringe villages of Coimbatore, Tamil Nadu: An alternate source of livelihood support (IFGTB)

Compost made using weed and flower wastes was added into decomposed coir pith in order to evaluate its efficacy on germination, growth and yield of vegetable crops like beans, bitter gourd, radish tomato, red chilli and brinjal. Addition of weed and flower compost increased the efficacy of the coir pith. Germination percentage of the vegetable seeds increased to 89% and 84% when sowed in developed coir pith and coir pith treated with weed and flower waste, respectively compared to conventional potting mixture which showed only 44% germination. An increment of 40-45% in growth of the vegetable seedlings was observed compared to the conventional potting mixture. This technology was transferred to WSHGs of Irular tribes who inhabit forest fringe villages in Coimbatore as alternate source of income for their livelihood.

Development of compost out of waste by involving tribals for their livelihood support: a part of Swachh Bharat Mission(IFGTB)

Woman Self Help Groups (WSHGs) Vinayaga and Masani were formed at Anamalai range of Anamalai Tiger Reserve, Pollachi, Coimbatore district at Thammampathi and registered under Community Organizer appointed by the Department of ST/SC Tribal Welfare, Govt. of Tamil Nadu. As a part of Swachh Bharat Mission, vegetable and flower waste composts added to TRB acted as an alternate potting mixture and enriched its nutrients and efficiency as promising potting media. Onsite demonstration was also given to explain in detail about the application of TRB in agriculture and allied sectors to 120 tribal women belonging to various settlements inhabiting the forest fringe villages of Coimbatore and Pollachi region. Meetings were organized with the buyers, exporters to motivate the tribals to become entrepreneurs and generate further source of income.

Development of fast-food products enriched with *Moringa oleifera* (Drumstick) leaves and skill upgradation training to rural women(TFRI)

Moringa oleifera (drumstick/sahajan) leaves were collected, processed and stored for further biochemical analysis and product development. Biscuits, papads, vermicelli were prepared by incorporating *M. oleifera* leaf powder. Studies on nutritional value and other food parameters are being carried out for the developed food products. Findings of the studies may help in improving the nutritional status of tribal/rural women and children by including these food products in their day-to-day diet and thereby overcoming from nutrient deficiencies.

Exploration of adhesive materials for incense sticks from the plant species (TFRI)

Basella alba (Poi), *Aloe vera* (Ghirtkumari), *Crategu laevigata* (Nag Phani), *Dalbergia latifolia* (Kala shisham), *Cassia tora* (Charota), *Hyptis suaveolens* (Ban tulsi) and *Bombax ceiba* (semul) were collected for exploration of adhesive material for making incense sticks. Mucilage was isolated from these plant parts and jiggat (adhesive) was prepared in 14 different combinations. Incense sticks were prepared using jiggat and their burning time was determined.

Jiggat preparation from different plants

2.6.4

Biofuels and Bioenergy

Pretreatment of *Pongamia pinnata* (L.)(Honge) seed for deacidification and rapid oil extraction (IWST)

Pongamia pinnata seeds are important source for biodiesel production. Oil extraction time may be reduced significantly by adopting new seed pretreatment method. Due to prior treatment of seeds with microwave, almost 50% deacidification was achieved. Further, the iodine value and saponification value did not vary due to microwave treatment. The peroxide value, oxidative stability and fatty acid composition of the oil remain unchanged under optimum conditions. The study may be beneficial for biodiesel producing units.

2.7 FOREST PROTECTION

PROJECTS UNDER THE THEME			
Projects	**Completed**	**Ongoing**	**Initiated**
Plan	07	25	07
Externally Aided	11	12	02

2.7.1 Insect pests, diseases and control

Epidemiology and management of *Chlorophorus annularis*– A major borer of cut and dry bamboo (FRI)

Chlorophorus annularis a primary borer of dry bamboos, infests bamboos including *Bambusa polymorpha, B. balcooa, B. giganteus, B multiplex, B. tulda, B. vulgaris, B. spinosa* and *Dendrocalamus strictus*. It was observed that 0.04% chlorpyriphos controlled the pest by 39.13% however, 0.02% chlorpyriphos controlled 34.78% of borer attack. Pest management using various preservatives like CCB, Borax and Ziboc against bamboo borer on green bamboo (*B. balcooa*) was also studied. Ziboc was found to be the most effective preservative which controlled the borer by 68.13%,followed by CCB (67.42 %),whereas Borax (6%) provided 49.64% borer control.

Preservative treatment in dry bamboo

Xylotrechus basifuliginosus Heller wood borer on Kharsu oak, *Q. semecarpifolia* Smith pair in mating

Insect pests of western Himalayan oak and their control (FRI)

Garella ruficirra (Noctuoidea: Nolidae) infesting young shoots of *Quercus lanata* in Kumaon region of Uttarakhand was reported for the first time.

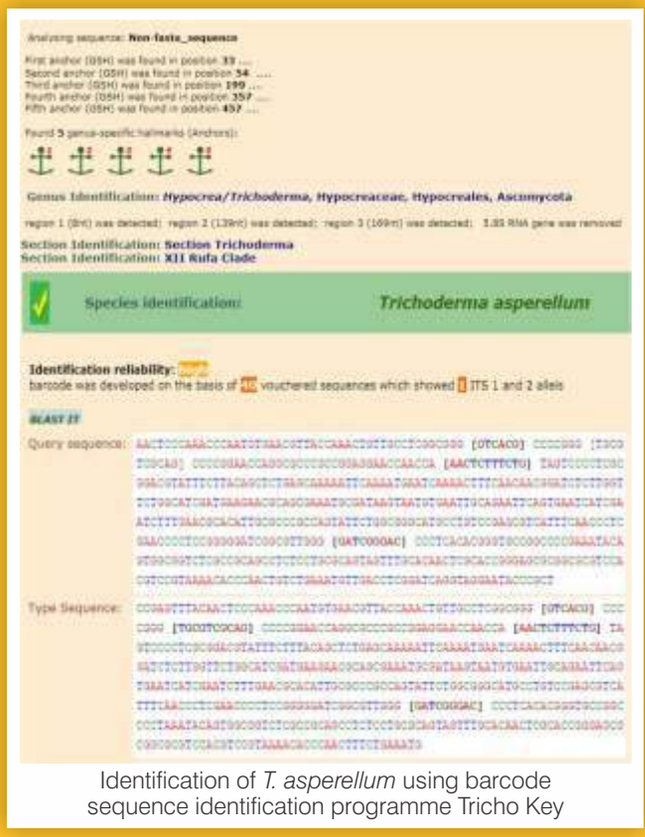
Life cycle of *Xylotrechus basifuliginosus* (wood borers) on *Q. semecarpifolia* (Kharsu oak) and *Aphrodisium hardwickianum* (Oak Stem Borer) on *Q. leucotrichophora* (Ban Oak) are being studied. Database on insects infesting western Himalayan oaks is under preparation covering 186 species (90 coleoptera; 85 lepidoptera & 11 Hemiptera).

Screening of poplar clones for tolerance against poplar leaf defoliator, *Clostera cupreata* (FRI)

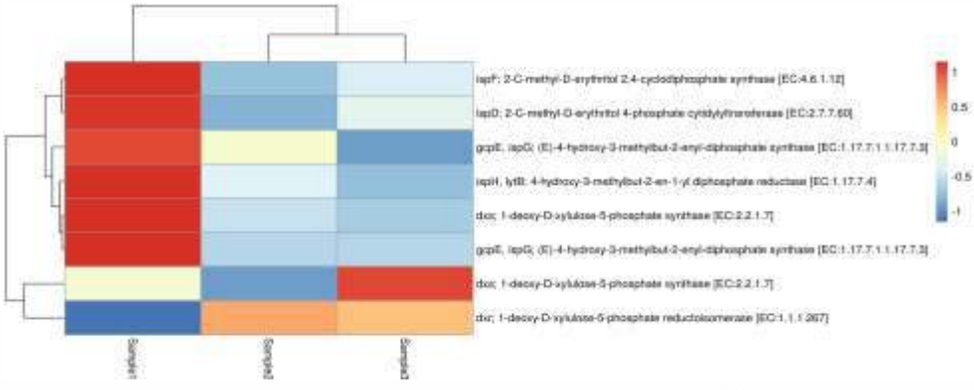
Relative resistance levels in 53 poplar clones (developed by FRI, WIMCO and UKFD Lalkuan; USA, and Australia) against *Clostera cupreata* through laboratory experiments under 'No Choice' and 'Choice' were screened. Phytochemical analysis for phenol, tannin and flavenoid content in leaves of selected clones was also carried out. Based on the results10 clones viz., FRI-FS-149, L-64/84, ST-238, WSL-7, WSL-18, FRI-FS-46, FRI-FS-60, FRI-AM-114, FRI-FS-26 and FRI-AM-135 were found to be relatively resistant.

Expression profiling of mevalonate (MVA) pathway and methyl erythritol 4-phosphate (MEP) pathway transcripts in *Cymbopogon winterianus* under pathogen stress(FRI)

Rapid DNA isolation protocol for *Trichoderma* species suitable for PCR amplification and sequencing has been standardized. The *Trichoderma* species viz., *T. asperellum, T. virens* and *T. harzianum* tested against the target pathogen (*Curvularia andropogonis*) significantly reduced the mycelial growth of the target pathogen. Genes involved in terpenoid precursor MVA and MEP pathways were expressed in higher levels in Trichoderma treated plants as compared to the diseased plants. Application of Trichoderma-based bio-formulation suppressed the development of blight symptoms in field conditions.



Identification of *T. asperellum* using barcode sequence identification programme Tricho Key



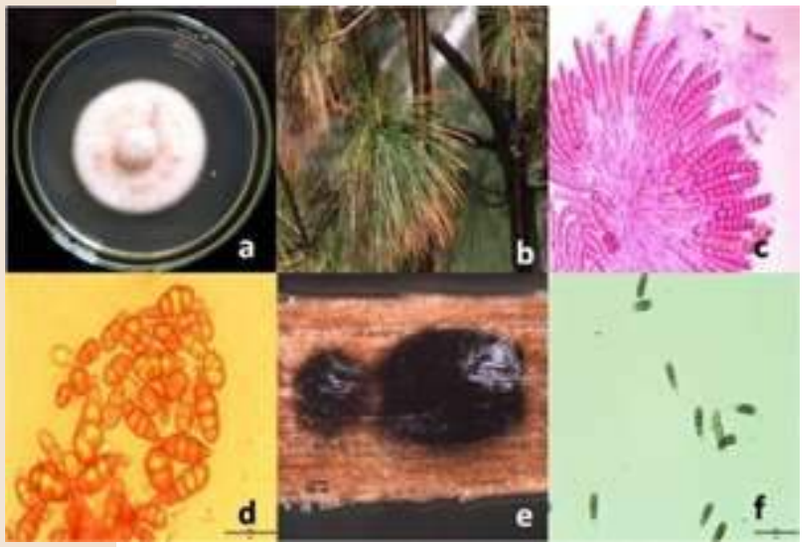
Heatmap showing differentially expressed transcripts of MEP pathway in Sample 1 (Trichoderma-treated), Sample 2 (Healthy) and Sample 3 (Infected)

Evaluation of anti-fungal properties and chemical characterization of active principle(s) of *Berberis aristata* collected from different provenances of Himachal Pradesh (FRI)

Thirteen *Berberis aristata* root samples collected from Himachal Pradesh were extracted with the solvents of elutropic series. All the extracts were screened against three phytopathogenic fungi, namely, *Fusarium solani, Rhizoctonia solani* and *Sclerotium rolfsii*. Root extracts of *B. aristata* collected from Sungri region showed complete inhibition of all the three test fungi at 15% concentration.

Mortality of *Pinus wallichiana* in Nanda Devi Biosphere Reserve (FRI)

Fusarium solani was frequently isolated from the rhizospheric soil/decayed roots collected from the symptomatic trees of *Pinus wallichiana*. *Sordaria fimicola*, with distinctive characteristics was frequently isolated from *P. wallichiana* needles showing reddish brown symptoms. Other fungal isolates such as *Alternaria* sp., *Lophodermium* sp., *Pestalotiopsis* sp., *Curvularia* sp., were also isolated from the symptomatic needles. Four species of bark beetles viz., *Ips stebbingi, Polygraphus major, Pityogenes scitus* and *Pityogenes spessivtsevi* have been identified.



(a) Pure culture of *Fusarium solani*; (b) Symptoms; (c) *Sordaria fimicola perithecia*; (d) Conidia of *Alternaria* sp.; (e) Fruiting bodies of *Lophodermium* sp., (f) Conidia of *Pestalotiopsis* sp.

Providing technical advice for the upkeep and maintenance of Holy Bodhi tree (FRI)

The holy Bodhi vriksha at Bodhgaya was regularly examined for pathological, entomological, physiological and edaphic problems and accordingly treatments and management practices were recommended and their execution was monitored regularly. The health of the holy tree has significantly improved by implementing recommendations of FRI.

Conservation and management of heritage Pipal tree at village Main, Bellaganj (FRI)

Dendrophthoe falcata, a hemiparasitic angiosperm, infected the holy Pipal tree at historical Koteshwarnath temple near Gaya, Bihar. The removal of *D. falcata* followed by disinfectant application was conducted. The pathological and entomological problems were addressed with prescribed treatments and now the tree is in sound health.

Restricted root space compromised the tree root health & stability. Fungal sporophore at root collar indicating root decay

Health status assessment of avenue trees along major city roads of Chandigarh (FRI)

The general observation showed that the trees were mainly affected by pathogens. Many of the problems were species-specific, such as *Ficus infectoria* was found to be affected by poor architecture and root problems. *Alstonia*

scholaris had insect-pest attack and butt rot problem. *Enterolobium cyclocarpum* trees were suffering from root asphyxiation. *Terminallia bellerica* had weak branch unions and *Ganoderma* root rot. Cankers badly affected *Grevillea robusta* trees.

Cankers predisposed the trees to decay

Dead trees with high risk of failure

Pterospermum acerifolium trees were found to be stressed due to less root space and fungal attack. *Sterculia alata* was severely affected by heart rot disease.

Investigations on Casuarina mortality in different agro-climatic zones of Tamil Nadu and development of suitable management measures including identification of tolerant materials (IFGTB)

Mortality study of *Casuarina equisetifolia* and *C. junghuhniana* in 15 districts of five agro-climatic zones of Tamil Nadu revealed bacterial wilt, collar rot, stem wilt diseases and bark feeding caterpillar attack in different age groups of plantations. Heart-rot disease caused by species of *Fomes* and *Phellinus* and collar rot disease caused by *Diplodia natalensis* were reported for the first time in *C. equisetifolia*. Bacillus species isolated from soil samples of healthy Casuarina plantations was screened for its bio-control efficacy against various pathogens and the product was later released as'Bio-Bacillin' (Bacillus velezensis) during Tree Growers Mela-2020 organized by IFGTB.

Bio-Bacillin released during Tree Growers Mela-2020 at IFGTB on 10 March 2020

Development of biopesticide formulation from seed oil of *Simarouba glauca* DC for use in forestry (IFGTB)

The biopesticide formulation "Simca BC (Bean of paradise)" has been developed using seed oil of *Simarouba glauca* based on the significant bio-pesticidal activity against the targeted insect pests of forestry and agriculture crops at laboratory, nursery and field level. The product was released by DG, ICFRE, Dehra Dun in the Regional Research Conference on 20 November 2019 at IFGTB, Coimbatore.

Bioformulations of *Micromonospora* for bio-control and bio-fertilization activity in Casuarinas (IFGTB)

Micromonospora sp. was isolated from the root nodules of *Casuarina equisetifolia* and applied for controlling wilt disease of CH5 clones at farmers field in Tindivanam. This application resulted incomplete recovery from the bacterial wilt.

Application of Jivamrut

Production of organic fertilizers/organic pesticides and their application in forest nurseries (TFRI)

Experiments were laid out at Seoni, Indore Ujjain and Ratlam forest nurseries. 'Jivamrut' at 10% concentration was found to increase height and girth of seedlings significantly. Jivamrut preparation was demonstrated to nursery staff. Hands-on training was imparted to field staff for preparation of organic fertilizers and bio-pesticides.Target plants were Khamair, Teak, Neem, Eucalyptus, Albizia sp., Aonla, Mango, Sitaphal, Jamun and Amrud.

Hands on training to SFD personnel on Jivamrut preparation

Development of biopesticide formulation using the seed extract of *Hydnocarpus pentandra* for management of insect pests of agriculture/forestry importance (IFGTB)

Hydnocarpus pentandra is a potential source to develop oil-based biopesticide. LC-MS analysis of *H. pentandra* revealed the presence of hydnocarpic acid (12.95%), chaulmoogric acid (47.2%) and gorlic acid (28.3%) in seed oil and confirmed through 1H and 13C NMR spectra. A nematode-based protein was selected for in *silico* molecular docking studies with cyclopentenyl fatty acids and compared with Azadirachtin A as a standard drug. Based on the results obtained, the biopesticide was formulated using Hydnocarpus seed oil and was evaluated against various insect pests of agriculture and forestry in different regions of the country. Toxiclogical data was obtained as per CIB&RC for registration of the biopesticide for commercialization in collaboration with Varsha Bioscience Ltd., Hyderabad.

Premature dying of trees of *Acrocarpus fraxinifolius* (Balangi) in parts of Kodagu district(IWST)

Acrocarpus fraxinifolius is planted as an important shade tree by coffee growers and is being cultivated in coffee plantations of Kodagu district (Karnataka). Premature decline/dieback of *A. fraxinifolius* was observed to be a problem in some parts of Kodagu district, exclusively at Virajpet taluk, Karnataka. Shade lopping pruning practice (SLPP) in an unscientific manner affected the branch collar zone (BCZ), at many instances leading to decay of trees. Close proximity and density of coffee plants and other trees around *A. fraxinifolius* was also found to be one of the factors in accumulation/adding of stress to predisposed trees. Mature *A. fraxinifolius* trees from Somvarpet taluk showed decline where root rot pathogen *Phytophthora cinnamomi* was found to cause this disease.

Assessment of the potential hazard risk of ageing urban trees in and around Bengaluru City(IWST)

Urban tree health study at Malleshwaram, Bengaluru revealed that out of 454 trees studied, 223 trees were unhealthy. Unscientific anthropogenic practices e.g.,improper pruning and frequent disturbance around trees were recorded. Many trees fell under high hazard category. *Peltophorum ferrugineum* was found to be most susceptible to decay fungi. Most of the trees had disturbed collar zone indicating the possibility of root damage.

The role of bio-fertilisers in restoration of problematic sites like mine reject sites of Karnataka (IWST)

Twenty indigenous locally available species were selected and inoculated with bio-fertilizer (AM fungi and PS bacteria). Better growth results for height and collar diameter of treated seedlings in nursery conditions were observed. These seedlings were translocated to mine dump area Vibhuthi Gudda. Survival percentage was less in *Tectona grandis* and *Artocarpus integrifolia* as compared to other species.

Development of integrated insect pest and disease control system for *Albizia* and *Dalbergia* in plantations of Madhya Pradesh and Maharashtra (TFRI)

A survey was conducted in 47 plantations of Madhya Pradesh and Maharashtra for recording the impact of insect-pests and diseases in *Albizia lebbek, A. procera* and *Dalbergia sissoo*. Treatment by chlorpyrifos 0.05% incombination with ridomil 0.2%, mulching and application of chaubatia paste was found to be most effective against insect pests/diseases in *D. sissoo, A. lebbek* and *A. procera* plantations. Treatment of trizophos 0.06% was found to be most effective against pod and seed borer *Bruchus bilineatopygus* in *A. lebbek* plantations.

Bark eating caterpillar *Indarbela quadrinotata* on *A. lebbek*

Canker on *D. sissoo*

Canker on *Albizia procera*

Top dying of Sissoo

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

Documentation of diversity and abundance of insect pollinators visiting the blossoms of *Prosopis cineraria, Capparis decidua* and *Acacia senegal* was completed. On *P. cineraria* (37), *A. senegal* (50) and *C. decidua* (44) species of insect pollinators were recorded. Study of foraging behaviour and pollination efficiency index of insect pollinators showed that bees were the most abundant floral visitors, followed by syrphid flies and butterflies. Total number of pollen grains on pollinators' body varied from species to species. Among bees, maximum pollen grains were recorded from *Apis florea* and *A. dorsata* followed by *Amegila* sp. and *Xylocopa* sp.

2.7.2
Mycorrhizae, rhizobia and other useful microbes

Identification of superior strains of arbuscular mycorrhizal fungi and Rhizobium for improving planting stocks of *Pterocarpus santalinus* (IFGTB)

Superior strains of AM fungi and Rhizobium were identified based on their infectivity and nitrogenase activity in *Pterocarpus santalinus*. These strains were isolated from the native populations of *P. santalinus* in Seshasylum forest area at Tirupati, mass multiplied and inoculated into the seedlings of *P. santalinus*. The seedlings showed improved growth and biomass in nursery conditions due to inoculation of AM fungi and Rhizobium strains. The Rhizobium strains were identified as *R. aegyptiacum* and *R. mesoamericanum* after 16s rRNA sequencing. The nitrogenase activity was higher in *R. aegyptiacum* than *R. mesoamericanum*.

Exploration of potential beneficial microbes in different forest and agriculture ecosystems in Kolli Hills, Tamil Nadu and imparting training-cum-demonstration on bio-fertilizer production and application in nursery and field (IFGTB)

Microbial diversity was investigated in different ecosystems in Kolli Hills, Namakkal district, Tamil Nadu. Pure cultures of plant growth promoting rhizobacteria (PGPR), actinomycetes and AM fungi were isolated from root zone soil samples of 45 different hosts. Nursery experiment was conducted for studying their efficacy on growth improvement of 10 different economically important tree species. Around 30-40% growth and biomass enhancement occurred in combined application.

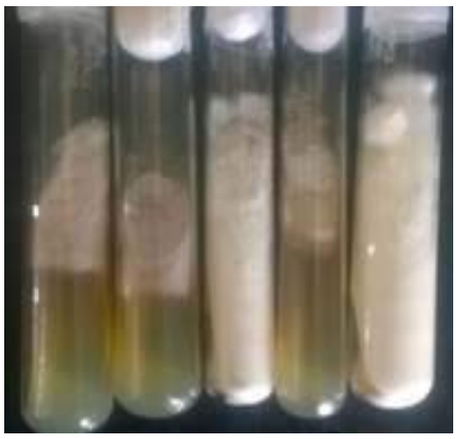
Studies on improving livelihood generation through scientific intervention in *Pinus gerardiana* (Chilgoza) and important wild mushrooms in Himachal Pradesh (HFRI)

Information on traditional harvesting practices of cones/seeds in 10 villages of Kinnaur district was documented and compared with mechanized harvesting with respect to production of new shoots/cones. Maturity indices and seed viability were recorded for the cones and seeds collected from Kinnaur and Chamba districts. The results revealed that the seeds stored in different storage containers and storage temperature retained viability of 9-67% after 15 months of storage. The seeds stored in airtight polysac container have recorded maximum viability.

Pinus gerardiana forests and 5 fringe villages in Kinnaur and 16 villages in Chamba districts were surveyed to document ethnomycological information and collection of mushrooms. *Geastrum* sp. (Earth star) was dominant genus with 6 species, followed by *Morchella* sp. (Morel, Guchhi), *Amanita* sp. (Amanita) and *Ramaria* sp.(sea coral) with 4 species each. Germplasm of 55 wild mushrooms is being maintained. Eight wild mushrooms were analyzed for antioxidant assay and antimicrobial activity. Seventeen mushrooms were analyzed for nutritional status including macro and micro elemental composition. Three onsite one day sensitization training programmes were conducted on 'Uses and conservation of chilgoza pine and wild mushrooms' for stakeholders in Kinnaur district at Reckong Peo, Akpa and Choltu (Tapri).

Cantherellus minor (Pili Chhatri)

Sarcosphaera crassa (Peziza)



Mushroom germplasm

Density Assessment

Cone harvesting

2.7.3

Weeds and invasive species

Spatial mapping and modeling of wattle invasion in Shola grassland ecosystems of Tamil Nadu and Kerala (IFGTB)

Spatial mapping of wattle invasion in Shola grassland ecosystem was done using multi-temporal (2008 and 2017) satellite images of Landsat 7 (ETM), Landsat 8, Resourcesat-2 LISS IV and 21AT Triples at in Palni, Nilgiri Hills and Idukki. The spatial extent of pure wattle (5,908.37 ha), wattle with mixed dense forest (7,402.67 ha), wattle with mixed plantation (191.85 ha), wattle with pine plantation (41.63 ha), and eucalypts with wattle plantation (8,952.32 ha) has not changed significantly. However, the extent of wattle with shola forests increased while the extent of grasslands has reduced in Nilgiris. In Palni hills, the extent of wattle with mixed forests has increased (9,956.0 ha) similarly Eucalypts with wattle plantation has also increased (5,351.20 ha). In Idukki also, increased extent of wattle has been recorded. The regeneration of wattle was more in the edges of habitats and in open areas. Sites suitable for native shola/grassland restoration and sites vulnerable for wattle invasion have been identified for management interventions.

Acacia mearnsii De Wild

Profuse regeneration of wattle in shola-grassland ecosystem

Wattle invasion in Shola-grassland ecosystem

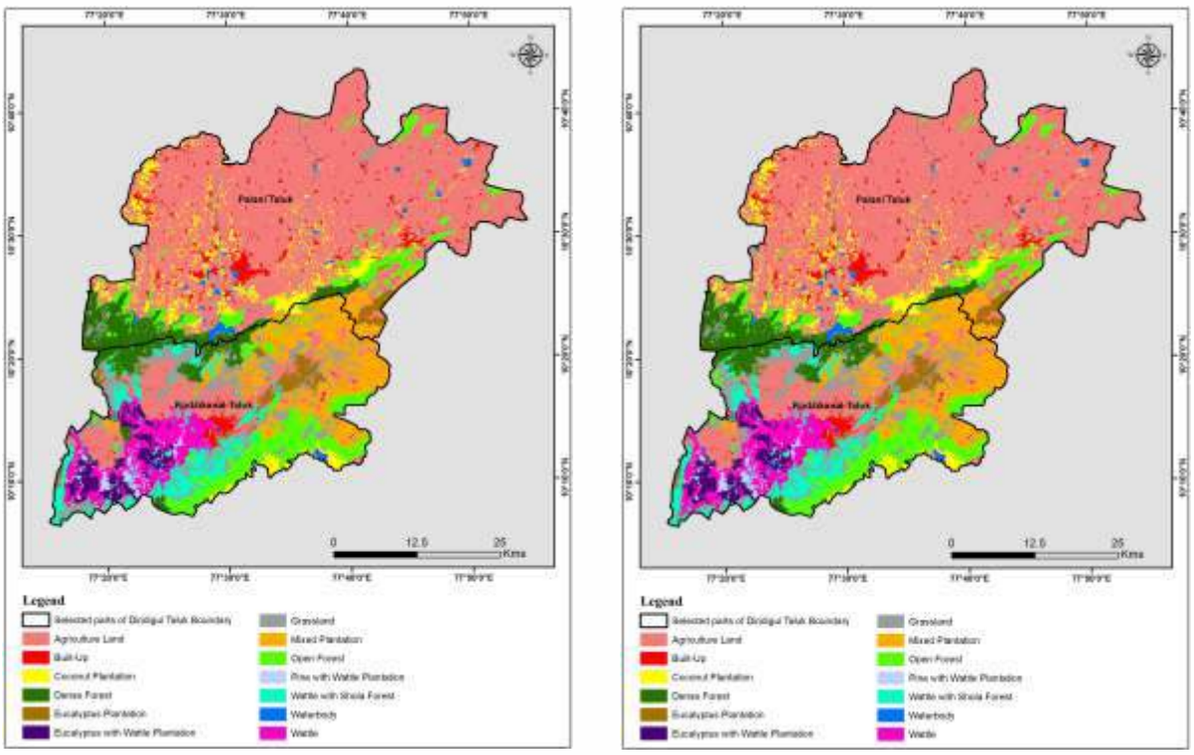


Figure a & b. Extent of wattle and other Land use and Land Cover in parts of Dindigul District, Tamil Nadu (2008 & 2017)

2.7.4

Forest fire and grazing

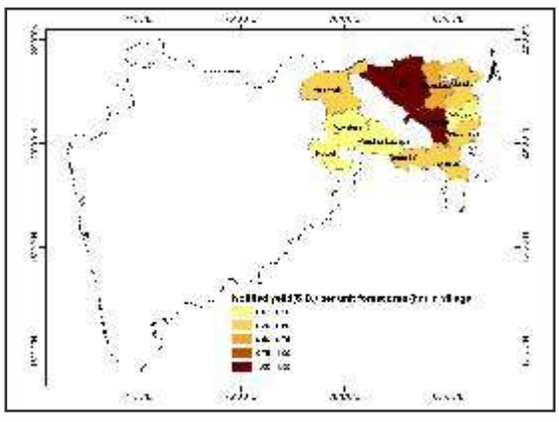
Post fires impact on soil properties and micro-organisms in chirpine and oak forests of Uttarakhand (FRI)

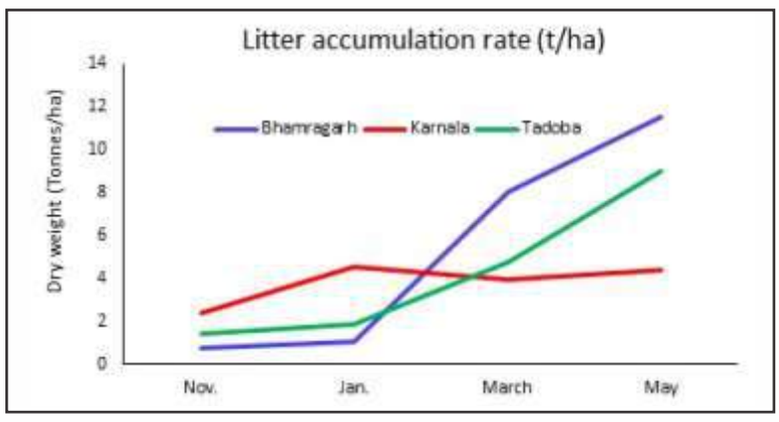
Estimation of the SOC, available N, P and K in burnt and un-burnt areas showed an increased level of SOC and nitrogen in fire affected sites as compared to unburnt sites. The available phosphorus (P) in the forest showed decrease in burnt forest as compared to unburnt forest. Overall, the SOC, N, P and K decreased with increase in soil depths at all sites after a year or more time period and also the soil nutrient status was found lower in these forests. The pH was found to be acidic in chirpine forest of Binai beat under Tons Forest Division and Barkot beat, Upper Yamuna Forest Division of Uttarakhand. The study led to the conclusion that fire significantly affects soil properties with detrimental change in pH, bulk density, organic matter and available nutrients.

Developing a predictive fire model for forests of Maharashtra in relation to various factors and to delineate suitable strategies (TFRI)

Historical data reveals that most of the forest fire incidences are confined to the eastern part of Maharashtra, which is vulnerable to fire as it is hot and dry as compared to the Konkan region, which is hot and humid. Besides anthropogenic activities and low humidity, the higher rate of litter accumulation (19.17 t/ha) is also an additional factor for forest fire in the deciduous forest in Vidarbha region compared to the evergreen forest (15.26 t/ha) of Western Ghats in Maharashtra. Anthropogenic activities in the leaf fall season (March-April) like collection of tendu leaves, mahua flowers, grazing, hunting etc. are the main causes of forest fires which vary division to division.

Litter collection from the experimental pit in the field





Month wise (dry) litter accumulation rate (t/ha)

3 CHAPTER

EDUCATION VISTAS

3 EDUCATION VISTAS

3.1 FRI (Deemed to be) University

- 5th Convocation of FRI (Deemed) University, Dehradun was organized on 7 September 2019.

FRI DU organized 5th Convocation-2019

- Admissions to M.Sc. courses and Ph.D. programme were made on the basis of All India Competitive Entrance Test. In the academic year 2019-20, 60 Research Scholars were registered for Ph.D. at the FRI (Deemed to be) University and a total of 29 Ph.D. degrees have been awarded.
- Under the SAARC Fellowship Programme as announced by Hon'ble Prime Minister, students from different SAARC countries have joined various M.Sc. and Ph.D. programmes.
- Students' profile and Placement Brochures for all the M.Sc. courses were prepared. FRI deemed to be University provided assistance in placement of students of different courses to various Industries/ organizations which visited the FRI DU for campus interview.

Academic Courses and Admission

The FRI (Deemed) University has been offering the following M.Sc. courses on a regular basis. The academic requirements for these courses are as under:

Forestry

Bachelor degree with at least one of the subjects from Botany, Chemistry, Geology, Mathematics, Physics and Zoology or B.Sc. in Agriculture or Forestry.

Wood Science & Technology

Bachelor degree with Physics, Chemistry and Mathematics or B.Sc. in Forestry with minimum 50% marks.

Environment Management

Bachelor degree in any branch of basic or applied sciences or Bachelor's degree in Forestry or Agriculture or BE in Environment Sciences.

Cellulose & Paper Technology

Graduation with minimum 50% marks in aggregate in sciences with Chemistry as one of the subjects, BE/B.Tech.(Chemical or Mechanical Engineering).

Scientists of FRI are working as faculty members for teaching Indian Forest Service Probationers at Indira Gandhi National Forest Academy, Dehradun and M.Sc. courses in FRI (Deemed) University.

3.2
Training Organized

S. No.	Name of Institute	No. of Training Programme	No. of Participants
1.	ICFRE, HQ	32	1091
2.	FRI, Dehradun	38	1247
3.	IFGTB, Coimbatore	21	232
4.	IWST, Bengaluru	21	1212
5.	TFRI, Jabalpur	47	2958
6.	AFRI, Jodhpur	03	74
7.	RFRI, Jorhat	30	1380
8.	HFRI, Shimla	22	591
9	IFP, Ranchi	17	1341
10.	IFB, Hyderabad	43	2727
	Total	274	12853

Training on "Identification of butterflies and birds"was organized for frontline staff of state forest department, eco-club teachers, students and other stakeholders at Botanical Garden, UT Chandigarh on 27 February 2020 under VVK activities. A total of 54 participants including forest officials, eco-club teachers and other stakeholders from different parts of the Chandigarh were imparted with the training.

Scientist interaction with the participants and a group photo with resource persons and participants at Chandigarh

Training on "Health assessment of trees" was organized for frontline staff of state forest department, eco-club teachers, students and other stakeholders at Botanical Garden, UT Chandigarh on 28 February 2020 under VVK activities. A total of 42 participants including forest officials, eco-club teachers and other stakeholders from different parts of the Chandigarh were imparted the training.

Scientist interaction with the participants and a group photo with resource person and participants at Chandigarh

Trainees with the faculty

Training on "Insect Pest Management in Forest Nurseries, Plantation and Natural Forests"was held for IFS Officers sponsored by MoEF&CC held from 25 to 29 November 2019 at FRI, Dehradun.

Inauguration of the training by D.G. ICFRE

A two-days MoEF&CC sponsored training programme on "Butterfly Monitoring and Butterfly Inclusive Eco-tourism as a Source of Livelihood" for IFS Officers was held on 3 to 4 December 2019 at FRI. A total of 15 participants from 12 states attended the training.

Training Workshop for IFS Officers

Training on Skill Development in Parataxonomy for communities of Gangotri–Govind and Darma-Byans Valley

Participants from Eco Task Force

Participants of course on Forestry, Wildlife and Disaster Risk Reduction

Participants of Forest Certification in Indian Context

Training on Forest Economics

HFRI, Shimla in collaboration with J&K State Forest Research Institute, Jammu organized a one-day training programme on Cultivation of Non-Timber Forest Products (NTFPs) in Jammu region: 'A step towards enhancing farmer's income and livelihood for the farmers of Jammu region' on 26 February 2020. A total of 34 progressive farmers of the Jammu region and PCCF (Wildlife), CF, DFOs and staff of J&K Forest Department; Director, SFRI, Jammu, CF; Scientists and staff of HFRI, Shimla participated.

Training Programme on cultivation of NTFPs on Jammu region

HFRI, Shimla organized a one-week compulsory training for Indian Forest Service Officers on conservation of medicinal plants and benefits sharing with local communities from 26 to 30 August, 2019 at HFRI, Shimla. A total of 16 IFS officers from twelve different states participated.

HFRI, Shimla organized three days training for stakeholders on "Cultivation of important temperate medicinal plants: an option for diversification and augmentation of rural income" from 25 to 27 September, 2019 at Shimla. The training was sponsored by MoEF&CC, Govt. of India. A total of 33 officials i.e., elected representatives, Gram Panchayat members, members of NGOs, teachers, ITBP officials, Eco Task Force officials, bank personnel, etc. participated in the training.

3.3
Visits Abroad

- Dr. Suresh Gairola, Director General, ICFRE participated in the meeting on Sharing Transboundary Cooperation on various issues of direct relevance to India's National Priorities at ICIMOD, Kathmandu (Nepal) from 25 to 27 August 2019.
- Dr. Suresh Gairola, Director General, ICFRE, **Dr. V.P. Tewari, IWST, Bengaluru; Dr. Sangeeta Gupta, Scientist-G, FRI, Dehradun and Dr. B.N. Diwakara, Scientist-E, IWST, Bengaluru** participated in the 25th IUFRO World Congress on Forest Research and Cooperation for Sustainable Development at Curitiba, Parana, Brazil from 29 September to 05 October 2019.
- Dr. Suresh Gairola, DG, ICFRE and Dr. R.S. Rawat, Scientist, ICFRE participated in the UNFCCC COP-25 at Madrid, Spain from 05-07 December 2019 for organizing a side event on land degradation neutrality and REDD+ readiness in India at India Pavilion of COP-25.
- Dr. R.S. Rawat, Scientist, ICFRE participated in Workshop on Transboundary Landscape Programme: Outlook and Synergy Building for 2020 and beyond at Chitwan, Nepal from 26-27 December 2019.
- Dr. V. Jeeva, Scientist-F, ICFRE attended 7th International Wildland Fire Conference at Brazil from 28 October to 1 November 2019.
- Dr. Rajeev Pandey, Scientist-E,ICFRE Visited Faro, Portugal to attend III Lead Author Meeting (LAM-3) of WG II for the contribution to IPCC for AR6 from 26 January to 1 February, 2020.
- Dr Ashok Kumar, Scientist F, FRI; Dr. B.N Diwakara, Scientist-E, IWST, Bengaluru and Dr. Amit Kumar Verma, Technical Officer, FRI, Dehradun attended the 4th World Agroforestry Congress held at Montpellier, France from May 20 to 22, 2019.
- Dr Maneesh Singh Bhandari, Scientist-D, visited Sousse, Tunisia to attend 2nd CAJG – Springer Conference of the Arabian Journal of Geosciences held from 25 to 28 November 2019.
- Dr. Rajeev Pandey, Scientist-E, FRI, Dehradun attended Second Lead Author Meeting (LAM 2) of IPCC at Kathmandu, Nepal from 14 to 19 July 2019.
- Dr. A. Nicodemus, Scientist-F and Dr. A. Karthikeyan, Scientist-F IFGTB, Coimbatore attended the Sixth International Casuarina Conference from 21 to 25 October 2019 at Karbi, Thailand.
- Dr. Rekha R. Warrier, Scientist-F, IFGTB, Coimbatore attended Regional Forest Genetics Workshop from 21 to 23 October 2019 at Beijing, China.
- Dr. K.K. Pandey, Scientist-G attended UNEP - Environmental Effects Assessment Panel meeting held at Alexandra, New Zealand from 22 to 30 September 2019.
- Dr. M.P. Singh, Director, IWST; Dr. V.P. Tewari, GCR and Dr. B.N. Diwakara, Scientist-E, as part of Indo-German collobarative research project, visited Georg-August University, Germany from 25 to 29 November 2019.
- Sh. Satya Prakash Negi, Conservator of Forests, HFRI, Shimla attended 'Certificate Programme in Public Policy' at University of California, Berkeley, USA from 14 January to 10 May 2019.

3.4

Participation in Seminars/Workshops/Trainings

S. No.	Name of Institute	No. of Seminars/Symposia/Workshops/Trainings
1.	ICFRE, HQ	11
2.	FRI, Dehradun	54
3.	IFGTB, Coimbatore	52
4.	IWST, Bengaluru	21
5.	TFRI, Jabalpur	29
6.	AFRI, Jodhpur	38
7.	RFRI, Jorhat	19
8.	HFRI, Shimla	27
9	IFP, Ranchi	38
10.	IFB, Hyderabad	15
	Total	304

4 CHAPTER

EXTENSION PANORAMA

4 EXTENSION PANORAMA

Centre of Excellence for Sustainable Land Management

Hon'ble Prime Minister of India Shri Narendra Modi ji while addressing the High-Level Segment of Fourteenth Conference of Parties (COP-14) to the United Nations Convention to Combat Desertification (UNCCD) at India Expo Centre and Mart, Greater Noida, NCR on 9 September 2019 made an announcement to set up a Centre of Excellence at Indian Council of Forestry Research and Education (ICFRE) to promote South-South cooperation to develop scientific approach and facilitate induction of technology on land degradation issues.

Organizing 14th Session of Conference of Parties (COP-14)

India has organised COP-14 to UNCCD at India Expo Centre and Mart, Greater Noida, NCR from 02-13 September 2019. ICFRE has participated in the Exhibition and Technology Fair organized during the event, focusing on research efforts in Restoration of Degraded Lands and Combating Desertification. ICFRE Exhibition in COP-14 of UNCCD highlights its works on development of models to combat desertification. Hon. Ralph Everard Gonsalves, Prime Minister of St. Vincent and the Grenadines; Hon. Shri Prakash Javadekar, Union Minister of Environment, Forest and Climate Change and Minister of Information and Broadcasting, Govt. of India; Hon. Shri Babul Supriyo, Minister of State, MoEF&CC, New Delhi; Mr. Ibrahim Thiaw, Executive Secretary of the United Nations Convention to Combat Decertification (UNCCD) and other dignitaries from India and abroad visited the ICFRE stall.

Besides the exhibition, ICFRE also organized a side event on Restoration of Degraded Forest Lands and Combating Decertification at COP-14 on 13 September 2019 with the objective to share the best practices/models developed by ICFRE institutes on restoration of degraded forest lands and to combat decertification. ICFRE research support will be helpful in achieving the LDN targets by 2030. About 110 national and international delegates participated in the side event.

Organization of a side event at COP-14 of UNCCD

Organisation of Side Event on 'Land Degradation Neutrality and REDD+ Readiness in India' at COP-25 of UNFCCC

ICFRE organised a side event in collaboration with ICIMOD on 'Land Degradation Neutrality and REDD+ Readiness in India' at India Pavilion of Twenty Fifth Session of Conference of Parties (COP-25) of United Nations Framework Convention on Climate Change (UNFCCC) at Madrid (Spain) on 6 December 2019.

The event has showcased the achievements of REDD+ Himalaya Project to a global audience and provided a platform to the project partner countries for sharing their knowledge and learning under South-South Cooperation.

About 35 delegates from many countries including the Minister of Natural Resources and Environmental Conservation, Myanmar participated in the side event.

Organization of a side event at COP-25 of UNFCCC

Participation in CMS COP-13

Hon'ble Prime Minister Shri Narendra Modi ji inaugurated the Thirteenth Session of the Conference of the Parties (COP-13) to the Convention on the Conservation of Migratory Species of Wild Animals held at Gandhi Nagar, Gujarat on 17 February 2020 through video conference. The theme of the COP-13 was "Migratory species connect the planet and together we welcome them home". ICFRE participated in the event held during 17-22 February 2020 by putting a stall in the exhibition. Visitors from many countries including Hon'ble Minister of State MoEF&CC Shri Babul Supriyo visited the ICFRE stall.

Hon'ble Shri Babul Supriyo, MoS, MoEF&CC, Govt. of India visiting ICFRE Stall at CMS COP-13 at Gandhinagar, Gujarat

World Bank Funded Ecosystem Services Improvement Project (ESIP)

Ecosystem Services Improvement Project(ESIP) is being implemented in the states of Chhattisgarh and Madhya Pradesh with the objective to improve forest quality; land management and non-timber forest produce (NTFP) benefits for forest dependent communities in selected landscapes. ICFRE is executing sub-component 1.2: Measuring and monitoring forest carbon stocks - capacity-building. Besides, ICFRE is also implementing one of the main components of ESIP on Scaling-up sustainable land and ecosystem management (SLEM) in selected landscapes.

Socio-economic surveys of villages of the project areas of Chhattisgarh and Madhya Pradesh were completed for collection of household data. 19 training programmes spreading over 35 days on various topics for 867 stakeholders were also conducted.

Baseline report on forest carbon stocks of ESIP areas of Madhya Pradesh has been prepared and shared with the MP State Forest Department, MoEF&CC and World Bank. The baseline total carbon stocks for the year 2019 have been estimated to be 8,07,323.78 tonnes for the ESIP areas of Madhya Pradesh. Forest areas under ESIP have the potential to sequester more carbon as maximum trees are young, which can build biomass in the subsequent years and therefore store the carbon in biomass.

Green Skill Development Programme (GSDP)

ICFRE is counducting training under Green Skill Development Programme (GSDP) of MoEF&CC under ENVIS scheme. FRI-ENVIS Resource Partner on Forestry and Forest-based Livelihood is coordinating training across the ICFRE institutes. However, IFGTB, Coimbatore has a separate ENVIS centre on 'Forest Genetic Resources and Tree Improvement' and conducts training thereon.

During the year 2019-20,15 training programmes were conducted for 286 participants out of which FRI-ENVIS conducted 12 programmes for 222 participants across the ICFRE institutes, while IFGTB-ENVIS conducted 3 programmes for 64 participants.

S.No	Course	Institute/Centre	No. of trainees	Duration of Course
1.	Paralegal Practices: Forestry Act and Policy	FRI, Dehradun	13	80hrs
2.	Value Addition and Marketing of NTFPs (plant Origin) : NTFP Products/Medicinal Plants		18	140hrs
3.	Forest Entomology and Pest Control		13	216hrs
4.	Propagation and Management of Bamboo	FRC ER, Prayagraj	20	240hrs
5.	Waste Management	AFRI, Jodhpur	17	300 hrs
6.	Value Addition and Marketing of NTFPs(plant Origin): NTFP Products/ Medicinal Plants		19	140hrs
7.	Bamboo Crafts	TFRI, Jabalpur	13	420 hrs
8.	Value Addition and Marketing of NTFPs (plant Origin): NTFP Products/ Medicinal Plants		20	140hrs
9.	Bamboo Crafts	RFRI, Jorhat	19	420 hrs
10.	Propagation and Management of Bamboo		20	240hrs
11.	Propagation and Management of Bamboo	IWST, Bengaluru	25	240hrs
12.	Propagation and Management of Bamboo	IFP, Ranchi	25	240hrs
13.	Plant Tissue Culture Techniques and its Applications	IFGTB, Coimbatore	64	320hrs
14.	Forest Entomology & Pest Control			216hrs
15,	Quality Planting Material Producer			240hrs

Glimpses of the GSDP Trainings conducted by ICFRE Institutes

Prakriti Programmes

Prakriti, a scientist-student connect programme, was envisaged and accordingly ICFRE entered into MoUs with Kendriya Vidyalaya Sangathan (KVS) and Navodaya Vidyalaya Samiti (NVS). The programme is now operational in all ICFRE institutes throughout the country. During the year, over 25,000 students and teachers from 232 KVs, 38 JNVs and 151 other schools and colleges located in different parts of the country have been sensitized/educated through various programmes spreading over 259 days.

Institute wise status of activities under Prakriti from April, 2019 to February, 2020

Name of Institute	No. of Organization			No. of Days	No. of Participants
	KVS	NVS	Others		
AFRI, Jodhpur	24	04	01	22	4059
FRI, Dehradun	134	06	01	49	3366
HFRI, Shimla	18	09	00	20	1164
IFB, Hyderabad	16	02	00	18	1665
IFGTB, Coimbatore	02	00	118	70	7658
IFP, Ranchi	09	11	01	21	2948
IWST, Bengaluru	03	00	27	30	2372
RFRI, Jorhat	02	05	00	07	1010
TFRI, Jabalpur	24	01	03	22	1532
Total	**232**	**38**	**151**	**259**	**25,774**

National Forest Library and Information Centre (NFLIC)

National Forest Library and Information Centre (NFLIC) is the richest in document collection on forestry and allied sciences in South and South-east Asia. NFLIC has been providing all types of library and information services, viz., reference referral, lending, reprography, current awareness, inter-library loan, retrieval of information from machine-readable database, etc. to its users. During the year 22,297 books were loaned to the users for outside reading. Besides 45,528 documents were consulted inside the library. The document collection of the NFLIC was enriched by the addition of 656 books and other documents. NFLIC subscribed to 58 Indian periodicals and 13 foreign journals in the year. It also received 491 issues of the periodicals gratis. NFLIC has been selling ICFRE publications through its Book Depot. During the year 469 books were sold to the State Forest Departments, universities, etc. and revenue of Rs. 80,279/- was earned.

Six Library and Information Science students from various institutes/universities successfully completed their one-month library internship from NFLIC. NFLIC received Rs. 30,000/- from these interns as library internship fee.

Environmental Information System (ENVIS)

MoEF&CC, New Delhi had established ENVIS Centre on Forestry at NFLIC, Dehradun 21 years ago. The Centre conducts various activities such as preparing databases on Indian Forestry Abstracts, Participatory Forest Management, *Prosopis juliflora*, Poplars, and Environment and Forests which are accessible through the website of the Centre at URL: www.frienvis.nic.in.

ENVIS Resource Partner on Forest Genetic Resources and Tree Improvement at IFGTB released the Tamil version of the Mobile App'Forest Tree Diseases'.FGR database was enriched. Awareness programmes were organized on occasions of environmental importance.

Publications

ENVIS-FRI compiled and published six issues of Environment and Forests News Digest in CD format. The issues are also accessible through the website of the Centre -www.frienvis.nic.in. ENVIS-IFGTB published the quarterly newsletter "Van Vigyan" (ISSN: 2394-7543).

4.1

Van Vigyan Kendras (VVKs), Demo Village (DV), Tree Growers Mela (TGM)

ICFRE institutes established 31 VVKs and 9 DVs. A total of 62 training programmes were organized across the country. Personnel from forest departments, NGOs, JFMCs, students, teachers, artisans, farmers, tribals etc. benefitted greatly from these.

VVKs/DVs training programmes organized during the year

S.No.	Name of Institute	No. of Training Programmes	No. of Participants
1.	FRI, Dehradun	06	279
2.	IFGTB, Coimbatore	01	62
3.	IWST, Bengaluru	08	940
4.	TFRI, Jabalpur	04	300
5.	RFRI, Jorhat	10	337
6.	HFRI, Shimla	01	40
7.	IFP, Ranchi	07	202
8.	IFB, Hyderabad	25	2600

Training at VVK Ambikapur, Chhattisgarh on 16 and 17 January 2020

Tree Growers Mela 2019

IFGTB, Coimbatore organized Industrial Tree Growers Mela on 22 October 2019 at Jayankondam, Ariyalur district in collaboration with Tamil Nadu Newsprint & Papers Limited (TNPL), Karur. About 450 tree growers/farmers from Jayankondam, Ariyalur and nearby districts of Tamil Nadu participated in the Mela. A book 'Makathana Vilaichaltharaum Marasagupadi Muraigal' (in Tamil) was released during the Mela.

Industrial Tree Growers Mela at IFGTB

Kisan Mela in Leh

An Exhibition was also organized for the farmers to display various technologies in clonal forestry, package of practices for major tree crops, pest & disease management in nursery and plantations. Nearly 450 participants including tree growers, field officials of Tamil Nadu Forest Department and representatives of wood-based industries attended the event.

HFRI, Shimla in collaboration with Agriculture and Forest Department, Leh organized a Kisan Mela at Leh on 6 September 2019, in which more than 135 people including farmers, foresters, NGOs, etc. participated.

Tree Growers Mela, 2020

IFGTB organized two days Tree Growers' Mela 2020 at IFGTB, Coimbatore on 10 and 11 March 2020 with financial assistance from CAMPA. Two new publications of IFGTB namely, "Cultivation of *Neolamarckia cadamba*" (in Malayalam) and "Malaivembu Sagupadi-Kala Vazhikatti" (in Tamil) and a Bio product - Bio Bacillin- were released in the mela.

1,000 Tree growers, farmers, IFGTB staffs and scholars participated in the Mela.

Scientist, FRI interact with Hon'ble CM, Uttarakhand in USG Meet-20

Scientist, FRI interacting with Hon'ble Governor, Uttarakhand

Participation in Kisan Mela, Exhibitions

- AFRI, Jodhpur participated in Kisan Mela-evam-Krushi Navachar Divas 2019 organized by CAZRI, Jodhpur on 16 September 2019. Different technologies/practices on sand dune stabilization, rehabilitation of saline lands, agroforestry and silvipastoral models, rehabilitation of water-logged areas, carbon sequestration, khejri mortality management and seedling of forestry plants and medicinal plants were exhibited.
- FRI, Dehradun participated in the exhibition organized during Uttarakhand State Geoinformatics Meet 2020 at Nalapani, Dehradun organized by Uttarakhand Space Applications Centre (USAC), Dehradun (Uttarakhand) on 10 February 2020.

Technologies Transferred

FRI, Dehradun

- Onsite propagation technique of *Litsea glutinosa* (Maida-lakri) was demonstrated to the trainees of different Forest Divisions of different states.
- Low cost cultivation technique of *Ganoderma lucidum* has been demonstrated using used tea leaves for spawn preparation and poplar billets as substrate. Complete harvesting of first mature crop takes only 70-80 days; whereas in other methods it may take up to 120 days.
- FRI, Dehradun has been actively involved in conservation of heritage, urban and important trees such as 'Bodhi Vriksha' at Bodh Gaya, Bihar, Ta Prohm temple trees in Cambodia, 'Vat Vriksha' at Jyotisar Kurukshetra, Haryana, trees at Tollygunj, West Bengal and Rastrapati Bhavan, New Delhi.

IFGTB, Coimbatore

- A farmer-friendly mobile app was released on 22 October 2019 in the Tree Growers Mela. In this App, only 5% of sampling need to be done by measuring only girth of every 20th trees in the field by walking all along the tree rows so that entire plantation is covered and representative trees are measured for estimation of yield of standing crop. This mobile app is now available in Google Play Store as "CYCUS"- which stands for Casuarina Yield Calculating Utility Software.
- A Material Transfer Agreement (MTA) has been signed by IFGTB and Andhra Paper Limited on 4 October 2019 to test IFGTB's 25 clones each of Casuarina and Leucaena in different locations in Andhra Pradesh. The Company has paid a one-time fee of Rs. 5,00,000/- for using the clones for research purpose and will enter into a non-exclusive license for commercial use of any of the clones found to be outstanding in the field trials.
- IFGTB is providing technical consultancy to M/s Andhra Paper Limited to increase the productivity of Casuarina and Leucaena plantations in the East and West Godavari districts of Andhra Pradesh. During the year around 50 lakh plants of IFGTB clones CH-1 and CH-2 were produced by the Company and supplied to farmers through the Company's farm forestry programme. Multilocation clonal trials of Casuarina and Leucaena were established with new clones developed by IFGTB.
- Two CSOs of Casuarina have been established in the M/s Seshasayee Paper and Boards Limited nursery area during 2019, using the high-yielding clones developed by IFGTB through its long-term breeding programme. The seeds to be produced by these orchards will be genetically superior with a broad genetic base to meet the needs of the Company's farm forestry programme.

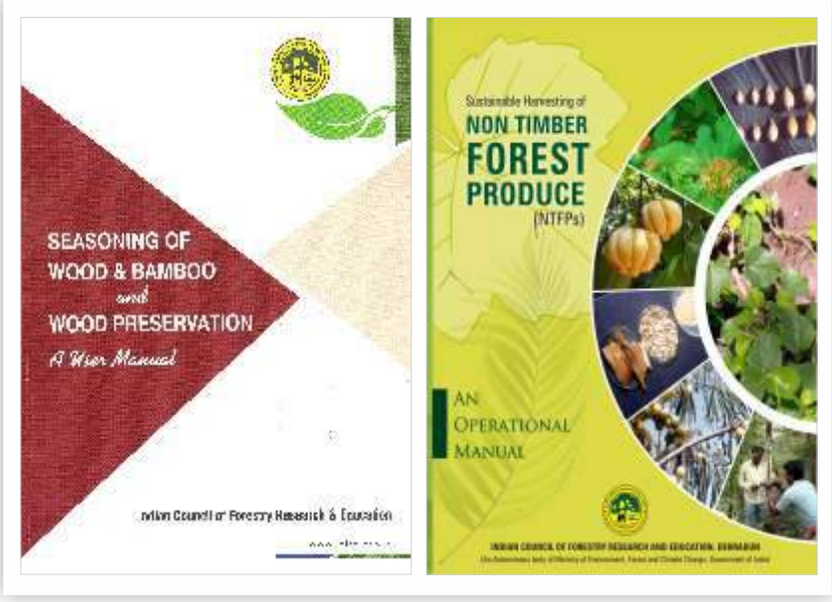
4.2

Research Publication

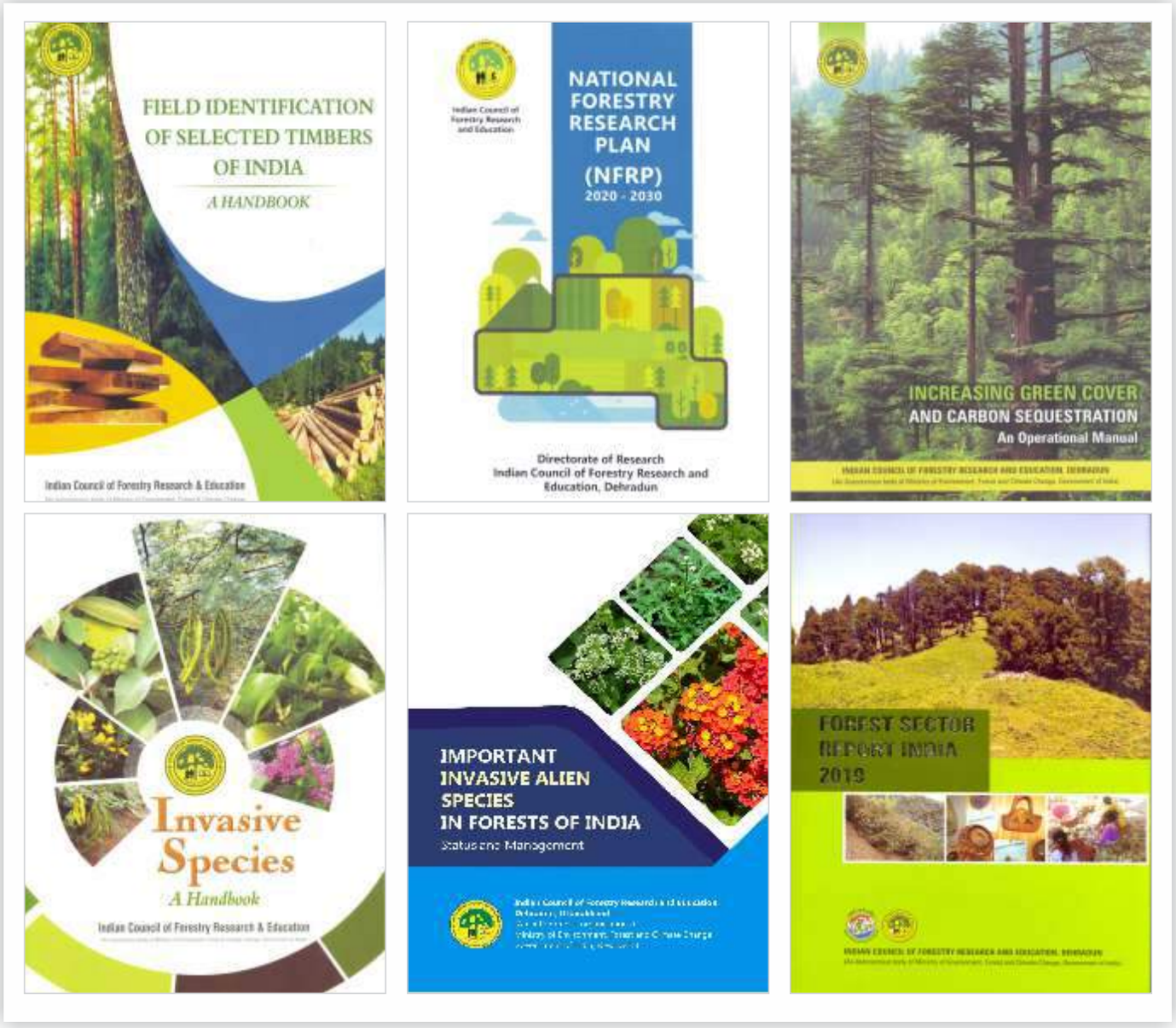
Publications are important tools for communicating the research output to the target audience. ICFRE has brought out a number of publications in different forms which are as follows:

Institutes	Books	Booklets/ Brochure/ Bulletins/ Pamphlets	Articles in Seminars/ Conferences/ Workshops etc.		Popular Articles in Journals	Research Papers Proceedings		Chapters in Books/
			Articles	Abstracts		Foreign	Indian	
ICFRE	15	01	-	02	09	15	6	2
FRI	03	10	09	40	09	75	82	22
IFGTB	06	18	21	33	11	09	32	33
IWST	-	09	48	44	02	28	10	15
TFRI	04	23	17	07	05	07	35	07
AFRI	02	-	06	03	04	-	13	05
RFRI	01	03	04	02	08	05	13	05
HFRI	02	13	-	16	01	04	12	03
IFP	01	-	04	04	-	07	09	-
IFB	41	02	04	3	14	01	01	05

Some important publications:



User Manuals/Handbooks/ Guidebooks etc. - Productivity Enhancement in Forestry Plantations; Seasoning of Wood & Bamboo and Wood Preservation; Modern Nursery Techniques; Forest Seed Management; Cultivation of Selected NWFPs; Invasive species; Mine Reclamation; Field Identification of Selected Timbers of India; Indian Mangroves; Increasing Green Cover and Carbon Sequestration; Soil and Water Conservation; Forest Insect Pests and Diseases; Sustainable harvesting of Non Timber Forest Produce (NTFPs); Forest-based Technologies for Improving Livelihood. National Forestry Research Plan (NFRP) 2020-2030, Forest Sector Report India-2019, Coffee Table Books - *Vansandhan* and Nature's Kaleidoscope: Biodiversity of the New Forest, Dehradun.



4.3

Seminars/ Symposia/Workshops organized

Scientists and researchers of ICFRE are recurrently involved in exchange of knowledge and information update about modern trends in forestry research and related areas through organizing and participating in symposia/ seminars/workshops/ meetings, etc. Some of the important topics discussed during the year include Genetically-improved Planting Stock as an Important and Valuable Resource for Increasing Productivity of Plantations Forests; FGR; Molecular Biology in FGR Conservation; Modern Trends in Plant Taxonomy; Essential Oils, Perfumery & Aromatherapy; Emerging Trends in Bioprospecting of Phytoresources; Forest Landscape Restoration; Bamboo-based Community Enterprise Development; Bamboo planting stock Certification and Nursery Accreditation Programme; Waste Management, Solid Waste, Bio-Chemical Waste, Plastic Waste, E-Waste; Construction and Demolition Waste; Sustaining Demand for Himalayan Medicinal Herbs: Role of Conservation Assessment & Management Prioritization (CAMP);Biodiversity-its Conservation, Convention and Management; Bio-Pesticides: Opportunities and Challenges in Forestry; Role of Forestry Seeds in Production of Quality Planting Stock; Role of Insects as Bio-Indicators in Forest Ecosystem; Insects for Food Security; Carbon Sequestration Pattern in Protected Areas of Jharkhand; Forest and Tree Cover of India, etc.

Institutes	No. of seminars/ symposia/ workshops/ meetings	No. of days	No. of participants
ICFRE	07	09	305
FRI	10	09	651
IFGTB	22	21	1288
IWST	02	02	88
TFRI	11	11	575
AFRI	21	23	654
RFRI	25	30	835
HFRI	48	48	2388
IFP	27	27	2530
IFB	18	23	484

4.4
Consultancies

ICFRE, Dehradun

Eleven consultancies awarded by Tehri Hydro Development Corporation India Ltd; Govt. of Karnataka; MoEF&CC GoI, New Delhi; Coal India Limited, Kolkata; NTPC Ltd., Noida; NMDC Ltd., Hyderabad; Singreni Collieries Company Ltd., Kothagudem; Chhattisgarh Forest Department, Raipur; Deptt. of Forest and Environment, Bhubaneswar; and SECL M.P. on preparation of reclamation and rehabilitation plans for iron ore mines, monitoring and evaluation of catchment area treatment plans and afforestation plans, cumulative environmental impact assessment of hydroelectric projects in Sutlej river basin, environmental performance evaluation, indexing and environmental audit of coal mines, biodiversity assessment studies with respect to coal and iron ore mines etc. Among the eleven ongoing consultancy projects, three were initiated and one consultancy was awarded during the year. Seventeen scientific study reports were prepared and submitted to concerned authorities.

FRI, Dehradun

- The action plans for ecological restoration of the Mine Over Burden dumps were prepared and executed to bring 44 ha area of mine spoils under green cover. Capacity building training on "Ecological Restoration for Integrated Environment Management in coal mines" was organized for the field staff and officers of BCCL Dhanbad at BCCL Dhanbad from 22-27 April, 2019.
- In pursuance of the Hon'ble National Green Tribunal's order to assess the damage due to sand mining, preparation of eco-restoration plan, NPV of future ecosystem services for river Subarnrekha, Balasore (Odisha) was done.
- In pursuance of the Hon'ble National Green Tribunal's order and the directions of the MoEF&CC for environmental compensation payable for the illegal mining in Ganga River at Haridwar, funded by Uttarakhand Geology and Mine Department, was conducted.
- Evaluation of CAMPA plantations of Punjab and Uttarakhand is being conducted.

IFGTB, Coimbatore

- Preparation of Reclamation and Rehabilitation Plan for Category C mines of Bellary, Chitradurga and Tumkur districts of Karnataka.
- Environmental auditing of open cast coal mines of Coal India Ltd.
- Preparation of Reclamation and Rehabilitation Plan for NMDC mines in Kirandul, Chhattisgarh.

- Developing Approach and Methodology for Index Rating of Environmental Compliance Conditions and Performance evaluation of coal mines of CIL.
- Auditing of Environmental and Forest Clearance Compliance in mining areas of Singareni Collieries.
- Biodiversity Assessment Study with respect to Hasdeo-Arand Coalfields comprising Tara, Parsa, Parsa East, Kente extension and coal block area in Surguja District, Chhattisgarh.

IWST, Bengaluru

- Consultancy project sponsored by M/s Decathlon Sports India on "Wood quality parameters of different species used for producing cricket bats" was completed.
- A short-term consultancy work was conducted at BHEL campus, Bengaluru for health assessment of trees for transplantation, where 62 trees of different species were investigated.

TFRI, Jabalpur

- Monitoring of NTPC Ltd. accelerated Afforestation Programme of Plantation of 10 Million Trees-In Seven States (M.P. and Maharashtra).
- Implementable forestry research for ash utilization - promotion and development of research park at Adani Maharashtra Power Ltd.,Gondia.
- Controlling fugitive dust emission through biological reclamation of flyash lagoons in Shree Singaji Thermal Power Project, Khandwa (M.P.) under M.P. Power Generating Co. Ltd.
- Wildlife Conservation Plan for Damini and Rajendra Underground Coal Mines, South Eastern Coalfields Limited, Sohagpur (MP) was prepared.

AFRI, Jodhpur

- 605 plants of 19 tree species with varying morphological and phenological characters were planted along the boundary wall as well as on the road sides of the newly constructed High Court Campus, Jodhpur for intended ecosystem services.

RFRI, Jorhat

- Establishing the correlation between fresh and dry weight of bamboo on seasonal basis for use by Assam Bio Refinery Pvt. Limited (ABRP), Numaligarh.
- Evaluation of CAMPA activities executed by state forest departments of Manipur, Meghalaya and Tripura.

HFRI, Shimla

- Himachal Pradesh State Biodiversity Board, Shimla entrusted HFRI, Shimla to prepare People's Biodiversity Register(PBRs) of Solan and Shimla. PBRs of 21 Biodiversity Management Committees of Shimla has been completed.

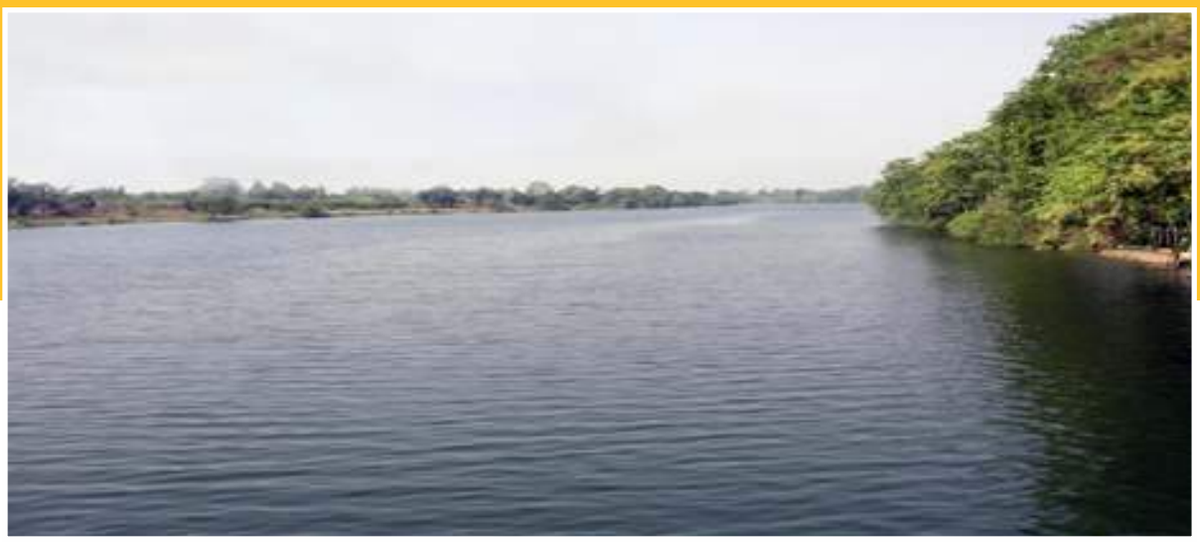
Preparation of Detailed Project Report (DPR) on Rejuvenation of 13 Rivers through forestry intervention.

ICFRE has been entrusted by NAEB for "Preparation of Detailed Project Report (DPR) for Rejuvenation of 13 Major Indian Rivers through Forestry Interventions". This is a flagship project of the MoEF&CC, New Delhi.

ICFRE institutes organized a number of workshops and capacity building programmes involving various stakeholders. A three-day workshop to scrutinize

Workshop on DPR organized by AFRI, Jodhpur

and finalize the draft DPRs thus prepared was held from 6 to 8 January 2020. Workshop to finalize the DPRs was held on 12 and 13 March 2020. During the workshop, the draft DPRs prepared for rivers Luni, Narmada, Cauvery and Yamuna were discussed in detail and specific suggestions were given. Accordingly, draft reports for rivers Luni and Narmada were finalised.



Sl. No.	ICFRE institute	River(s)	River length(km.)	States associated
1	Himalayan Forest Research Institute (HFRI), Shimla	Beas	230	Himachal Pradesh, Punjab
		Chenab	504	Himachal Pradesh, Jammu & Kashmir
		Jhelum	165	Jammu & Kashmir
		Ravi	720	Himachal Pradesh, Punjab
		Sutlej	1050	Himachal Pradesh, Punjab, Chandigarh
2	Institute of Forest Biodiversity (IFB), Hyderabad	Godavari	1465	Maharashtra, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Odisha, Karnataka, Telangana
3	Institute of Forest Productivity (IFP), Ranchi	Mahanadi	851	Chhattisgarh, Odisha, Jharkhand, Maharashtra
4	Tropical Forest Research Institute (TFRI), Jabalpur	Narmada	1312	Madhya Pradesh, Maharashtra, Gujarat
5	Institute of Wood Science and Technology (IWST), Bengaluru	Krishna	1400	Maharashtra, Karnataka, Andhra Pradesh
6	Forest Research Institute (FRI), Dehradun	Yamuna	1376	Uttarakhand, Himachal Pradesh, Haryana, Delhi, Rajasthan, Madhya Pradesh , Uttar Pradesh
7	Arid Forest Research Institute (AFRI), Jodhpur	Luni	511	Rajasthan
8	Rain Forest Research Institute (RFRI), Jorhat	Brahmaputra	916	Arunachal Pradesh, Assam, West Bengal, Manipur, Meghalaya, Nagaland, Sikkim
9	Institute of Forest Genetics and Tree Breeding (IFGTB),	Cauvery	800	Tamil Nadu, Kerala, Karnataka

4.5

Technical Services

FRI, Dehradun

130 wood samples received from Police, Customs, NCT, Intelligence Officer, Divisional Forest Officer, Dy. Central Vigilance Officer and private firms were identified.

IWST, Bengaluru

- 210 wood samples received from different agencies were identified and analysed for their wood properties and generated revenue of Rs. 17.30 lakhs.17 wood samples were tested for identification related to Red sanders wood.25 biomass samples received from FRI were tested for their calorific value.
- 70 trials on Wood Plastic Composite were taken for M/s Spectrus Sustainable Solutions Pvt. Ltd. during the year.

TFRI, Jabalpur

- Analyzed 1,358 soil and forest floor samples received from Forest Survey of India, Nagpur for their organic carbon content and revenue was generated.
- Analyzed 1,184 soil samples received under ESIP project, ICFRE, Dehradun for organic carbon and dry weight determination.

IFP, Ranchi

Analysed1,607 soil samples received from FSI, Kolkata and SFD, Jharkhand and generated revenue of Rs. 9,82,497.

4.6

Activities of Rajbhasha

Activities pertaining to Rajbhasha Hindi were carried out across the ICFRE institutes and Head quarters. Activities include:

- 33 Quarterly meetings of official language implementation committees.
- 19 Quarterly training workshops on implementation of official language Hindi.
- Rajbhasha inspection.

ICFRE and its institutes enthusiastically observed Hindi Week/Fortnight during the month of September 2019.

DG, ICFRE addressing the opening ceremony of Hindi Fortnight 2019 at ICFRE, Dehradun

4.7
Awards and Honours

- Dr. Vipin Parkash, Scientist-E, FRI, Dehradun was awarded Excellence Research Fellow Award-2019 by Association of Plant Science Researchers; Dehradun.
- Ms. Ranjana Negi, Scientist-D, FRI, Dehradun was awarded III prize in poster presentation in International Conference on Cultivation and Sustainable Use of High-altitude Medicinal and Aromatic Plants for the Socio-economic Development held at Forest Research Institute, Dehradun on 29-30 November 2019.
- Ms. Sobia Baig, Ms. Rakhi Tyagi and Ms. Sapna Bhardwaj of FRI, Dehradun were separately awarded with Young Scientist awards for their posters presented in 14th UCOST Science Congress held on 27-29 February 2020.
- Ms. Rakhi Tyagi, FRI, Dehradun won Outstanding Research Scholar award for oral presentation of a paper in National Conference organized by Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut on 20-21April 2019.
- Dr. A. Balasubramanian, Research Officer, IFGTB, Coimbatore received ICFRE Outstanding Employee Award for the year 2019 on 26 Jan 2020.
- Shri Deepak Yadav, Technical Officer, TFRI, Jabalpur was posthumously conferred the Life Time Meritorious Award by ICFRE, Dheradun on 26 January 2020.
- Care Himalayan Award-2019 was awarded to Dr. Sher Singh Samant, Director, HFRI, Shimla for outstanding achievement and contribution towards significant development in Himalaya.
- Dr. K.K. Pandey, Scientist-G, IWST, Bengaluru has been appointed as Co-chair of UNEP - Environmental Effects Assessment Panel (EEAP) for a period of 4 years. This is the first time an Indian Scientist has been appointed asCo-chair of this prestigious panel.
- Dr. G. Singh, Scientist-G, AFRI, Jodhpur was awarded S.K. Seth prize for the year 2017 for the best paper on Environment and Ecology published in 'The Indian Forester'.

Shri Satanu Saikia, Technical Officer, RFRI, Jorhat was awarded "ICFRE Outstanding Employee Award-2019" on 26 January 2020

Shri Dinesh Dhiman, Private Secretary, HFRI, Shimla was awarded "ICFRE Outstanding Employee Award-2019" on 26 January 2020

Radio Talks

- Recording and broadcasting of 16 Radio talks on various forestry issues by the scientists of FRI, Dehradun on All India Radio Dehradun.
- Recording and telecasting of 10 Doordarshan talks on various forestry issues/technologies by the scientists of FRI, Dehradun on Doordarshan, Dehradun.
- Dr. G.R. Rao, Director TFRI delivered an interactive talk about various research and extension activities being carried out by TFRI on AIR Jabalpur broadcasted on 13 January 2020.

4.8

Special Activities (Van Mahotsava, Forestry Day and Other occasions)

Earth Day

FRI, Dehradun; IWST, Bengaluru; TFRI, Jabalpur; AFRI, Jodhpur; RFRI, Jorhat; HFRI, Shimla;IFP, Ranchi.

International Day for Biological Diversity

"International Day for Biological Diversity 2019" under Theme on "Our Biodiversity, Our food, Our health" on 22 May 2019 was celebrated by – FRI,Dehradun, TFRI, Jabalpur, AFRI, Jodhpur, RFRI, Jorhat, HFRI, Shimla and IFP, Ranchi.

World Environment Day

World Environment Day with the theme "Air Pollution" on 5 June 2019 - FRI,Dehradun, IFGTB, Coimbatore, TFRI, Jabalpur, AFRI, Jodhpur, RFRI, Jorhat, HFRI, Shimla, IFP, Ranchi and IFB, Hyderabad.

World Environment Day at HFRI, Shimla

FRI, Dehradun organized Van Mahotsav

Van Mahotsav

FRI, Dehradun celebrated Van Mahotsav on 22 July 2019 at Jawahar Navodaya Vidayalya Shankarpur, Sahaspur, Dehradun. IWST, Bengaluru organized Van Mahotsav activity on 3 Aug 2019. Van Mahotsav was celebrated at KV TFRI on 23 July 2019 and on 5 July 2019 at FRC-SD, Chhindwara. AFRI, Jodhpur celebrated Van Mahotsav on 31 July 2019. HFRI celebrated the Van Mahotsav on 30 July 2019 and IFP, Ranchi organized 'Van Mahotsav' on 5 July 2020.

National Forest Martrys Day

FRI, Dehradun observed the day on 11 September 2019.

Constitution Day

FRI, Dehradun, HFRI, Shimla, IFP, Ranchi observed the day on 26 November 2019.

National Science Day

FRI, Dehradun celebrated the day on 28 February 2020.

World Bamboo Day

IFGTB, Coimbatore celebrated World Bamboo Day on 18 September 2019.

Vigilance Awareness week

All ICFRE institutes observed Vigilance Awareness week from 28 October 2019 to 2 November 2019.

Wildlife Conservation Week

FRC-SD, Chhindwara celebrated the week from 2 October to 4 October 2019.

International Day of Forests

FRI, Dehradun celebrated International Day of Forests by online Painting and Essay Competitions for the students of KV and NVs.

World Day to Combat Desertification

AFRI, Jodhpur observed the day on 17 June 2019.

National Technology Day

RFRI, Jorhat observed the day on 11 May 2019.

International Mountain Day

HFRI, Shimla celebrated the day on 11 December 2019.

Swach Bharat Abhiyan

All ICFRE institutes implemented Swach Bharat Abhiyan during the month of October 2019.

International Yoga Day

FRI, Dehradun, IFGTB, Coimbatore, IWST, Bengaluru, TFRI Jabalpur, RFRI, Jorhat, HFRI, Shimla and IFP, Ranchi celebrated International Yoga Day on 21 June 2019.

HFRI, Shimla celebrated International Yoga Day

5 CHAPTER

ADMINISTRATION AND INFORMATION TECHNOLOGY

5 ADMINISTRATION AND INFORMATION TECHNOLOGY

5.1 Information Technology

Introduction

Information Technology Division at ICFRE HQ plays an important role in supporting research, administrative and other activities. ICFRE is using Information Communication Technology, progressively providing the users 24x7 services to their satisfaction. IT Division caters to the Information Communication Technology needs of all institutes under ICFRE and ICFRE HQ. It is keeping pace with the technological advancement of ICT within the allocated budget to the best possible extent. Apart from providing the regular services, new initiatives are also being taken from time to time.

The following new initiatives were taken during 2019-20.

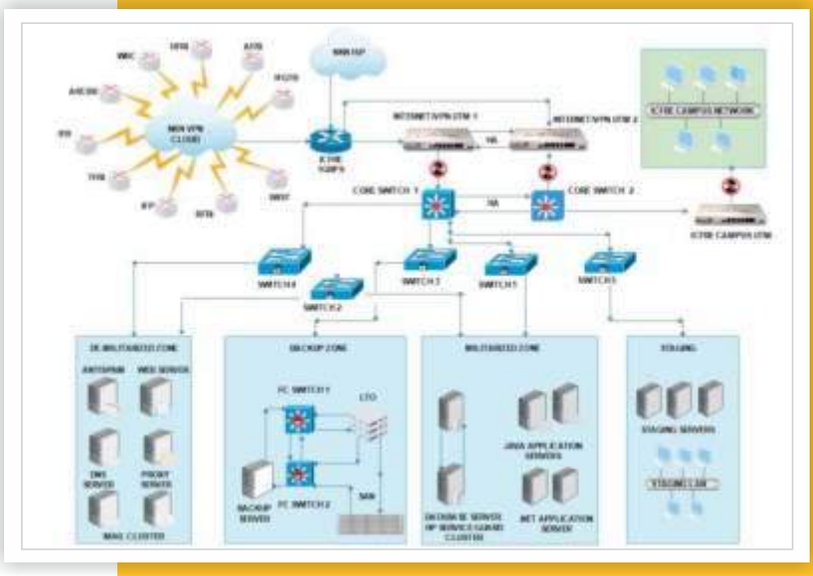
- **Upgradation of ICFRE Data Centre (Server Farm)**

ICFRE Data Centre services are available 24*7*365 at ICFRE HQ, ICFRE Institutes and Centres across the country since 01.02.2010.

Upgradation of ICFRE Data Centre was done in 2019. The Operation and Maintenance (O&M) contract for the ICFRE Data Centre also commenced in 2019 for the next five years.

Some of the services provided by Data Centre are Mail, Internet, Web, Videoconferencing, Antivirus, FTP, Network Security System, Databases, Building Management System (BMS), Virtual Private Network (VPN) services, Push Mail Service, Web-casting, etc.

Around 58 Web applications/ websites are hosted by the Data Centre. It has more than 1,500 active email accounts on Mail Server. Service Desk and IFRISDESK are institutional frameworks for the resolution of issues across ICFRE.



Data Centre Architecture

- **The following new applications/websites were developed / implemented:**

A. **Website of Detailed Project Report (DPR) for rejuvenation of major rivers in the country through forestry interventions:** The ICFRE through its institutes are preparing DPRs of 13 major rivers of the country *viz.*, Beas, Chenab, Jhelum, Ravi, Sutlej, Yamuna, Brahmaputra, Mahanadi, Narmada, Krishna, Godavari, Cauvery, Luni belonging to 9 river systems for their rejuvenation through forestry interventions following a holistic approach. IT Division, ICFRE developed the website for the same. URL of the website is http://riversdpr.icfre.org/.

A screenshot of the website of DPR for rejuvenation of major rivers in the country through forestry interventions

A screenshot of the application for DPR for rejuvenation of major rivers in the country through forestry interventions.

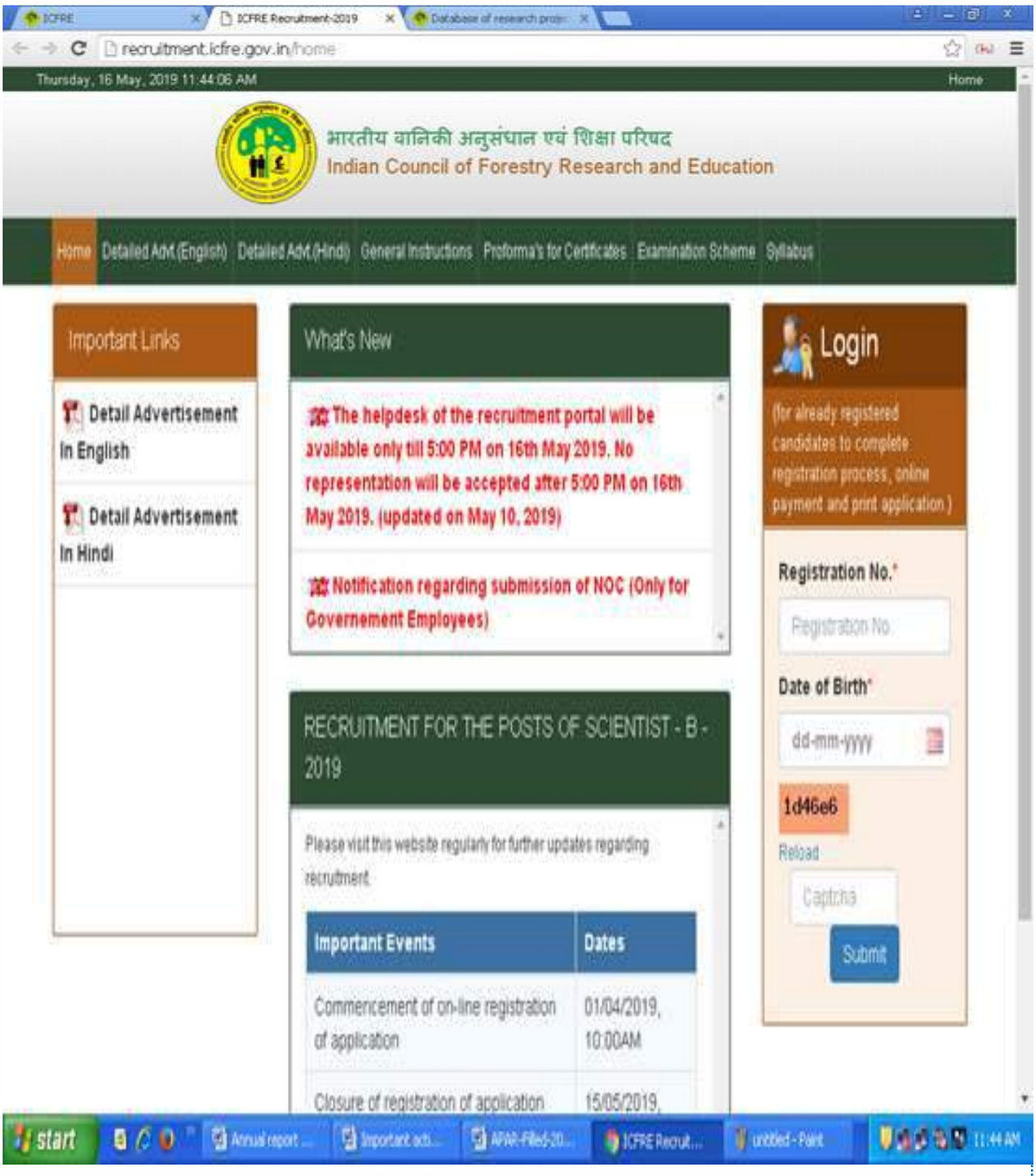
B. **Web Application for Detailed Project Report (DPR) for rejuvenation of major rivers in the country through forestry interventions:** IT Division, ICFRE also developed the web application for Detailed Project Report (DPR) for rejuvenation of major rivers in the country through forestry interventions. URL of the application is http://dprapp.icfre.org.

C. IT Division, ICFRE hosted the following websites of Detailed Project Reports (DPRs) in year 2019

- DPR Krishna: URL of the website is http://dprkrishna.icfre.org/.
- DPR Brahamputra: URL of the website is http://dprbrahmaputra.icfre.org/.
- DPR Yamuna: URL of the website is http://dpryamuna.icfre.org/.

- DPR Godavari: URL of the website is http://dprgodavari.icfre.org/.
- DPR Narmada: URL of the website is http://dprnarmada.icfre.org/.
- DPR Indus: URL of the website is http://dprindus.icfre.org/.

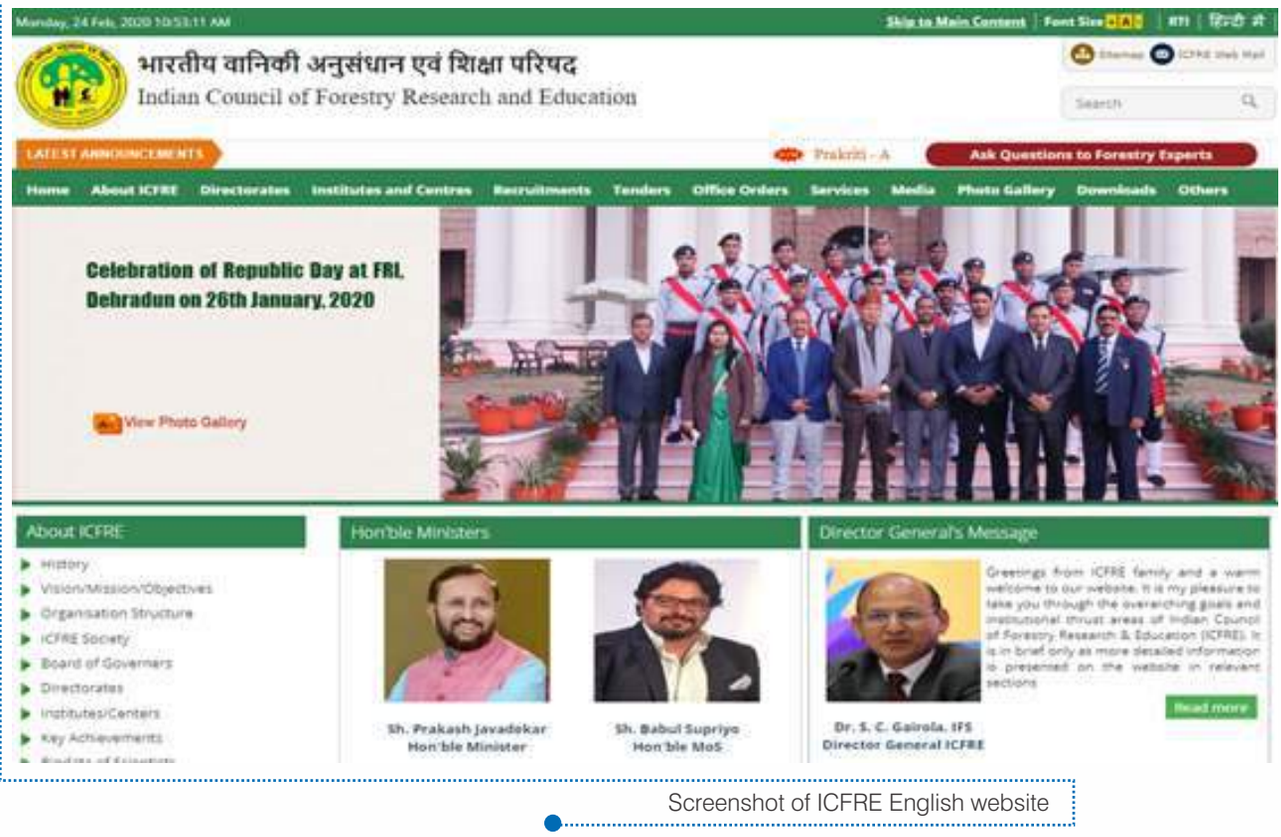
D. **Online application for the recruitment of Scientist-B at ICFRE:** IT Division, ICFRE conceptualized, designed and tested the portal for recruitment of scientists at ICFRE. URL of the application is http://recruitment.icfre.gov.in.



A screenshot of the online application for the recruitment of Scientist-B at ICFRE

E. **ICFRE bilingual websites:** ICFRE bilingual websites were redeveloped and are as per the current Guidelines of Indian Government Websites (GIGW). URL of the English website is http://icfre.gov.in/ and hindi website is http://hindi.icfre.org/.

Screenshot of ICFRE Hindi website



Screenshot of ICFRE English website

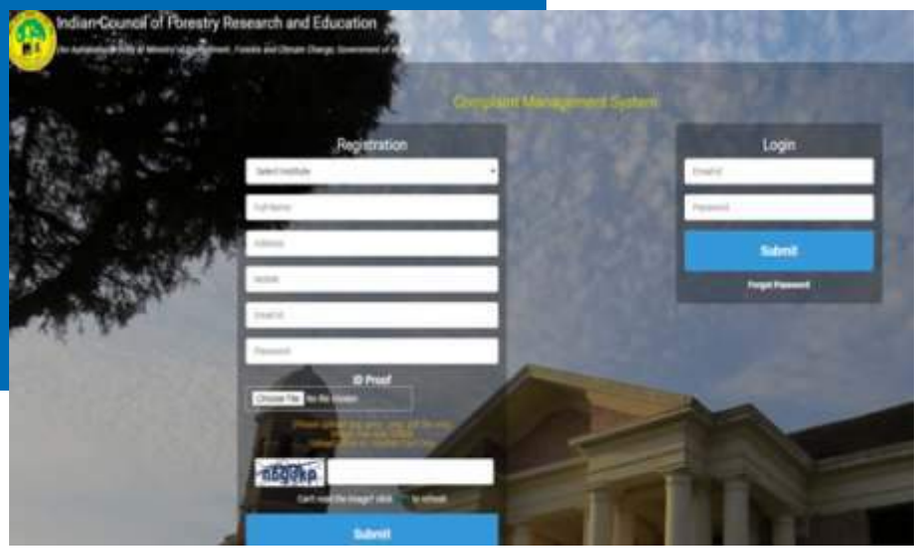
F. **RFRI, Jorhat website:** RFRI, Jorhat website was designed, developed and implemented on live server. URL of the website is http://rfri.icfre.gov.in.

A screenshot of RFRI website

G. **ESIP website:** Ecosystem Services Improvement Project (ESIP) website was designed and developed by IT Division, ICFRE. URL of the website is http://esip.icfre.org/.

A screenshot of ESIP website

H. **Complaint Management System:** An online Complaint Management System was implemented for FRI, Dehradun campus. URL of the Complaint Management System is http://complaint.icfre.org/



Screenshot of Complaint Management System

- **Maintenance of Software Applications/Websites**

  Apart from the aforementioned new websites, the following applications/websites developed in the previous years are also being regularly maintained and updated from time to time.

  1. Pensioners database
  2. HFRI Shimla website (bilingual)
  3. IFB Hyderabad Website
  4. AFRI Jodhpur Website (bilingual)
  5. Guest House Booking Portal
  6. Fixed Assets Database and Application
  7. Interactive Portal: Interface with Stakeholders
  8. Annual Property Returns Portal
  9. GPF Application
  10. Information System for Secretary Office (Men-in-Position).

  Around 58 websites/Database/CMSs/applications including applications and websites of ICFRE institutes which are on live server are being maintained.

- **Updation of website of ICFRE (http://icfre.gov.in)**

  ICFRE's website is updated in a very timely manner. 1,771 updates were done on the ICFRE website during April 1, 2019 to March 31, 2020.

- **Upgradation of Videoconferencing (VC)**

  Videoconferencing Services were implemented in April 2008 across ICFRE HQ and Institutes and have been functioning since then. The new MCU for Video Conferencing (VC) system was installed in the year 2019 at ICFRE Data Centre. Due to this, VC can be established through Endpoints, Desktops, Laptops, Mobiles etc. VC can be connected to the internal as well as external organization through public IPs. VC can be connected to 100 locations at the same time.

- **Maintenance of LAN**

  Upgradation of LAN was completed successfully at ICFRE HQ and eight Institutes in the month of August 2017. The Operation & Maintenance (O&M) of existing and upgraded hardware/software of LAN at ICFRE HQ, nine Institutes and three Centres commenced on 01.09.2017 for five years.

- **e-Office**

  Inputs were provided to MoEF&CC related to ICFRE and its Institutes for implementation of e-Office.

- **National Knowledge Network (NKN) connectivity**

  National Knowledge Network (NKN) connectivity has been provided to 12 locations of ICFRE since September 2013. The National Knowledge Network (NKN) connectivity availability is more than 99% at ICFRE HQ. The 100 Mbps internet leased line is provided by NKN through Rail Tel India at ICFRE HQ and media for 1 Gbps internet leased line through

BSNL is also provided at ICFRE HQ. The said arrangement is made for ensuring reliable, high availability of internet and VPN services. Internet services extend across ICFRE locations throughout the country.

- **Maintenance Contract of IT Hardware (Computers, laptop, Printer, Scanner and Franking machine) at ICFRE HQ**

  An agreement between ICFRE and M/s Jayson Infoware Pvt. Ltd., Dehradun was signed on 22.03.2019 for Maintenance Contract of Computers, Printers, Scanners, Laptops and Franking Machine for a period of three years.

All the nine Institutes under ICFRE have IT Cells, maintain their own respective websites, have robust LAN & WAN facilities and are connected with NKN (National Knowledge Network).

Website of Institutes under ICFRE

S.No.	Name of the Institute	Website
1.	FRI, Dehradun	http://fri.icfre.gov.in
2.	TFRI, Jabalpur	http://tfri.icfre.gov.in
3.	AFRI, Jodhpur	http://afri.icfre.gov.in
4.	HFRI, Shimla	http://hfri.icfre.gov.in
5.	IFP, Ranchi	http://ifp.icfre.gov.in
6.	IFB, Hyderabad	http://ifb.icfre.gov.in
7.	IFGTB, Coimbatore	http://ifgtb.icfre.gov.in
8.	RFRI, Jorhat	http://rfri.icfre.gov.in
9.	IWST, Bengaluru	http://iwst.icfre.gov.in

FRI, Dehradun

IT & GIS Discipline functions under the Facility and Services Division of FRI and hosts the Bioinformatics Centre, Information Technology (IT) Cell and GIS Centre. Since its establishment in the year 2009, the discipline has been providing essential services related to IT and RS-GIS for research, education, extension and training. The discipline provides all necessary support services in the domain of IT and RS-GIS to all divisions of FRI, ICFRE, FRI (Deemed to be) University and other associated organizations. The IT Cell functions as the central service providing unit in the Information & Communication Technology domain, Bioinformatics Centre implements research and training as per the mandates of DBT, whereas the GIS Centre provides support to research and training activities in the domain of RS-GIS.

The GIS Centre is also one of the recognized centres of Indian Institute of Remote Sensing (IIRS), Dehradun for conducting IIRS-sponsored distance learning course under outreach programme of EDUSAT (http://www.iirs.gov.in/EDUSAT-News).

RFRI, Jorhat

- Developed the web site on "DPR for rejuvenation of Brahmaputra River through forestry intervention".
- Developed a Data portal on "DPR for rejuvenation of Brahmaputra River through forestry intervention".

5.2
Administration

A brief note on general administration activities along with information on the following:

5.2.1 SEVOTTAM

SEVOTTAM has been implemented at all ICFRE offices. It symbolizes the Government's intent to move from 'administration' mind set to 'service orientation' in delivery of public services. It emphasizes the relationship between the service provider and service receivers. It is a standardized services delivery excellence model whose main features are to identify the services provided by the organization, to set norms for each service, to ensure delivery as per norms, to assess quality of delivery on a continuous basis, and to proactively redress the public grievances.

5.2.2 Details of publicity efforts made and awareness campaigns organized on Charter for the Citizen/Clients;

AFRI, Jodhpur

Various events were organized, literature published and talks delivered by AFRI officials during different events, conferences, workshops which greatly helped in publicity efforts. Awareness campaigns were organized on Charter for Citizen/Clients.

IWST, Bengaluru

In order to publicize and create awareness among the end users and general public, IWST has published many handouts which are distributed free of cost in Krishi Melas, trainings and demonstration programmes, VVKs, etc.

The Institute also has brought out many publications/ technical bulletins in Kannada, English, Hindi and Telugu and which are made available to the public on payment basis.

HFRI, Shimla

Awareness among stakeholders about the Citizen/Client Charter of the Institute through various training programmes being organized by the institute. The staff is also being encouraged to implement the Client Charter in its true spirit for the benefit of the stakeholders

5.2.3 Details of internal and external evaluation of implementation of Citizens/Clients Charter in the Organization and assessment of the level of satisfaction among Citizens/Clients.

IWST, Bengaluru

Internal - The Internal evaluation of the implementation of Charter is being done by GCR/Director and ADGs/DDGs/DG

External – In due course of time, mechanism for External evaluation of implementation of Charter in the organization will be developed.

AFRI, Jodhpur

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

HFRI, Shimla

The Client Charter is being monitored at the end of financial year. In addition to above, the Institute is also apprizing the stakeholders about the extension activities proposed in the Client Charter and Action Plan and encouraging them to attend these programmes for the ultimate benefit of forests and environment.

IFB, Hyderabad

All research programmes were evaluated internally by GCR and Director and also by the Assistant Director General (M&E). Both new projects as well as progress of ongoing ones have also been scrutinized by RAG comprising both internal and external experts.

5.3

Welfare measures for the SC/ ST/ backward/ minority communities/ women

IWST, Bengaluru

IWST has a Grievance and Redressal Cell to attend the grievances of IWST employees. The cell is also looking after several welfare measures for SC/ST/OBC employees of the Institute. The employees put their grievances if any to Grievance and Redressal Officer, which are immediately attended to. In this regard, an association of SC/ST employees has been formed which is assisting in the overall development and welfare of SC/ST employees.

TFRI, Jabalpur

- The interest of the above section is being safeguarded and as per the guidelines of Government of India, a Liaison Officer is in position who monitors the promotions/ recruitment as per the roster.
- Recruitment made during the 2019-2020.
  MTS- 10 posts, Forester-01
- Promotions made during 2019-20 under Group "C" posts: 07 nos.

AFRI, Jodhpur

To promote the general interest of SC/ST/OBC employees, an SC/ST/OBC Employees Welfare Association was formed at AFRI. As per the DOPT's guidelines for various social groups, Liaison Officers had been nominated.

128th Birth anniversary celebrated of Bharat Ratna Baba Saheb Dr.B.R. Ambedkar in AFRI, Jodhpur

To spread the message of equality and harmony among the various sections of society, the SC/ST/OBC Employees Welfare Association of AFRI celebrated Dr. B.R. Ambedkar Jayanti on 14th April 2019 to commemorate the birthday of Bharat Ratna Baba Saheb Ambedkar.

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्

Indian Council of Forestry Research and Education

देहरादून–Dehradun

उत्तराखण्ड–Uttarakhand

तुलन पत्र
2019-20

BALANCE SHEET
2019-20

नवम्बर 30, 2020

November 30, 2020

ASHISH KUMAR GUPTA & ASSOCIATES
Chartered Accountants

Independent Auditor's Report

To
The Members
Indian Council of Forestry Research and Education
Dehradun-248006
Uttarakhand

Report on the Financial Statements

We have audited the financial statements of Indian Council of Forestry Research and Education, which comprised the Balance Sheet as at March 31, 2020 and the Income and Expenditure Account for the year ended 2020 and notes to the financial statement including summary of significant accounting policies.

In our opinion, and to the best of our information and according to the explanations given to us the aforesaid financial statements, subject to the audit observations provided below, the consequential impact, if any, whereof is not quantifiable, give a true and fair view, in conformity with the accounting principles generally accepted in India, of the financial statement of the entity for the financial year 2019-20.

Responsibilities of Management and Those charges with Governance for the Financial Statements.

Management is responsible for the preparation and presentation of these financial statements that give a true and fair view of the financial position and financial performance of the entity in accordance with the accounting principles generally accepted in India.

In preparing the financial statements, management is responsible for assessing the entity's ability to continue as going concern and also includes design implementation and maintenance of adequate internal financial controls that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditors Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We have taken into account the relevant provisions and rules framed thereunder, the accounting and auditing standards and matters which are required to be included in the audit report under the provisions of the Act and the Rules made thereunder.

Head Office : RAJ PLAZA COMPLEX
1st Floor, 75 Rajpur Road, Dehradun (U.K.)
Mob. : 9358111116 9997431932
e-mail : akgupta70@gmail.com, akgupta70@rediffmail.com

We conducted our audit in accordance with the standards on Auditing issued by the Institute of Chartered Accountants of India. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control.
  Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the entity's ability to continue as a going concern. If we conclude that a material uncertainty exists. We are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the entity to cease to continue as a going concern.
- We communicate with those charged with governance regarding, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We believe that we have obtained sufficient and appropriate audit evidences to provide a basis for our audit opinion that the financial statements are true and fair from material misstatements, subject to the observations provided as under -

1. Forest and Travelling Advances are not timely recovered by the ICFRE Divisions within the time frame as prescribed under Rule 323(2) of GFR 2017.

2. ICFRE has not maintain a system of taking Input Tax Credit under GST on the supplies taken from various private and non-private bodies. Due to the reason of which, ICFRE is paying double taxi.e both at time of Input supplies as well as output supplies, resulting in huge revenue loss.

3. During the verification of vouchers, it was found that most of the institute under ICFRE, are not receiving GST invoice as per the prescribed rules mention under Goods and Services Tax Rules, as in most of the Invoices, the GST number of ICFRE is not mentioned.

4. An amount of Rs 16,67,000 refunded by CCU-NE in the financial year 2019-20 has been adjusted from schedule 11 of the financial statements from total advance of Rs 59,17,000/-, however the balance outstanding in the balance sheet to CCU-NE (Budget Section) was not reconciled with the records provided during verification.

Scope Limitation due to COVID-19

The disclaimer of opinion provided in the above report is based on the information, facts and reports made available to us by ICFRE. We wish to highlight that due to COVID-19 induced restrictions on physical movements and strict timelines, the institute from various location could not be present physically for conducting the audit work.

FOR ASHISH KUMAR GUPTA & ASSOCIATES
(CHARTERED ACCOUNTANTS)

Preeti Gupta

(CA PREETI GUPTA)
FCA, PARTNER
MEMBERSHIP NO. 408004
DATED: 30-11-2020
PLACE: DEHRADUN
UDIN: 20408004AAAAAR5614

CONTENTS

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

BALANCE SHEET AS AT 31ST MARCH, 2020

(Amount in Rs.)

CORPUS/CAPITAL FUND AND LIABILITIES	SCHEDULE	CURRENT YEAR AS ON 31.03.2020		PREVIOUS YEAR AS ON 31.03.2019	
		RS.	RS.	Rs	RS.
CORPUS/CAPITAL FUND	1		1,18,15,89,487.39		1,29,68,16,112.37
RESERVES AND SURPLUS	2		-		-
EARMARKED/ENDOWMENT FUNDS :	3		86,13,70,801.30		62,63,85,938.50
a) One Time Special Grant		-		-	
b) Project Unspent Balance		70,45,67,821.30		48,06,02,772.50	
c) Chair of Excellence		15,68,02,980.00		14,57,83,166.00	
SECURED LOANS AND BORROWINGS	4		-		-
UNSECURED LOANS AND BORROWINGS	5		-		-
DEFFERRED CREDIT LIABILITIES	6		-		-
CURRENT LIABILITIES AND PROVISIONS					
(A) CURRENT LIABILITY:	7		13,68,39,682.00		13,06,06,144.00
(B) PROVISIONS:		-	-		-
TOTAL			2,17,97,99,970.69		2,05,38,10,194.87

ASSETS		CURRENT YEAR AS ON 31.03.2020		PREVIOUS YEAR AS ON 31.03.2019	
		RS.	RS.		RS.
FIXED ASSETS	8		1,05,58,77,127.38		1,09,58,45,962.58
INVESTMENTS-FROM EARMARKED/ENDOWMENT FUNDS					
a)F.D.R.(For One Time Special Grant)	9		15,66,93,442.00		14,56,35,000.00
bF.D.R.(With Institutes)					-
INVESTMENTS-OTHERS	10		-		-
a) F.D.R.(With Institutes)					
CURRENT ASSETS, LOANS, ADVANCES ETC.	11		96,72,29,401.31		81,23,29,232.29
MISCELLANEOUS EXPENDITURE			-		-
a)(to the extent not written off or adjusted)					
TOTAL			2,17,97,99,970.69		2,05,38,10,194.87

SH ARUN SINGH RAWAT , (Director General, ICFRE)

SH SUNIL DUTT SHARMA , (Deputy Director General, Admin., ICFRE)

SH RAJ KUMAR BAJPAI,(ASSISTANT DIRECTOR GENERAL, Admin, ICFRE)

SH BRIJESH KUMAR SHARMA, (SECTION OFFICER, BUDGET SECTION, ICFRE)

AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED
FOR ASHISH KUMAR GUPTA & ASSOCIATES
(CHARTERED ACCOUNTANTS)

(CA PREETI GUPTA)
FCA, PARTNER,
MEMBERSHIP NO. 408004
DATED: 30/11/2020
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

INCOME	Schedule	Current Year 31.03.2020	Previous Year 31.03.2019
		RS	RS.
Income from sales/services	12	6,22,69,109.93	30,79,762.00
Grants/Subsidies	13	2,25,00,00,000.00	2,13,49,00,000.00
Fees/Subscriptions	14	1,66,93,439.00	1,24,03,066.84
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to	15	-	-
Income from Royalty, Publications etc.	16	5,81,33,965.17	-
Interest Earned	17	2,56,11,688.80	1,28,64,394.00
Other Income	18	17,65,99,267.31	15,59,31,932.36
Revenue earn in plan account		1,48,00,975.46	
Revenue earn in other than plan accounts		47,513.00	
Increase/(decrease) in stock of finished goods and works-in-progress	19	-	-
Total(A)		**2,60,41,75,978.67**	**2,31,91,79,175.20**

EXPENDITURE	Schedule	Current Year 31.03.2020	Previous Year 31.03.2019
		RS.	RS.
Establishment Expenses	20	2,01,58,14,112.00	1,76,16,74,916.39
Other Administrative Expenses etc.	21	60,83,56,519.23	46,79,88,217.02
Expenditure on Grants, Subsidies etc.	22		5,24,704.00
Interest	23		-
Revenue earn transfer to own revenue account		1,56,71,823.22	
Depreciation(Net Total at the year end-corresponding to Schedule 8)		15,12,91,420.20	16,26,23,714.43
TOTAL(B)		**2,79,11,33,874.65**	**2,39,28,11,551.84**
Balance being excess of Income over Expenditure(A-B)		(18,69,57,895.98)	(7,36,32,376.63)
Transfers to Special Reserve(Specify each)		-	-
Transfer to/from General Reserve		-	-
BALANCE BEING DEFICIT CARRIED TO CORPLUS FUND		(18,69,57,895.98)	(7,36,32,376.63)
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

SH ARUN SINGH RAWAT , (Director General, ICFRE)

SH SUNIL DUTT SHARMA , (Deputy Director General, Admin., ICFRE)

SH RAJ KUMAR BAJPAI,(ASSISTANT DIRECTOR GENERAL, Admin, ICFRE)

SH BRIJESH KUMAR SHARMA, (SECTION OFFICER, BUDGET SECTION, ICFRE)

AS PER OUR SEPARATE REPORT OF EVEN DATE ANNEXED
FOR ASHISH KUMAR GUPTA & ASSOCIATES
(CHARTERED ACCOUNTANTS)

(CA PREETI GUPTA)
FCA, PARTNER,
MEMBERSHIP NO. 408004
DATED: 30/11/2020
PLACE: DEHRADUN

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

SCHEDULE 1-CORPUS/CAPITAL FUND	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
	RS.	RS.	RS.	RS.
Balance as at the beginning of the year		1,29,68,16,112.37	1,26,59,87,553.00	
Op.Balance of Capital Fund Account			-	
Op.Balance of General Fund Account			-	
Add: Advance to CCU for buidling Capitalised		-	2,94,60,936.00	1,29,54,48,489.00
Add: Contributions towards Corpus/Capital Fund		5,00,00,000.00		
Add: Fixed Assets Capitalized during the year		2,33,98,271.00		
Less: Refund to Ministry		(16,67,000.00)		7,50,00,000.00
Add/Less: Surplus/ (Deficit) income over expenditure for		(18,69,57,895.98)		(7,36,32,376.63)
BALANCE AS AT THE YEAR-END		1,18,15,89,487.39		1,29,68,16,112.37

SCHEDULE 2-RESERVES AND SURPLUS	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
	RS.	RS.	RS.	RS.
1. **Capital Reserve:**				
As per last Account		-	-	-
Addition during the year		-	-	-
Less: Deductions during the year		-	-	-
2. **Revaluation Reserve:**		-	-	-
As per last Account		-	-	-
Addition during the year		-	-	-
Less: Deductions during the year		-	-	-
3. **Special Reserves:**		-	-	-
As per last Account		-	-	-
Addition during the year		-	-	-
Less: Deductions during the year		-	-	-
4 **General Reserve:**		-	-	-
As per last Account		-	-	-
Addition during the year		-	-	-
Less: Deductions during the year		-	-	-
TOTAL		-	-	-

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS	FUND –WISE BREAK UP			TOTALS	
	ONE TIME SPECIAL GRANT	PROJECT ACCOUNTS	Chair of Excellence	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.		RS.	RS.
a)Opening balance of the funds	-	48,06,02,772.50	14,57,83,166.00	62,63,85,938.50	56,92,92,607.00
b)Additions to the Funds:				-	-
i) Donations/grants				-	-
One Time Special Grant (General)				-	-
One Time Special Grant (Creation of Assets!)				-	-
ii) Income from investments made on account of funds			1,10,19,814.00	1,10,19,814.00	99,03,597.00
iii) Other additions (specify nature)				-	-
iv) Project Receipts		77,72,71,189.59		77,72,71,189.59	52,83,47,511.24
TOTAL(a+b)	-	**1,25,78,73,962.09**	**15,68,02,980.00**	**1,41,46,76,942.09**	**1,10,75,43,715.24**
C) Utilisation/Expenditure towards objectives of funds				-	-
i) Capital Expenditure				-	-
- Fixed Assets		2,33,98,271.00		2,33,98,271.00	2,94,60,936.00
- Others				-	-
				-	-
ii) Refunded to Ministry				-	-
- Amount refunded to ministry of Environment & forests				-	-
- Amount transferred to Chair of Excellence Fund				-	-
				-	-
iii) Revenue Expenditure				-	-
- Salaries, Wages and allowances etc.				-	-
- Rent				-	-
- Other Administrative expenses				-	-
- Project Payments		52,99,07,869.79		52,99,07,869.79	45,08,15,740.74
				-	-
iv) Amount wrongly entered				-	8,81,100.00
TOTAL(C)	-	**55,33,06,140.79**	-	**55,33,06,140.79**	**48,11,57,776.74**
NET BALANCE AS AT THE YEAR END(a+b-c)	-	**70,45,67,821.30**	**15,68,02,980.00**	**86,13,70,801.30**	**62,63,85,938.50**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

SCHEDULE 4-SECURED LOANS AND BORROWINGS:	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
	RS.	RS.	RS.	RS.
1. Central Government	-	-	-	-
2. State Government(Specify)	-	-	-	-
3. Financial Institutions				
a) Term Loans	-	-	-	-
b) Interest accrued and due	-	-	-	-
4. Banks:				
a) Term Loans	-	-	-	-
-Interest accrued and due	-	-	-	-
b) Other Loans(specify)	-	-	-	-
-Interest accrued and due	-	-	-	-
5. Other institutions and Agencies	-	-	-	-
6. Debentures and Bonds	-	-	-	-
7. Others(specify)	-	-	-	-
TOTAL	-	-	-	-

Note: Amount due within one year

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

Schedule 5-UNSECURED LOANS AND BORROWINGS	Current Year 31.03.2020 RS.	Previous Year 31.03.2019 RS.
1. Central Government	-	-
2. State Government	-	-
3. Financial Institutions	-	-
4. Banks:	-	-
a) Term Loans	-	-
b)Other Loans (specify)	-	-
5. Other Institutions and Agencies	-	-
6. Debentures and Bonds	-	-
7. Fixed Deposits	-	-
8. Others(specify)	-	-
TOTAL	-	-
Note: Amount due within one year		

SCHEDULE 6-DEFERRED CREDIT LIABILITIES:	Current Year 31.03.2020 RS.	Previous Year 31.03.2019 RS.
a) Acceptances secured by hypothecation of capital equipment and other	-	-
b) Others	-	-
TOTAL	-	-
Note: Amounts due within one year		

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount (Rs)

SCHEDULE 7-CURRENT LIABILITIES AND PROVISIONS	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
	RS.	RS.	RS.	RS.
A.CURRENT LIABILITIES				
1.Acceptances				-
2.Sundry Creditors:				-
a)For Goods				-
b)Others				-
3.Advances Recovery from staff on behalf of ICFRE				-
4.Interest accrued but not due on:				-
a)Secured Loans/borrowings				-
b)Unsecured Loans/borrowings				-
				-
5.Statutory Liabilities:				-
a)Overdue				-
b)Others				-
				-
6.Other Current Liabilities				-
Security & EMD Account		1,65,63,691.00		1,46,27,038.00
Amount Payable to Controller, Pension Cell, ICFRE		60,27,279.00		60,41,833.00
Amount Payable to Other offices on behalf of staff deputaion		(18,680.00)		(18,540.00)
Amount Payable to PAO (F), NEW DELHI		5,79,003.00		5,78,883.00
Amount Payable to Other Units				
Saving Fund	89,361.00		89,361.00	
Death Claim	44,013.00		44,013.00	
Advance Recovery	541.00		541.00	
Other	15,40,971.00		15,40,971.00	
CGEIS	(1,941.00)	16,72,945.00	(1,941.00)	16,72,945.00
Amount Payable to Others				
L.I.C.			-	
T.D.S./Service Tax/ Professional Tax				
Payable to Controller ICFRE				
Misc. Recoveries				
Inter Unit Account				
Salary Payable Account				
Opening Balance	10,77,05,985.00		10,56,46,316.00	
Add: Salary of March 2020 paid in April 2020	11,20,15,424.00		10,77,05,985.00	
Total	21,97,21,409.00		21,33,52,301.00	
Less: Paid in April, 2019	(10,77,05,985.00)	11,20,15,424.00	10,56,46,316.00	10,77,05,985.00
TOTAL(A)		13,68,39,682.00		13,06,08,144.00
B.PROVISIONS				
1.For Taxation		-	-	-
2.Gratuity		-	-	-
3.Superannuation/Pension		-	-	-
4.Accumulated Leave Encashment		-	-	-
5.Trade Warranties/Claims		-	-	-
6.Others(Specify)		-	-	-
TOTAL(B)		-	-	-
TOTAL(A+B)		13,68,39,682.00		13,06,08,144.00

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

SCHEDULE 8 -FIXED ASSETS													
DESCRIPTION	GROSS BLOCK											NET BLOCK	
	As on 01.04.2019	Addition during the year before 30.09.2019	Addition during the year after 30.09.2019	Transfer During the Year	As on 31.03.2020	Rate of depreci-ation	As at the beginning of the year	On Additions during the year before 30.09.2019	On Additions during the year after 30.09.2019	Prior period Deprec iation	Total up to the Year-end	As at the Current year-end	As at the previous year-end
	RS.	RS	RS.	RS.	RS.	RS.	RS.	RS.	RS.		RS.	RS.	RS.
A. Fixed Assets:													
1.LAND:													
a)Freehold	1,08,79,420.00	-			1,08,79,420.00	0%	-	-	-		-	1,08,79,420.00	10,34,91,420.00
b)Leasehold	-			-	-	-	-	-	-		-	-	-
2.BUILDINGS:	-			-	-	-	-	-	-		-	-	-
a)On Freehold Land	1,18,74,32,184.00		4,05,66,197.00		1,22,79,98,381.00	10%	34,87,44,513.20	8,38,68,767.08	20,28,309.85		43,46,41,590.13	79,33,56,790.87	83,76,12,894.00
EQUIPMENT	-				-	-	-	-	-		-	-	-
a) Scientific Equipment	25,08,76,138.00	45,82,358.00	2,61,16,370.00		28,15,74,866.00	15%	14,38,15,889.58	1,67,46,390.96	19,58,727.75		16,25,21,008.29	11,90,53,857.71	11,90,98,857.00
b) I.T Equipment	9,57,82,138.00	43,31,909.00	1,64,16,375.00		11,65,30,422.00	40%	4,79,85,987.60	2,08,51,223.76	32,83,275.00		7,21,20,486.36	4,44,09,935.64	83,37,815.00
4.VEHICLES	1,18,93,337.00		9,79,650.00		1,28,72,987.00	15%	74,07,770.55	6,72,834.97	73,473.75		81,54,079.27	47,18,907.73	52,77,137.00
5.FURNITURE,FIXTURES	2,34,08,841.00	8,08,385.00	26,15,982.00		2,68,33,208.00	10%	99,07,665.55	14,30,956.05	1,30,799.10		1,14,69,420.70	1,53,63,787.31	1,44,93,217.00
6.OFFICE EQUIPMENT	10,16,88,572.00	19,51,386.00	65,65,035.00		11,02,04,993.00	15%	5,68,36,486.15	70,20,520.78	4,92,377.63		6,43,49,384.55	4,58,55,608.45	4,93,08,953.00
8.ELECTRIC INSTALLATIONS	21,81,700.00		21,990.00		22,03,690.00	15%	13,58,872.80	1,23,424.08	1,649.25		14,83,946.13	7,19,743.87	9,68,032.00
9.LIBRARY BOOKS	8,38,97,546.00	46,67,364.00	6,13,072.00		8,91,77,982.00	40%	5,78,60,301.00	1,22,81,843.60	1,22,614.40		7,02,64,759.00	1,89,13,223.00	4,12,30,906.00
10.TUBEWELLS & W.SUPPLY	-	3,31,576.00	5,92,040.00		9,23,616.00	0%	-	-	-		-	9,23,616.00	-
12.TOOLS & EQUIPMENTS	33,87,384.00	5,100.00	1,57,796.00		35,50,280.00	15%	21,09,834.00	1,92,397.50	11,834.70		23,14,066.20	12,36,213.80	15,03,000.00
TOTAL OF CURRENT YEAR	1,77,14,27,260.00	1,66,78,078.00	9,46,44,507.00	-	1,88,27,49,845.00		67,60,27,320.43	14,31,88,358.77	81,03,061.43	-	82,73,18,740.62	1,05,54,31,104.38	1,18,15,22,231.00
PREVIOUS YEAR													
II.CAPITAL WORK-IN-PROGRESS	4,46,023.00	-	-	-	4,46,023.00		-	-	-		-	4,46,023.00	4,46,023.00
TOTAL	1,77,18,73,283.00	1,66,78,078.00	9,46,44,507.00	-	1,88,31,95,868.00	-	67,60,27,320.43	14,31,88,358.77	81,03,061.43		82,73,18,740.62	1,05,58,77,127.38	1,18,19,68,254.00

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

SCHEDULE - 9 INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS	CURRENT YEAR 31.03.2020	PREVIOUS YEAR 31.03.2019
	RS.	RS.
1. In Government Securities		
> F.D.R.(For One Time Special Grant)	15,66,93,442.00	14,56,35,000.00
> F.D.R.(With Institutes)		
2. Other Approved Securities	-	-
3. Shares	-	-
4. Debentures and Bonds	-	-
5. Subsidiaries and Joint Ventures	-	-
6. Others(to be specified)	-	-
TOTAL	**15,66,93,442.00**	**14,56,35,000.00**

SCHEDULE 10- INVESTMENTS-OTHERS	CURRENT YEAR 31.03.2020	PREVIOUS YEAR 31.03.2019
	RS.	RS.
1. In Government Securities		
> F.D.R.(With Institutes)		-
2. Other approved Securities	-	-
3. Shares	-	-
4. Debentures and Bonds	-	-
5. Subsidiaries and Joint Ventures	-	-
6. Others(to be specified)	-	-
TOTAL	**-**	**-**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount (Rs)

SCHEDULE - 11 CURRENT ASSETS,LOANS, ADVANCES ETC.	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
	RS.	RS.	RS.	RS.
A.CURRENT ASSETS:				
	-			
1.INVENTORIES:	-			
> Stores and Spares	-	-		
> Loose Tools	-	-		
> Stock in trade	-	-		
> Finished Goods	-	-		
> Work-In- Progress	-	-		
> Raw Materials	-	-		
	-			
2.Sundry Debtors:	-	-		
> Debts Outstanding for a period exceeding six months	-	-		
> Others	-			
	-			
4.Cash balances in hand(including cheques/drafts and		2,62,085.00		1,41,405.55
5.Bank Balances:				
a)With Scheduled Banks:				
> On Current Accounts	94,93,366.42		3,55,90,931.04	
> On Deposit Accounts	6,19,21,521.00		9,01,13,775.00	
> On Savings Accounts	78,09,24,059.90	85,23,38,947.32	53,99,61,862.70	66,56,66,568.74
b)With non-Scheduled Banks:	-			
> On Current Accounts	-		-	
> On Deposit Accounts(includes margin money)	-			
> On Savings Accounts	-	-	-	-
	-			
6.Cheque in Transit	-	-	-	-
Revenue t/f by IFGTB-Coimbtore		29,59,484.00		
Revenue t/f by ARCBR		1,82,166.00		
TOTAL (A)		**85,57,42,682.32**	-	**66,58,07,974.29**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2020

Amount-(Rs)

SCHEDULE 11 – (A) CURRENT ASSETS,LOANS,ADVANCES ETC.(Cont.)	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
	RS.	RS.	RS.	RS.
B.LOANS,ADVANCES AND OTHER ASSETS				
1. Loans:				
a) Staff Advance	71,83,143.00		63,88,984	
b) Other Entities engaged in activities/ objectives similar to that of the Entity				
c) Other(Statuotry Dues)	65,45,184.00	1,37,28,327.00	67,28,157.00	1,31,17,141.00
2. Advances and other amounts recoverable in cash or in kind or for value to be received:				
a) On Capital Account				
CPWD-TFRI	-		2,00,255.00	
CPWD-NE RFRI	4,25,000.00		60,17,600.00	
CCU- NE BUDGET SECTION	42,50,000.00		59,17,000.00	
CCU- (PLAN ACCOUNT)FRI	(25,79,500.00)		2,73,65,500.00	
CCU-(OTSG) BUDGET SECTION			-	
CCU- IFGTB	12,83,413.00		12,83,413.00	
CCU-IWST	15,105.00		6,97,100.00	
SCIENTIFIC EQUIPMENTS- IWST	-		7,81,472.00	
ADVANCES FOR MUSEUM RENOVATION- FRI	30,00,000.00			
ADVANCES FOR BUILDING RENOVATIONS-	63,63,084.00	1,27,57,102.00	66,70,200.00	4,89,32,540.00
b) Others				
Amount Recoverable From Controller, Pension Cell, ICFRE		96,22,628.00		8,42,911.00
Amount Recoverable From PAO (F) NEW DELHI		24,75,967.00		24,75,967.00
Amount Recoverable From Other Units				
Inter unit accounts	6,08,34,226.00		4,38,40,226.00	
Misc Recoveries	61,71,926.00		61,71,926.00	
Payable to contoller ICFRE	38,98,615.99		81,21,476.00	
Other Unit	(85,663.00)	7,08,19,104.99	(85,663.00)	5,80,47,965.00
3. Income Accrued:				
a) On Investments from Earmarked/Endowments Funds				
b) On Investments-Others				
c) On Loans and Advances		20,83,590.00	2,31,04,734.00	2,31,04,734.00
d) Others (includes income due unrealized - Rs.....)				
4. Claims Receivable		-		
TOTAL(B)		**11,14,86,718.99**		**14,65,21,258.00**
TOTAL(A+B)		**96,72,29,401.31**		**81,23,29,232.29**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT

FOR THE YEAR ENDING 31ST MARCH, 2020

SCHEDULE 12 – INCOME FROM SALES/SERVICES	Current Year 31.03.2020	Previous Year 31.03.2019
1) Income from Sales		
a) Sale of Finished Goods	1,17,94,641.00	-
b) Sale of Raw Material	38,762.00	-
c) Sale of Scrap	-	-
	-	
2) Income from Services	-	
a) Service Charges	3,03,84,736.41	30,79,782.00
b) Professional /Consultancy Services	2,00,59,170.52	-
c) Agency Commission and Brokerage	-	-
d) Maintenance Services(Equipment/Property)	-	-
e) Others(Specify)	11,800.00	-
f) Shairing Cost received from Other Users of KV	-	-
	-	
TOTAL	**6,22,89,109.93**	**30,79,782.00**

SCHEDULE 13 –GRANTS/SUBSIDIES	Current Year 31.03.2020	Previous Year 31.03.2019
(Irrevocable Grants& Subsidies Received)	-	-
	-	-
1) Central Government	-	-
- To Plan (GC-General)	2,25,00,00,000.00	2,13,49,00,000.00
- Refund from KV	-	-
- To North East (GC-General)	-	-
	-	-
2) State Government	-	-
3) Government Agencies	-	-
4) Institutions/Welfare Bodies	-	-
5) International Organisations	-	-
6) Others(Specify)	-	-
	-	-
TOTAL	**2,25,00,00,000.00**	**2,13,49,00,000.00**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2020

SCHEDULE 14 –FEES/SUBSCRIPTION	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
1) Entrance Fees		
2) Annual Fees/Subscription		5,11,683.00
3) Seminar/Program Fees/Recruitment fees	1,66,93,439.00	1,16,31,550.00
4) Consultancy Fees		2,59,833.84
5) Others(Sharing Cost)		
TOTAL	**1,66,93,439.00**	**1,24,03,066.84**

SCHEDULE 15-INCOME FROM INVESTMENTS	Investment -Others	
(Income on Invest .from Earmarked/Endowment funds transferred to Funds)	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
1) Interest	-	
a) On Govt. Securities	-	-
b) Other Bonds/Debentures	-	-
2) Dividends:	-	-
a) On Shares	-	-
b) On Mutual Fund Securities	-	-
3) Rents	-	-
4) Others(Specify)	-	-
	-	-
	-	
TOTAL	-	-

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH, 2020

(Amount – Rs.)

SCHEDULE 16 – INCOME FROM ROYALTY, PUBLICATION ETC.		Current Year 31.03.2020	Previous Year 31.03.2019
		RS.	RS.
1) Income from Royalty		-	-
2) Income from Publications		-	
3) Others (specify)		2,17,40,068.00	
4) Revenue Received (House Licence Fees,Guest House,Mandap etc.		3,63,93,897.17	-
TOTAL		5,81,33,965.17	-

SCHEDULE 17 – INTEREST EARNED ETC.		Current Year 31.03.2020	Previous Year 31.03.2019
		RS.	RS.
1) On Term Deposits:		-	
a) With Scheduled Banks		11,20,518.00	
b) With Non-Scheduled Banks			
c) With Institutions			
d) Others			
2) On Saving Accounts:			
a) With Scheduled Banks		2,40,91,612.80	1,22,21,678.00
b) With Non—Scheduled Banks			
c) Post Office Savings Accounts			
d) Others			
3) On Loans:			
i) Interest accrued during the year			
a) Employees/Staff		3,99,558.00	6,42,716.00
ii) Interest earned during the year			
a) Employees/Staff			
4) Interest on Debtors and Other Receivables			-
		-	
TOTAL	-	2,56,11,688.80	1,28,64,394.00

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT
FOR THE YEAR ENDING 31ST MARCH, 2020

(Amount – Rs.)

SCHEDULE 18 – OTHER INCOME /PRIOR PERIOD ITEMS:	CURRENT YEAR 31.03.2020 RS.	PREVIOUS YEAR 31.03.2019 RS.
1) Profit on Sale/disposal of Assets:	-	
a) Owned assets	-	
b) Assets acquired out of grants, or received free of cost	-	
2) Revenue (Excluding interest on bank deposits, loans and	14,01,94,415.25	9,25,37,814.22
2) Recovery of various amount from OTSG	-	-
3) Fees for Miscellaneous Services	13,67,168.00	
4) Miscellaneous Income	3,42,34,925.06	6,18,88,731.68
5) Revenue earn but not yet transfer	8,02,779.00	5,66,838.46
6) Prior Period Items	-	
Income under booked	-	57,448.00
Ban+A19k interest over capitalised	-	8,81,100.00
TOTAL	17,65,99,287.31	15,59,31,932.36

SCHEDULE 19 – INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS	CURRENT YEAR 31.03.2020 RS.	PREVIOUS YEAR 31.03.2019 RS.
a) Closing stock		
- Finished Goods	-	-
- Work-in-progress	-	-
b) Less: Opening Stock	-	
- Finished Goods	-	-
- Work-in-progress	-	-
NET INCREASE(DECREASE) [a-b]	-	-

SCHEDULE 20 – ESTABLISHMENT EXPENSES	CURRENT YEAR 31.03.2020 RS.	PREVIOUS YEAR 31.03.2019 RS.
a) Salaries and Wages	-	
NON PLAN (General Component-General)	-	
Plan (General Components-General)	-	
Salaries	1,48,26,29,498.00	1,46,13,87,632.00
Grant to KV	10,02,64,000.00	12,52,78,641.00
b) Allowances and Bonus	2,08,88,104.00	-
c) Contribution to Provident Fund	-	-
d) Contribution to other Fund (specify)	29,61,88,000.00	-
Revenue Paid to pension cell ICFRE	10,57,99,000.00	16,12,64,000.00
Revenue transfer to ICFRE PHS	1,00,00,000.00	1,00,00,000.00
e) Misc Expenditure in Revenue Account	-	2,86,887.39
f) Expenses on Employees' Retirement and Terminal Benefits	-	-
g) Other (Refunded to Ministry)	45,510.00	34,57,756.00
h) Salary paid in excess than provision of previous year	-	-
TOTAL	2,01,58,14,112.00	1,76,16,74,916.39

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT
FOR THE YEAR ENDING 31ST MARCH, 2020

(Amount – Rs.)

SCHEDULE 21 – OTHER ADMINISTRATIVE EXPENSES ETC.	CURRENT YEAR 31.03.2020		PREVIOUS YEAR 31.03.2019	
Administrative Expenses	RS.		RS.	
A. Infrastructure		-		
a. Rent and Taxes	1,32,35,618.00	-	2,36,14,218.00	
b. Elect./Water Charges	3,98,25,758.00	-	4,99,48,661.00	
c. Veh. Running Exp. (Fuel)	38,09,644.00		1,16,17,774.00	
d. Insurance	6,25,972.00	5,74,96,992.00	9,51,625.00	8,61,32,278.00
B. Repairs and Maintenance of Infrastructure of Assets				
a. Roads and Building (Minor works)	5,41,65,620.33		4,61,39,084.00	
b. Plants & Mach. (Equ. Secentific)	2,97,504.00		2,16,45,600.00	
c. Furniture and Fixtures	2,71,333.00			
d. Vehicle (Repair)	46,52,595.00			
e. Office/IT Euipment	1,12,32,483.00	7,06,19,535.33		6,77,84,684.00
C. Communication				
a. Postage and Telephone		30,55,534.00		3149784.46
D. Others		-		
a. Newspaper and Periodicals	30,63,448.00		39,77,987.00	
b. Stattionary	25,12,507.00		16,84,469.00	
c. Travel & Convey (N. Res.) Dom (TE)	1,32,65,027.00		2,60,46,115.00	
d. Legal and Prof. Charges	30,12,025.00		39,92,396.00	
e. Auditor's Renumeration	2,02,132.00		1,94,952.00	
f. Hospitality Expenses	-			
g. Medicines & Medical Consu.	47,55,504.00		44,33,135.00	
h. Liveries	1,30,000.00			
i. Contingency	18,01,91,681.19		17,57,64,690.00	
j. Others	71,59,716.23	21,42,92,040.42	2,84,277.00	21,63,78,021.00
Research Expenses				
Travel & Conv. (Res.)- Dom. (T.E.)	1,28,71,666.00			
Others Consumables (M&S)	94,44,313.00	-	1,09,67,751.00	
Other Research Expenditure(FRE)	2,52,42,902.50		2,74,53,058.00	
Fellowship	3,41,70,151.00		3,10,69,787.00	
Maint. Of Equipment	26,77,146.00			
Others (RAG,RPC meeting)	13,15,614.00		17,15,811.00	
Human Resource Development	53,16,310.00			
Seminar/ Conferences	34,39,779.00		92,87,674.00	
Other (Specified)	35,70,661.12		1,65,031.56	
ICFRE Awards				
Policy Research Studies		9,80,48,542.62		8,06,59,112.56
Extension				
Direct to Consumers- Projects	6,08,191.00		3,25,616.00	
Ext. Activities- VVK Demo. Training etc.	-		29,52,757.00	
Normal	37,67,983.00		41,41,194.00	
VVK	34,94,557.00			
Advertisement and Publicity	30,64,798.00		19,25,935.00	
Printing & Publication	50,83,488.00	1,60,19,017.00		93,45,502.00
Revenue paid to others		82,97,709.01		
Revenue Paid to DDG ICFRE		14,01,94,415.85		
Revenue t/f to others		332733.00		
Prior Period Expenses		0.00		5752040.16
TOTAL		**60,83,56,519.23**		**46,79,88,217.02**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
SCHEDULES FORMING PART OF INCOME EXPENDITURE ACCOUNT
FOR THE YEAR ENDING 31ST MARCH, 2020

(Amount – Rs.)

SCHEDULE 22 – EXPENDITURE ON GRANTS, SUBSIDIES ETC..	CURRENT YEAR 31.03.2020	PREVIOUS YEAR 31.03.2019
	RS.	RS.
a) Grants given to Institutions/Organisations		-
> Grants to Universities		24,704.00
b) Subsidies given to Institution/Organisations		5,00,000.00
TOTAL	-	5,24,704.00

SCHEDULE 23 – INTEREST.	CURRENT YEAR 31.03.2020	PREVIOUS YEAR 31.03.2019
	RS.	RS.
a) On Fixed Loans	-	-
b) On Other Loans (including Bank Charges)		
c) Other (specify)		
TOTAL	-	-

INDIAN COUNCIL FORESTRY RESEARCH AND EDUCATION

NOTES TO ACCOUNTS FOR THE YEAR ENDED MARCH 31, 2020

Schedule 24: Significant accounting policies and notes to accounts

Significant accounting policies

1. **Accounting convention**
   The financial statements have been prepared following going concern concept. Accounts are not maintained as per dual accounting concept. The entity has primarily followed cash system of accounting, in respect of salary which is accounted for on accrual basis at year end in the month of March.

2. **Use of Estimates**
   The preparation of financial statements requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities , the disclosures of contingent assets and liabilities on the date of the financial statements and reported amount of revenues and expenses during the period reported. Actual results could differ from those estimates.

3. **Depreciation**
   Depreciation in the books of accounts has been provided at written down value method at the rates specified in Income Tax Act 1961. Additions in fixed assets during the first half of the year are depreciated at full rates and additions in the later half are depreciated at half rates.

4. **Revenue Recognition**
   Revenue is recognized when income is actually transferred to 'own revenue account' maintained by centers.

5. **Fixed Assets, Intangible Assets and Capital Work in Progress**
   Fixed Assets have been valued at historical costs. The cost of an asset comprises its purchase price and any directly attributes cost of bringing the asset to working condition for its intended use.
   Capital work in progress includes cost of fixed assets that are not ready for their intended use at the date of balance sheet.

6. **Earmarked Fund**
   Project Accounts: The receipts and payments of consultancy projects and externally aided projects are included in this head.

7. **Grants and subsidies**

Amount of Grant from Ministry of Environment Forest and Climate Change (MOEF&CC) are recorded on receipts basis. Grants received for salaries and general expenses are recognized as income on receipt basis and grants received for procurement of capital assets is credited to Corpus Fund irrespective of their subsequent utilization.

8. **Employee Benefits**

The Society has various schemes of employee benefits such as Provident Fund, Gratuity and Pension Schemes. Pension, leave encashment etc. and the accounting in respect thereof is being done on cash basis. Accordingly, no provision has been made in books of accounts for expenditures pertaining to such schemes and are recorded on payment basis.

9. **Taxation**

The society is registered under section 12AA of the Income Tax Act, 1961. The income of society is exempt under section 12A.

10. **Contingencies Liabilities and assets**

A disclosure for a contingent liability is made when there is a possible obligation or a present obligation that probably will not require an outflow of resources or where a reliable estimate of obligation cannot be made.

Contingent liabilities are not recognized in the financial statements nor disclosed in the notes to the financial statements.

Notes to Accounts

1. **Capitalization of Advances**

- **Advances to CPWD-TFRI:** An advance of Rs 9,98,000/- was given to CPWD-TFRI for the purpose of Replacement of Filter Media and cleaning of Filtration Plant. Also, t otal expenditure till incurred by CPWD was Rs 11,98,255/-, including advances of prior period of Rs 2,00,255/-.
- **Advance to CPWD-RFRI:** An advance of Rs 60,17,600/- was outstanding as on 31.03.2019 in the books of accounts, however the actual balance as reconciled from the records is Rs 1,00,18,000/-. Till the end of Financial Year 2019-20, the expenditure incurred is Rs86,26,000/- for Vertical Extension for Existing vertical Centre & Rs 9,70,000 was transfer to electricals.Also, in the same financial year a fresh advance of Rs 3,79,000/- was given to CPWD-RFRI for the purpose of Repairing of Internal Road, out of which expenditure of Rs 3,76,00/- was incurred. Hence after giving effect to the above expenditure balance outstanding as on 31.03.2020 remains of Rs 4,25,000/-
- **Advance to CCU-FRI:** An advance of Rs 2,73,65,500/- was given to CCU-FRI till 31.03.2019. for the purpose of construction of Girls Hostel Building, however the

building was completed in Rs 2,99,45,000/-, hence the amount to be payable by FRI to CCU as on 31.03.2020 is Rs 25,79,500/-

- **Advance to CCU-IWST:** An advance of Rs 6,97,100/- was given to CCU-IWST for the purpose of Repair of Roads, of which expenditure of Rs 681995 has been incurred, and the rest amount was transferred to another work i.e for painting of community hall. Hence the advance left with CCU-IWST was Rs 15,105/-
- **Advance for Scientific Equipment:** An advance of Rs 7,81,472/- was outstanding as on 31.03.2019 in the name of Scientific Equipment under Current Assets Schedule 11A. The same was transferred to the Fixed Assets account in the Financial Year 2019-20
- **Advance for Building Renovations:** An advance of Rs 66,70,200/- was outstanding with IWST, of which further advance of Rs 54,18,495/- was given. In the Financial Year 2019-20, Lift of Rs 1995197/- was completed the same was capitalized under Building of Schedule 11 and Amount of Rs 3730414/- under Minor work of Schedule-11. Hence the amount left with IWST was Rs 63,63,084/-, the same was booked under new head in this financial Year with the name of *"Advance for Building Renovation-CCU(IWST)"*.
- **Capitalization of Fixed Assets under Project:** During the financial year 2019-20, an amount of Rs 2,33,98,271/- was incurred as capital expenditure, the same has been capitalized in the books of accounts in the financial year 2019-20

SH ARUN SINGH RAWAT, (Director General, ICFRE)

SH SUNIL DUTT SHARMA, (Deputy Director General, Admin, ICFRE)

SH RAJ KUMAR BAJPAI, (Asst Director General, Admin, ICFRE)

SH BRIJESH KUMAR SHARMA, (Section Officer, Budget Section, ICFRE)

For Ashish Kumar Gupta & Associates
Chartered Accountants

CA Preeti Gupta
(Partner, FCA)
Membership No.: 408004

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDING 31st, MARCH, 2020

RECEIPTS		AMOUNT RS.	PAYMENTS	AMOUNT RS.
I. Opening Balances				
a) Cash in Hand	1,41,405.55	66,58,07,974.29	Establishment Expenses	1,93,02,50,306.00
b) Saving Bank Balance	53,99,61,862.70		Other Administartion Expenses	69,06,85,936.22
c) Current Account Balance	3,55,90,931.04		Revenue t/f to own Revenue A/c	1,55,81,743.22
d) Deposit Balance	9,01,13,775.00		Refund to Minsitry(CCU)	16,67,000.00
			Project Payment	
Grants in Aid			a) For General Expenditure	52,99,07,869.79
a) For Salary	1,80,00,00,000.00	2,30,00,00,000.00	b) For Capital expenditure	2,33,98,271.00
b) For General	45,00,00,000.00		Interest t/f to own revenue for Chair of excellance	1,94,16,184.00
c) For Capital	5,00,00,000.00		Security and EMD	3,17,37,159.00
			Amount Payable to Controller Pension Cell	27,83,17,177.00
Project Receipts		77,72,71,189.59	Amount Payable to other Offices under Deputation	1,12,44,000.08
			Amount Payable to PAO(F) New Delhi	12,17,820.00
Chair of Excellence		17,73,05,795.00	Statutory Dues(TDS/GST)	15,70,95,506.00
a)Bank Interest	3,16,70,795.00		Fixed Assets purchased during the year	4,95,76,645.00
b)FD Matured	14,56,35,000.00		New FD created in Chair of Excellence	15,66,93,442.00
			Staff Advances	5,56,20,102.00
Security/ EMD		3,36,73,812.00	Amount Payable from controller ICFRE	11,94,81,070.00
Pension cell		27,83,02,623.00	Amount Payable from PAO(F) New Delhi	23,544.00
Other office under deputation		1,12,43,880.08	Amount Payable from other Units	-
PAO(F) New Delhi		12,17,940.00	Inter unit accounts	22,56,137.00
				-
Statutory Dues		15,72,78,479.00	**Closing Balance**	
			Cash and Bank Balance	
Inter Unit Accounts		12,84,400.00	a) Cash in hand	2,62,085.00
			b) Saving Account	78,09,24,059.90
Staff Advance Recovered		5,48,25,943.00	c) Current Account	94,93,366.42
			d) Deposit Balance	6,19,21,521.00
Recover from CCU		16,67,000.00	e) Cheque in Transit	31,41,650.00
Amount Recoverable from controller ICFRE		11,07,01,353.00		
Amount Recoverable from PAO(F) New Delhi		22,590.00		
Amount Recoverable from other Units		-		
Inter unit accounts		45,76,137.00		
Income from Sale /Services		6,23,66,609.93		
Fees /Subscriptions		1,66,93,439.00		
Income from Royalty / Publications		5,81,33,965.17		
Interest Earned		2,56,11,688.80		
Other Income		17,70,79,287.31		
Interest Earned in other than Revenue Account		47,513.00		
Revenue earn in Plan Account		1,48,00,975.46		
TOTAL		**4,92,99,12,594.63**	**TOTAL**	**4,92,99,12,594.63**

SH ARUN SINGH RAWAT (Director General, Admin., ICFRE)

SH SUNIL DUTT SHARMA (Deputy Director General, Admin., ICFRE)

SH RAJ KUMAR BAJPAI, (Asstt. Director General, Admin., ICFRE)

SH BRIJESH KUMAR SHARMA (Section Officer, Budget Section, ICFRE)

For Ashish Kumar Gupta & Associates
Chartered Accountants

(CA Preeti Gupta)
Partner, FCA
Membership No 408004
Date 30.11.2020
Place Dehradun

BALANCE SHEET OF CONTROLLER,PENSION CELL, OF
(GPF, GSLIS, PENSION SCHEME AND NEW PENSION SCHEME)
INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
AS ON 31ST MARCH, 2020

ANNEXURE 1

CORPUS/CAPITAL FUND AND LIABILITIES	CURRENT YEAR AS ON 31.03.2020	PREVIOUS YEAR AS ON 31.03.2019
GENERAL PROV.FUND A/C	89,45,52,826.89	83,83,07,636.00
GSLIS A/C	10,93,685.00	15,70,308.11
PENSION ACCOUNT	73,47,61,836.69	79,80,78,118.00
NEW PENSION FUND A/C	1,07,95,385.00	47,78,100.00
ICFRE PHS	3,87,31,352.61	4,24,99,299.61
TOTAL	1,67,99,35,086.19	1,68,52,33,461.72
FIXED ASSETS		
CURRENT ASSETS LOANS & ADV. INVESTMENTS-OTHERS	1,26,09,00,000.00	96,75,78,118.00
CASH & BANK BALANCES:	41,90,35,086.19	71,76,55,343.72
TOTAL	1,67,99,35,086.19	1,68,52,33,461.72

SH. ARUN SINGH RAWAT (Director General, ICFRE)

SH SUNIL DUTT SHARMA,(Dy. Director General, Admin., ICFRE)

SH RAJ KUMAR BAJPAI(Asstt Director General, Admin, ICFRE)

SH BRIJESH KUMAR SHARMA(Section Officer, Budget Section, ICFRE)

FOR ASHISH KUMAR GUPTA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA Preeti Gupta
(Partner, FCA)
Membership No: 408004
Dated: 30.11.2020

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 2

PENSION-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2020

INCOME	AMOUNT
Received from Revenue ICFRE	10,57,99,000.00
Interest	5,24,20,827.25
TOTAL:.....	15,82,19,827.25
EXPENDITURE	**AMOUNT**
Expenditure	155.24
Excess Of Income Over Expentiture	15,82,19,672.01
TOTAL:.....	15,82,19,827.25

GPF-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2020

INCOME	AMOUNT
Interest	6,40,37,285.00
TOTAL:.....	6,40,37,285.00
EXPENDITURE	**AMOUNT**
Expenditure	85.00
Excess Of Income Over Expentiture	6,40,37,200.00
TOTAL:.....	6,40,37,200.00

GSLIS-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2020

INCOME	AMOUNT
Interest	48,471.00
TOTAL:.....	48,471.00
EXPENDITURE	**AMOUNT**
Expenditure	-
Excess Of Income Over Expentiture	48,471.00
TOTAL:.....	48,471.00

NEW PENSION ACCOUNT INCOME & EXPENDITURE A/C FOR THE YEAR ENDING 31ST MARCH, 2020

INCOME	AMOUNT
Interest	4,04,901.00
TOTAL:.....	4,04,901.00
EXPENDITURE	**AMOUNT**
Expenditure	-
Excess Of Income Over Expentiture	4,04,901.00
TOTAL:.....	4,04,901.00

ICFREPHS INCOME & EXPENDITURE A/C FOR THE YEAR ENDING 31ST MARCH, 2020

INCOME	AMOUNT
Received from Revenue ICFRE	1,00,00,000.00
Interest	28,38,597.00
TOTAL:.....	1,28,38,597.00
EXPENDITURE	**AMOUNT**
Expenditure	-
Excess Of Income Over Expentiture	1,28,38,597.00
TOTAL:.....	1,28,38,597.00

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
DETAILS OF PENSION FUND AS ON 31ST MARCH 2020

ANNEXURE 7

Recieots	GPF (3491)	GSLIS (3498)	PENSION FUND (3660)	NEW PENSION (4994)	ICFREPHS (7440)	TOTAL	Previous year
Opening Balance	83,83,07,635.89	15,70,308.00	79,80,78,118.68	47,78,100.00	4,24,99,299.61	1,68,52,33,462.18	1,80,53,24,046.16
Add : Bank Interest	6,40,37,285.00	48,471.00	5,24,20,827.25	4,04,901.00	28,38,597.00	11,97,50,081.25	15,87,46,417.00
						0.00	
Add : Tfd.from General Fund						0.00	1,30,447.00
Amount recd from PAO (F) New Delhi						0.00	8,07,346.00
Amount recd from other offices	6,98,652.00		6,61,622.00			13,60,274.00	31,15,588.00
Saving Fund under GSLIS		23,40,060.00				23,40,060.00	2,26,280.00
Death Claim / Insurance Claim		4,63,578.00				4,63,578.00	0.00
Received from PAO						0.00	0.00
Subscription/contribution/Refund Adv	17,01,92,197.00	15,16,678.00	8,17,09,735.00	5,04,05,559.00	42,15,200.00	30,80,39,369.00	28,99,44,139.00
Amount recd from DDG Admin Revenue			10,57,99,000.00		1,00,00,000.00	11,57,99,000.00	17,12,64,000.00
Amount Received from DDG Admin Grant			29,61,88,000.00			29,61,88,000.00	0.00
Interest Recd. From Saving/ FDRs						0.00	0.00
Inter transfer						0.00	2,00,00,935.00
Any other reciepts		85.00				85.00	2,79,376.00
TOTAL:	**1,07,32,35,769.89**	**59,39,180.00**	**1,33,48,57,302.93**	**5,55,88,560.00**	**5,95,53,096.61**	**2,52,91,73,909.43**	**2,44,98,38,574.16**
Payments							
Less :							
Advances to Hospital						0.00	47,000.00
Death Claim Paid		7,07,450.00				7,07,450.00	2,14,324.00
Saving Fund		26,77,310.00			21,744.00	26,99,054.00	30,94,797.00
Subscription to LIC of GSILS /GINP		14,17,602.00				14,17,602.00	14,77,472.00
GPF Advance Reimbursement	1,53,93,803.00					1,53,93,803.00	2,00,42,355.00
GPF Part/Final Payment	7,89,01,000.00					7,89,01,000.00	7,69,70,000.00
GPF Final Payment	8,43,88,055.00					8,43,88,055.00	7,51,14,422.00
Pensionary Benefit paid			17,54,39,145.00			17,54,39,145.00	11,08,86,236.00
Pension Transfer to AO, ICFRE			28,40,00,000.00			28,40,00,000.00	31,33,92,898.00
Pension Arrears						0.00	
Paid to NSDL on A/c of NPS Contr.				4,47,35,371.00		4,47,35,371.00	3,65,20,400.00
DCRG			5,82,77,852.00			5,82,77,852.00	9,74,08,129.00
Inter unit transfer						0.00	2,00,00,935.00
Medical reimbursement						0.00	3,26,079.00
ISO Charges/Miscellenous Payments						0.00	
Payment to other Institutes		43,133.00	8,23,78,314.00	57,804.00	2,08,00,000.00	10,32,79,251.00	91,00,000.00
Advances paid (FRI and HFRI)						0.00	
GSLIS						0.00	
Misc payments	85.00		155.24			240.24	10,065.44
TOTAL:	**17,86,82,943.00**	**48,45,495.00**	**60,00,95,466.24**	**4,47,93,175.00**	**2,08,21,744.00**	**84,92,38,823.24**	**76,46,05,112.44**
Closing Balance Flexi	35,00,000.00			95,00,000.00		1,30,00,000.00	1,60,00,000.00
FDR's	89,00,00,000.00		31,99,00,000.00		3,80,00,000.00	1,24,79,00,000.00	1,52,50,00,000.00
Cash at Bank Account	10,52,826.89	10,93,685.00	41,48,61,836.69	12,95,385.00	7,31,352.61	41,90,35,086.19	10,57,33,462.18
Balance A-B	**89,45,52,826.89**	**10,93,685.00**	**73,47,61,836.69**	**1,07,95,385.00**	**3,87,31,352.61**	**1,67,99,35,086.19**	**1,68,52,33,461.72**
TOTAL:	**89,45,52,826.89**	**10,93,685.00**	**73,47,61,836.69**	**1,07,95,385.00**	**3,87,31,352.61**	**1,67,99,35,086.19**	**1,68,52,33,462.18**

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
DDO (Admin.), ICFRE (Hqtr.), Dehradun

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
		RS.
Income from sales/services	6,078,887.00	925,000.00
Grants/Subsidies-Salary and General	182,650,000.00	195,673,000.00
Fees/Subscriptions	11,916,000.00	56,318,000.00
Income from Investments (Income on Invest .from		
Income from Royalty, Publications etc.	4,500.00	12,500.00
Interest Earned	5,940,662.00	531,169.00
Other Income	24,597,170.00	21,877,690.86
Increase/(decrease) in stock of finished goods and works-in-progress	-	
	-	-
Total	231,187,219.00	275,337,359.86

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	138,036,759.00	138,460,968.00
Other Administrative Expenses etc.	51,391,648.00	51,759,805.00
Creation of assets under Capital	11,908,456.00	57,819,390.00
Expenditure on Grants, Subsidies etc.		24,704.00
Interest paid	5,327,930.00	5,831,169.00
Depreciation(Net Total at the year end-corresponding to Schedule 8)		
prior period item (Depreciation for last year).		
Other Income	12,631,465.00	21,879,890.86
Institutional Charges	5,603,887.00	925,000.00
Income from Royalty, Publications etc.	-	12,500.00
	224,900,145.00	276,713,426.86

Signature of Accounts Officer
with Seal

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
VAN VIGYAN BHAWAN , New Delhi

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services		
Grants/Subsidies-Salary and General	2,950,886.04	2,774,000.00
Grants/Subsidies-Capital	226,248.00	520,000.00
Fees/Subscriptions		
Rent receipts	1,810,922.00	1,403,043.00
Intrest received from Mainteance charges	120,390.00	291,730.00
Intrest received from bank	4,954.00	6,185.00
Income from Mainteance charges	1,457,800.00	1,432,800.00
Intrest from Maintenance charges	170,961.00	120,390.00
Increase/(decrease) in stock of finished goods and works-in-progress	-	
Total	6,742,161.04	6,548,148.00

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses from service charges	613,382.28	851,793.00
Other Administrative Expenses etc.	2,813,869.62	2,772,015.50
Creation of assets under Capital	224,480.00	511,030.00
Interest paid	120,390.00	291,730.00
deductions		15,194.06
Revenue transferred to DG ICFRE	1,947,076.21	1,672,255.54
Total	5,719,198.11	6,114,018.10

Signature of DDO with Seal

D.D.O.
Van Vigyan Bhawan
Sector-5, R. K. Puram
New Delhi-110 022

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
ACCOUNTS OFFICER, FOREST RESEARCH INSTITUTE, DEHRADUN

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services	38,373,436.24	43,459,269.00
Grants/Subsidies-Salary and General (418083000+75000000+167688000+60358247)	721,129,247.00	797,220,440.00
Grants/Subsidies-Capital	14,414,000.00	
Fees/Subscriptions		
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		
Interest Earned		
Other Income		
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
	-	
Total	773,916,683.24	840,679,709.00

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	514,020,740.00	543,701,597.00
Other Administrative Expenses etc.	167,689,471.00	187,291,418.00
Creation of assets under Capital	14,357,216.00	9,130,374.00
Expenditure on Grants, Subsidies etc.		
Interest paid		
Depreciation(Net Total at the year end-corresponding to Schedule 8)		
prior period item (Depreciation for last year).		
Other Income (Revenue transferred to DG ICFRE)	36,344,655.24	
Institutional Charges		
Income from Royalty, Publications etc.		
Total	732,412,082.24	740,123,389.00

Signature of DDO with Seal

एच.एस.रावत/H.S. Rawat
लेखा अधिकारी/Accounts Officer
वन अनुसंधान संस्थान / FRI
देहरादून / Dehradun

Forest Research Centre for Eco Rehabilitation, Prayagraj

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services	22,353.00	-
Grants/Subsidies-Salary and General	1,73,34,000.00	1,63,09,000.00
Grants/Subsidies-Capital	5,39,000.00	1,42,000.00
Fees/Subscriptions	52,000.00	18,000.00
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)	-	-
Income from Royalty, Publications etc.	-	-
Interest Earned	1,47,311.00	1,29,865.00
Other Income (Institutional Charges)	28,000.00	89,250.00
Other Income (Project Balance)	8,23,442.52	-
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
Total	1,89,46,106.52	1,66,88,115.00

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	1,19,98,682.00	1,18,55,824.00
Other Administrative Expenses etc.	39,77,753.00	30,75,974.44
Creation of assets under Capital	5,39,703.00	1,41,156.00
Expenditure on Grants, Subsidies etc.	10,07,346.00	1,56,737.00
Interest paid	1,47,311.00	1,29,865.00
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).	-	-
Other Expenditure (Research Expenses)	11,60,172.00	6,83,491.00
Institutional Charges	28,000.00	89,250.00
Other Expenditure (Project Balance)	8,23,442.52	-
Total	1,96,82,409.52	1,61,32,297.44

Asuvartav

Signature of DDO
with Seal

आहरण एवं संवितरण अधिकारी
पारि–पुनर्स्थापन वन अनुसंधान केन्द्र
प्रयागराज

Annexure-37

INSTITUTE OF FOREST GENETICS AND TREE BREEDING,COIMBATORE-2
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services	20,92,218.00	4,81,376.00
Grants/Subsidies-Salary and General		
PLAN		
Salaries	15,82,06,000.00	17,04,73,000.00
General	4,41,47,000.00	4,32,76,000.00
Capital Assets	43,29,000.00	6,75,000.00
Fees/Subscriptions		
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.	38,214.00	59,456.00
Interest Earned	21,88,731.00	17,08,221.00
Other Income	48,10,581.93	83,34,323.80
Grants received under EAPs	6,41,09,696.32	6,05,97,713.30
Service Charges	4,03,947.00	3,79,427.00
Increase/(decrease) in stock of finished goods and works-in-	-	
	-	-
Total	28,03,25,388.25	28,59,84,517.10

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	17,23,17,270.00	15,83,39,958.00
Other Administrative Expenses etc.,	2,64,64,017.00	2,53,88,119.00
Research & Operational Expenses	1,73,71,397.00	18516973
Capital Assets	43,23,553.00	676575
Interest		
Other Payments		
Revenue Transferred to ICFRE HQ	90,23,658.93	1,05,28,733.80
Expenditure under EAPs	6,11,03,823.32	5,12,55,298.09
Expenditure under Service charges A/c	1,44,300.00	1,58,524.00
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).		
Other Income		
Institutional Charges		
Income from Royalty, Publications etc.		
Total	29,07,48,019.25	26,48,64,180.89

ACCOUNTS OFFICER
Institute of Forest Genetics and
Tree Breeding, Coimbatore - 2

Signature of DDO with Seal

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
Institute of Wood Science and Technology, Bangalore

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services	2,67,000	3,48,28,227
Grants/Subsidies-Salary and General	15,58,44,000	18,47,09,000
Grants/Subsidies-Capital	55,28,000	25,00,000
Fees/Subscriptions	17,85,549	-
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		-
Income from Royalty, Publications etc.		11,60,579
Interest Earned	19,84,139	35,25,916
Other Income	27,98,573	-
EAP/ Project	50,46,208	-
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
	-	-
Total	17,32,53,469	22,67,23,722

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	14,02,16,567	14,23,75,059
Other Administrative Expenses etc.	3,36,36,655	3,09,54,295
Creation of assets under Capital	55,27,510	24,99,996
Expenditure on Grants, Subsidies etc.		-
Interest paid		
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item		
Other Income		
Institutional Charges		-
Income from Royalty, Publications etc.		
Total	17,93,80,732	17,58,29,350

G.S.L.Rao
Drawing & Disbursing Officer
Institute of Wood Science & Technology, Bengaluru-03

Signature of DDO
with Seal

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

Name of the Institute/Centre TROPICAL FOREST RESEARCH INSTITUTE, JABALPUR

PLAN (GENERAL COMPONENT)

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	Rs	Rs.
Income from sales/services	6,619,213.00	8,312,556.00
Grants/Subsidies-Salary and General	190,933,000.00	213,365,000.00
Grants/Subsidies-Capital	2,371,000.00	2,991,000.00
Fees/Subscriptions		
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		
Interest Earned	3,223,162.00	1,801,102.61
Other Income	6,681,229.17	10,747,577.01
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
Total	209,827,604.17	237,217,235.62

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	Rs.	Rs.
Establishment Expenses (Inculuding KVS)	166,300,566.00	170,030,855.00
Other Administrative Expenses etc.	33,509,919.50	34,830,570.37
Creation of assets under Capital	2,369,491.00	
Expenditure on Grants, Subsidies etc.		
Interest paid	3,892,427.10	1,063,750.00
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).		8,939,859.76
Other Income		
Institutional Charges		
Income from Royalty, Publications etc.		
Total	206,072,403.60	214,865,035.13

Signature of Director
Director
वन वानिकी मे अनुसंधान संस्थान
Tropical Forest Research Institute
जबलपुर/Jabalpur (म. प्र.)

Signature of DDO
with Seal
D.D.O.
T.F.R.I., Jabalpur

Annexure-37

Name of Institute/Centre: FOREST RESEARCH CENTRE FOR SKILL DEVELOPMENT , CHHINDWARA(M.P.)
INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	Rs.	Rs.
Income from sales/services(Total Grants Received)	14783000.00	14112000.00
Grants/Subsidies	-	-
Fees/Subscriptions	-	-
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)	-	-
Income from Royalty, Publications etc.	-	
Interest Earned(Bank and HBA Interest)	105271.00	188176.00
Other Income	370422.00	196000.00
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
Total(A)	**15258693.00**	**14496176.00**
EXPENDITURE	**Current Year 31.03.2020**	**Previous Year 31.03.2019**
	Rs.	**Rs.**
Establishment Expenses(Salary)	11247524.00	12084125.00
Other Administrative Expenses etc.(General)	1635461.00	1656360.52
Expenditure on Grants, Subsidies etc.(capital)	1049146.00	11055.00
Interest paid	-	-
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).	-	-
TOTAL(B)	**13932131.00**	**13751540.52**
Balance being excess of Income over Expenditure(A-B) Transfers to Special Reserve(Specify each) Transfer to/from General Reserve		
BALANCE BEING DEFICIT CARRIED TO CORPLUS FUND		
SIGNIFICANT ACCOUNTING POLICIES CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS		

DIRECTOR
TFRI
CHHINDWARA

निदेशक / DIRECTOR
उ.व.अ.स. / T.F.R.I.
जबलपुर JABALPUR

(Dr. Vishakha Kumbhare)
DDO
FRC-SD
CHHINDWARA

D.D.O.
FRC-SD, Chhindwara

Annexure_37

Income & Expenditure Account for the Year ended 31st March, 2020

Name of Institute **: Arid Forest Research Institute, Jodhpur**

2019-20

(Amount in Rs.)

Income	Current Year 31.03.2020	Previous Year 31.03.2019
Income from Sales/ Service	0	0
Grants/ Subsidies -- Salary & General	150342000	158444000
Grants/ Subsidies -- Capital	1824000	668000
Fee/ Subscriptions	0	0
Income from Investments (Income on Invest from Earmarked/ Endowment Funds transferred to Funds)	0	0
Income from Royalty, Publications etc.	0	0
Interest Earned	262544	316627
Other Income	0	13759213
Increase/ Decrease in Stock of Finished Goods and Works-in-Progress	0	0
Total	**152428544**	**173187840**

Expenditure	Current Year 31.03.2020	Previous Year 31.03.2019
Establishment Expenses	124154476	116342610
Other Administrative Expenses etc.	33819530	31017100
Creation of Capital Assets	1621139	668166
Expenditure on Grants, Subsidies etc.	0	0
Interest paid	262544	316627
Depreciation (Net Total at the year end - Corresponding to Schedule B) Prior-Period Item (Depreciation for Last year)	0	0
Other Expenditure	0	0
Institutional Charges	0	0
Expenditure incurred on Royalty, Publications etc.	0	0
Total	**159857689**	**148344503**

Signature of DDO
with Seal

लेखा अधिकारी
Accounts Officer
शुष्क वन अनुसंधान संस्थान
Arid Forest Research Institute
जोधपुर/Jodhpur

Annexure-3

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
HIMALAYAN FOREST RESEARCH INSTITUTE, SHIMLA (H. P.)

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services	1,04,140.00	90,395.00
Grants/Subsidies	8,98,98,000.00	9,41,60,000.00
Fees/Subscriptions	10,17,097.00	2,97,345.00
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		
Interest Earned	2,05,078.00	2,23,429.00
Other Income	21,61,189.40	30,03,062.00
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
	-	-
Total(A)	9,33,85,504.40	9,77,74,231.00

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	7,78,50,900.00	7,32,07,174.00
Other Administrative Expenses etc.	1,56,29,495.00	1,30,56,623.00
Expenditure on Grants, Subsidies etc.	31,75,023.58	35,97,143.00
Interest paid		
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).		
TOTAL(B)	9,66,55,418.58	8,98,60,940.00
Balance being excess of Income over Expenditure(A-B)	(32,69,914.18)	79,13,291.00
Transfers to Special Reserve(Specify each)		
Transfer to/from General Reserve		
BALANCE BEING DEFICIT CARRIED TO CORPLUS FUND		
SIGNIFICANT ACCOUNTING POLICIES		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS		

Signature of DDO with Seal

Director
Signature of Director with Seal

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

Name of the institute: *Institute of Forest Productivity, Ranchi*

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services		
Grants/Subsidies-Salary and General		
Grants/Subsidies-Capital		
(1.) Salaries	6,88,01,000.00	7,96,32,000.00
(2.) General	1,34,78,000.00	1,31,25,000.00
(3.) Capital	26,65,000.00	4,38,000.00
Fees/Subscriptions		
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		
Interest Earned	7,78,221.00	3,46,108.00
Other Income		
Revenue Income	46,94,366.15	44,62,365.00
Increase/(decrease) in stock of finished goods and works-in-progress		
Total	**9,04,16,587.15**	**9,80,03,473.00**

EXPENDITURE	Current Year (31.03.2020)	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	7,05,06,889.00	7,24,41,754.00
Other Administrative Expenses etc.	1,10,42,310.00	99,84,525.00
Research and operational Expenses	21,55,874.00	32,25,854.00
Creation of assets under Capital	26,74,996.00	4,24,927.00
Expenditure on Grants, Subsidies etc.		
Interest paid	8,88,791.00	-
Revenue Income transferred to ICFRE HQ	45,59,568.15	51,54,031.00
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).		
Other Income		
Institutional Charges		
Income from Royalty, Publications etc.		
Total	**9,18,28,428.15**	**9,12,31,091.00**

Signature of DDO
with Seal
आहरण एवं वितरण अधिकारी
Drawing & Disbursing Officer
वन उत्पादकता संस्थान

Signature of Director
निदेशक / Director
वन उत्पादकता संस्थान
Institute of Forest Productivity

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
NAME OF THE INSTITUTE: INSTITUTE OF FOREST BIODIVERSITY, HYDERABAD.

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services		-
Grants/Subsidies	9,15,84,073.00	5,29,09,000.00
Fees/Subscriptions		
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		
Interest Earned	7,14,746.00	3,40,926.00
Other Income	25,04,183.00	10,32,134.00
Increase/(decrease) in stock of finished goods and works-	-	-
	-	-
Total(A)	**9,48,03,002.00**	**5,42,82,060.00**

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	4,73,42,946.00	3,64,93,446.00
Other Administrative Expenses etc.	2,20,03,938.22	1,01,69,998.00
Expenditure on Grants, Subsidies etc.		
Interest paid		
Depreciation (Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).	31,85,526.00	11,45,000.00
TOTAL(B)	**7,25,32,410.22**	**4,78,08,444.00**
Balance being excess of Income over Expenditure(A-B)	2,22,70,591.78	64,73,616.00
Transfers to Special Reserve(Specify each)		
Transfer to/from General Reserve		
BALANCE BEING DEFICIT CARRIED TO CORPLUS FUND	**2,22,70,591.78**	**64,73,616.00**
SIGNIFICANT ACCOUNTING POLICIES		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS		

Drawing and Disbursing Officer
आहरण एवं संवितरण अधिकारी
Drawing & Disbursing Officer
वन जैव विविधता संस्थान
Institute of Forest Biodiversity
हैदराबाद / Hyderabad - 14.

Director
निर्देशक / Director
वन जैव विविधता संस्थान
Institute of Forest Biodiversity
हैदराबाद / Hyderabad - 14.

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION,DEHRADUN

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

Rain Forest Research Institute, JORHAT

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services		
Grants/Subsidies-Salary and General		147195038
Grants/Subsidies-Capital	164882000	
Fees/Subscriptions	2268000	
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		1879077.84
Interest Earned	1417367	6495034
Other Income		
	-	
Increase/(decrease) in stock of finished goods and works-in-progress	-	
	-	-
Total	**168567367**	**155569149.84**

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses		
Other Administrative Expenses etc.		
Creation of assets under Capital		
Expenditure on Grants, Subsidies etc.	176553955	148122515.09
Interest paid		1203323
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).		
Other Income		
Institutional Charges		
Income from Royalty, Publications etc.		
Total	**176553955**	**149325838.09**

Signature of Director with Seal

निदेशक / Director
वर्षा वन अनुसंधान संस्थान
Rain Forest Research Institute
जोरहाट (असम) / Jorhat (Assam)

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
FOREST RESEARCH CENTRE FOR BAMBOO AND RATTAN, AIZAWL, MIZORAM

INCOME	Current Year 31.03.2020	Previous Year 31.03.2019
	RS	RS.
Income from sales/services	-	5,170.00
Grants/Subsidies-Salary and General	97,22,000.00	1,42,76,736.00
Grants/Subsidies-Capital	3,00,000.00	-
Fees/Subscriptions	-	-
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)	-	
Income from Royalty, Publications etc.	-	
Interest Earned	1,01,666.00	91,684.00
Other Income	4,47,072.00	3,19,412.00
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
	-	-
Total	1,05,70,738.00	1,46,93,002.00

EXPENDITURE	Current Year 31.03.2020	Previous Year 31.03.2019
	RS.	RS.
Establishment Expenses	50,67,705.00	69,15,409.00
Other Administrative Expenses etc.	44,03,967.00	55,23,831.00
Creation of assets under Capital	1,69,855.00	-
Expenditure on Grants, Subsidies etc.	-	-
Interest paid	1,01,666.00	91,684.00
Depreciation(Net Total at the year end-corresponding to Schedule 8) prior period item (Depreciation for last year).		
Other Income	2,34,046.00	
Institutional Charges	2,09,000.00	
Income from Royalty, Publications etc.		
Total	1,01,86,239.00	1,25,30,924.00

Signature of DDO
with Seal

Drawing & Disbursing Officer
Forest Research Centre
for Bamboo and Rattan
Aizawl : Mizoram

Annexure-37

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020
FOREST RESEARCH CENTRE FOR LIVELIHOOD EXTENSION , AGARTALA

INCOME	Current Year 31.03.2020 RS	Previous Year 31.03.2019 RS.
Income from sales/services		
Grants/Subsidies-Salary and General	5,475,000.00	6,899,000.00
Grants/Subsidies-Capital	75,000.00	
Fees/Subscriptions	-	
Income from Investments (Income on Invest .from earmarked/endow. Funds transferred to Funds)		
Income from Royalty, Publications etc.		
Interest Earned	74,539.00	41,143.00
Other Income (Sale of Plants, Tender Docs, Guest House Rent Etc)	84,405.00	92,400.00
Increase/(decrease) in stock of finished goods and works-in-progress	-	-
Total	5,708,944.00	7,032,543.00

EXPENDITURE	Current Year 31.03.2020 RS.	Previous Year 31.03.2019 RS.
Establishment Expenses	4,380,100.00	4,103,308.00
Other Administrative Expenses etc.	2,296,226.00	2,049,290.00
Creation of assets under Capital	24,610.00	-
Expenditure on Grants, Subsidies etc.	-	-
Interest paid	74,539.00	41,143.00
Depreciation(Net Total at the year end-corresponding to Schedule 8)	84,405.00	
prior period item (Depreciation for last year).		
Other Income	-	118,440.00
Institutional Charges	-	
Income from Royalty, Publications etc.	-	
Total	6,859,880.00	6,312,181.00

Signature of DDO
with Seal

DDO
Forest Research
Centre For Livelihood,
Extension (FRC-LE)

Statement of Allotment & Expenditure for the year 2019-20

(Rs.in lakh)

Sl. No.	Budget Sub-Head / Name of Institutes/Centres	Plan (GC)											
		Salaries				General				Capital			
		Budget Allot.	Opening balance	Total	Exp. 2019-20	Budget Allot.	Opening balance	Total	Exp. 2019-20	Budget Allot.	Opening balance	Total	Exp. 2019-20
1	ICFRE/Pension	2961.88	0.00	2961.88	2961.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	VVB, New Delhi	0.00	0.00	0.00	0.00	29.22	0.28	29.50	28.15	2.17	0.09	2.26	2.24
3	DDO, ICFRE	1329.16	183.78	1512.94	1380.38	497.34	0.20	497.54	513.93	119.16	0.00	119.16	119.09
4	FRI, Dehradun	4930.83	570.88	5501.71	5140.21	1679.48	0.08	1679.56	1676.89	144.14	0.01	144.15	143.57
5	FRC-ER, Prayagraj	111.74	19.73	131.47	119.98	59.00	0.17	59.17	61.43	5.39	0.01	5.40	5.40
6	IFGTB, Coimbatore	1582.06	317.94	1900.00	1721.99	441.47	0.14	441.61	438.36	43.29	0.01	43.30	43.24
7	IWST, Bangalore	1224.07	274.58	1498.65	1402.16	334.37	0.00	334.37	336.36	55.28	0.00	55.28	55.29
8	TFRI, Jabalpur	1576.38	225.06	1801.44	1660.52	332.95	4.49	337.44	330.66	23.71	0.04	23.75	23.70
9	FRC-SD, Chandrawati	116.81	19.77	136.58	112.49	20.56	1.44	22.00	16.33	10.46	0.04	10.50	10.50
10	AFRI, Jodhpur	1161.26	210.74	1372.00	1241.54	342.16	2.25	344.41	338.21	18.24	0.02	18.26	16.20
11	HFRI, Shimla	715.33	142.87	858.20	778.51	171.11	0.07	171.18	136.28	17.54	0.01	12.55	12.33
12	IFP, Ranchi	688.01	135.58	823.59	705.06	134.78	0.03	134.81	129.67	26.65	0.10	26.75	26.74
13	IFB, Hyderabad	444.51	75.06	519.57	473.43	116.48	0.00	116.48	116.47	12.54	0.00	12.54	12.54
14	RFRI, Jorhat	1075.35	200.65	1276.00	1159.17	283.20	0.03	283.23	271.71	22.68	0.32	23.00	23.00
15	FRC-LE, Agartala	39.49	9.97	49.46	43.82	11.88	8.47	20.35	22.97	0.75	0.00	0.75	0.25
16	FRC-BR, Aizawl	43.12	18.88	62.00	50.67	46.00	0.00	46.00	53.24	3.00	0.00	3.00	1.70
	Total	18000.00	2405.49	20405.49	18951.81	4500.00	17.65	4517.65	4490.66	500.00	0.65	500.65	495.79

Statement of Revenue received in Budget Section, ICFRE for the year 2019-20

(Rs.in lakh)

Sl No.	Name of Institutes/Centres	Revenue Generated								
		Externally Aided Projects	Consu-ltancy	Scientific Consultancy charges other than consultancy projects	Internal Resource Generation	Sale of Forest Products	Income from Interest	Misc. Income	Any other source which have not been mentioned above	Total
1	ICFRE	0.00	0.00	0.00	0.00	0.00	9.02	0.00	0.00	9.02
2	VVB, New Delhi	0.00	0.00	0.00	0.00	0.00	1.25	18.22	0.00	19.47
3	DDO, ICFRE	126.72	0.00	100.00	0.00	0.00	0.19	8.71	0.00	235.62
4	FRI, Dehradun	69.11	0.00	0.00	30.21	67.93	30.17	242.06		439.48
5	IFGTB, Coimbatore	19.48	0.00	0.00	3.24	9.14	0.18	21.95	6.65	60.64
6	IWST, Bangalore	22.05	20.89	0.79	20.51	2.67	19.82	29.78	0.78	117.29
7	TFRI, Jabalpur	23.24	34.12	25.00	1.61	1.14	23.32	71.35	0.30	180.08
8	AFRI, Jodhpur	32.43	0.00	0.00	2.00	18.77	2.33	117.63	0.01	173.17
9	HFRI, Shimla	13.02	0.00	0.00	6.63	0.00	0.98	9.80	1.32	31.75
10	IFP, Ranchi	1.93	0.00	0.00	11.72	2.46	26.38	3.01	0.10	45.60
11	FRC-ER, Prayagraj	8.79	0.00	0.00	0.52	0.05	1.22	0.16	0.00	10.74
12	FRC-SD, Chandrawati	0.00	0.00	0.00	2.59	0.05	1.59	0.51	0.01	4.75
13	IFB, Hyderabad	18.03	0.00	0.00	0.17	0.00	5.71	0.91	0.00	24.82
14	RFRI, Jorhat	9.22	0.03	0.00	3.64	1.72	12.96	18.13	4.69	50.39
15	FRC-LE, Agartala	2.56	0.00	0.00	0.00	0.66	0.93	0.18	0.18	4.51
16	FRC-BR, Aizawl	1.59	0.00	0.00	0.00	0.00	0.48	1.56	0.00	3.63
	Total	348.17	55.04	125.79	82.84	104.59	136.53	543.96	14.04	1410.96

Statement of Allotment & Expenditure upto October 2020

(Rs.in lakh)

Sl. No.	Budget Sub-Head Name of Institutes/Centres	Plan (GC)					
		Salaries		General		Capital	
		Budget Allot.	Exp. upto July 2020	Budget Allot.	Exp. upto July 2020	Budget Allot.	Exp. upto July 2020
1	ICFRE/Pension	2105.88	2750.70	126.53	0.00	40.00	0.00
2	VVB, New Delhi	0.00	0.00	25.00	7.54	0.00	0.00
3	AO, ICFRE	1500.00	827.81	381.47	243.54	57.00	14.52
4	FRI, Dehradun	5600.00	3479.01	1546.99	940.75	636.30	208.63
5	FRC-ER, Prayagraj	130.00	93.76	38.77	24.82	1.00	0.99
6	IFGTB, Coimbatore	1895.00	1026.43	341.63	157.47	21.30	1.38
7	IWST, Bangalore	1545.00	867.45	299.72	157.06	115.00	60.04
8	TFRI, Jabalpur	1700.00	865.88	275.74	112.45	66.25	45.24
9	FRC-SD, Chhindwara	124.00	69.04	16.00	6.34	0.00	0.00
10	AFRI, Jodhpur	1370.00	799.53	287.87	134.62	45.00	44.96
11	HFRI, Shimla	850.00	508.84	140.03	67.76	7.40	3.81
12	IFP, Ranchi	700.00	467.18	127.97	59.35	12.85	9.80
13	IFB, Hyderabad	520.00	309.35	96.43	47.08	0.20	0.00
14	RFRI, Jorhat	1270.00	795.12	226.79	110.47	2.70	0.00
15	FRC-LE, Agartala	48.00	30.83	20.12	10.58	0.00	0.00
16	FRC-BR, Aizawl	56.00	32.34	48.94	23.74	0.00	0.00
	Total	19413.88	12923.27	4000.00	2103.57	1005.00	389.37

Statement of Revenue Generated upto October, 2020.

(Rs.in lakh)

Sl. No.	Name of Institutes/Centres	Approved Revenue Target for 2020-20	Revenue Generated upto October, 2020
1	VVB, New Delhi	20.00	2.87
2	AO, ICFRE	400.00	287.97
3	FRI, Dehradun	400.00	345.85
4	FRC-ER, Prayagraj	15.00	0.44
5	IFGTB, Coimbatore	160.00	58.72
6	IWST, Bangalore	180.00	32.68
7	TFRI, Jabalpur	180.00	17.45
8	FRC-SD, Chhindwara	15.00	2.05
9	AFRI, Jodhpur	180.00	71.78
10	HFRI, Shimla	120.00	14.47
11	IFP, Ranchi	120.00	1.65
12	IFB, Hyderabad	60.00	1.84
13	RFRI, Jorhat	120.00	27.34
14	FRC-LE, Agartala	15.00	0.75
15	FRC-BR, Aizawl	15.00	2.50
	Total	2000.00	868.36

Proposed Budget Estimate for the Financial Year 2021-22

(Rs.in lakh)

Sl.No.	Budget Component	Proposed BE 2021-22
1	Grant-in-aid "Salary"	24000.00
2	Grant-in-aid "General"	5000.00
3	Grant-in-aid "Capital"	1900.00
	Total	**30900.00**

Target Proposed for Revenue ICFRE (Hqtr.) Institutes/Centres for the year 2021-22

(Rs.in lakh)

S.No.	Name of Institutes/Centres	Target Proposed
1	VVB, New Delhi	20.00
2	DDO, ICFRE	400.00
3	FRI, Dehradun	400.00
4	FRC-ER, Prayagraj	15.00
5	IFGTB, Coimbatore	160.00
6	IWST, Bangalore	180.00
7	TFRI, Jabalpur	180.00
8	FRC-SD, Chhindwara	15.00
9	AFRI, Jodhpur	180.00
10	HFRI, Shimla	120.00
11	IFP, Ranchi	120.00
12	IFB, Hyderabad	60.00
13	RFRI, Jorhat	120.00
14	FRC-LE, Agartala	15.00
15	FRC-BR, Aizawl	15.00
	Total	**2000.00**

ANNEXURES

ANNEXURE – I

Right to Information

A Public Information Officer and Appellate Authority are functioning in Public Authority, ICFRE under the RTI Act 2005. During the year 2019-20, RTI application (458) and RTI Appeals (30) are disposed off. Consolidated Quarterly RTI returns of the Public Authority are regularly uploaded by the ICFRE on CIC website (rtir.nic.in).

RTI Applications/ Requests	No. of applications received as transfer from other P/As u/s 6(3)	Received during the month (including cases transferred to other Public Authority)	Number of cases transferred to other Public Authorities u/s6(3)	Decisions where requests/ Appeals rejected	Decisions where requests/ Appeals accepted
1st Quarter	33	85	06	--	91
2nd Quarter	35	105	05	--	130
3rd Quarter	25	81	05	03	112
4th Quarter	15	121	11	--	125
Total	**108**	**392**	**27**	**03**	**458**
RTI First Appeals					
1st Quarter	N/A	03	N/A	--	03
2nd Quarter	N/A	15	N/A	--	13
3rd Quarter	N/A	02	N/A	--	02
4th Quarter	N/A	10	N/A	--	12
Total	**--**	**30**	**--**	--	**30**

NAME AND ADDRESS OF PUBLIC INFORMATION OFFICERS AND APPELLATE AUTHORITIES UNDER THE RIGHT TO INFORMATION ACT 2005 IN ICFRE AND ITS INSTITUTES

Headquarters / Institutes	Appellate Authorities	Public Information Officers	Subject matter(s) allocated
Indian Council of Forestry Research and Education (ICFRE Hq.), P.O. New Forest Dehradun-248 006	Smt. Kanchan Devi, IFS Dy. Director General (Education) Phone (O) : 0135-2224832, 0135-2758571 E-mail : dir_edu@icfre.org	Shri Rampal Singh, Phone (O) :0135-2224834, E-mail : rampals@icfre.org	All matters related to ICFRE Hqrs., Dehradun
Forest Research Institute, P.O. New Forest, Dehradun-248 006	Shri A.S. Rawat, IFS Director Forest Research Institute P.O. New Forest Dehradun- 248006 Phone: 0135-2224444, 2755277 Fax: 0135- 2757021 E-mail: dir_fri@icfre.org	Dr. N.K. Upreti Group Coordinator Research, FRI, P.O. New Forest Dehradun- 248 006 Phone : 0135- 2224315, 0135-2752670, 0135-2757021 Email: groupco_fri@icfre.org	All Research & Account matters
		Smt. Neelima Shah, IFS Registrar, FRI Phone: 0135- 2757021-26 (O) Email: registrar_fri@icfre.org	Establishment, Administrative & all other matters
		Dr. A.K. Tripathi, Registrar & PIO, FRI (D) University Phone: 0135-2224439 (O) 0135-2751826 (O) Email: tripathiak@icfre.org	University matters
Forest Research Centre for Eco-Rehabilitation (FRC-ER), 3/1, Lajpath Rai Road, New Katra, Prayagraj-211 002	Dr. Sanjay Singh Head Phone: 0532-2440795, Fax: 0532- 2440797 E-mail: dir_csfer@icfre.org	Dr. Kumud Dubey Scientist -E Phone:0532-2440796 Fax :0532-2440797 E-mail:kdubey_csfer@icfre.org	All matters related to FRC-ER, Prayagraj
Institute of Forest Genetics and Tree Breeding, Forest Campus, P.B.No 1061 R.S.Puram, Coimbatore - 641 002	Dr. C. Kunhikannan, Director, IFGTB, Coimbatore, Phone: 0422-2484100 (O) Fax. 0422-2430549 E-mail: dir_ifgtb@icfre.org	Dr. S. Murugesan, Scientist 'G', IFGTB, Coimbatore Phone: 0422-2484102 (O)	All matters related to IFGTB, Coimbatore
Institute of Wood Science & Technology, PO Malleswarum, Bengaluru -560003	Dr. M.P. Singh, IFS, Director, IWST, Bengaluru Phone : 080-23341731, E-mail: dir_iwst@icfre.org	Dr. H.R. Prabhudda, IFS IWST, Bengaluru, Phone: 080-22190107(O)	All matters related to IWST, Bengaluru

Tropical Forest Research Institute, Jabalpur P.O. – R.F.R.C, Mandla Road, Jabalpur – 482 021	Dr. G. Rajeshwar Rao, Director TFRI, Jabalpur Phone : 0761-2840483 Fax: 0761-4044002 E-mail: dir_tfri@yahoo.co.in	Shri AJK Asaiya, Scientist-C, TFRI Jabalpur. Phone: 0761-2744119 (O)	As per provision and guidelines provided under RTI Act, 2005
Forest Research Centre for Skill Development, (FRC-SD) P.O. Kundalikala, Poama, Chhindwara - 480001	Shri C. Behera, IFS, Head Phone : 07162-292061 E-mail:head_cfrhrd@icfre.org	Shri C. Behera, IFS, Head Phone : 07162-292061 E-mail:head_cfrhrd@icfre.org	As per provision and guidelines provided under RTI Act, 2005
Rain Forest Research Institute Post Box No. 136, Deovan, Sotai, A.T. Road, Jorhat- 785 001(Assam)	Dr. R.S.C. Jayraj Director, RFRI Jorhat Phone: 0376-2305101(O) Fax. 0376-2305130 E-mail: dir_rfri@icfre.org	Dr. R.K. Borah GCR RFRI, Jorhat Phone: 0376-2305103 (O)	All matters related to RFRI, Jorhat
Forest Research Centre for Bamboo & Rattan (FRC-BR), P.O. Box 171, Kulikawn Aizwal-796001	Dr. R.S.C. Jayraj Director, RFRI Jorhat Phone: 0376-2305101 (O) Fax: 0376-2305130 E-mail: dir_rfri@icfre.org	Shri Gautam Banerjee, DCF Public Information Officer (PIO) Phone: 0376-2350273 (O) Fax: 0376-2350274	All matters related to FRC-BR, Aizwal
Forest Research Centre for Livelihoods Extension (FRC-LE) Sal Bagan Forest Campus PO – Gandhigram Agartala- 799 012 Tripura	Pawan K. Kaushik Head Phone: 7005763402 (O) E-mail: head_frcle@icfre.org	Shri Ravi Dutt LDC Phone: 0381-2397097 (O) E-mail: duttr@icfre.org	All matters related to FRC-LE, Agartala
Arid Forest Research Institute, P.O. Krishi Upaz, Mandi, New Pali Road, Jodhpur, 342005.	Sh. M.R. Baloch, IFS Director, AFRI Jodhpur Phone: 0291-2742549 (O) Fax. 0291-2722764 E-mail: dir_afri@icfre.org	Shri K.C. Gupta, AFRI Jodhpur. Phone: 0291-2729122	All matters related to AFRI, Jodhpur
Himalayan Forest Research Institute, Conifer Campus, Panthaghati, Shimla – 171 009.	Dr. S.S Samant, Director, HFRI, Shimla Phone : 0177-2626778 (O), Fax : 0177-2626779 E-mail: dir_hfri@icfre.org	Smt. Shilpa, CTO HFRI Shimla Phone: 0177-2626778(O) Fax: 0177-2626779	All matters pertaining to HFRI, Shimla
Institute of Forest Productivity, NH 23, Gumla Road, Lalgutwa Ranchi-835303.	Dr. Nitin Kulkarni, Director, IFP Ranchi, Ph- 0651-2526140 8986608161 E-mail: dir_ifp@icfre.org	Mr. Sanjeev Kumar Scientist- E, IFP Ranchi, Phone : 9798967363 E-mail: san.forester@gmail.com	All matters related to IFP, Ranchi
Institute of Forest Biodiversity, Dulapally, Kompally, Post Hyderabad- 500100	Shri D. Jayaprasad, IFS Director, IFB, Hyderabad Phone: 040-66309501(O) Fax : 040-66309521 E-mail: director_ifb@icfre.org	Dr. GRS Reddy Scientist -G, IFB, Hyderabad Phone: 040-66309505 Email: grsreddy@icfre.org	All matters related to IFB, Hyderabad
Forest Research Centre for Coastal Ecosystem, HPCL Colony, Panduranga Puram Visakhapatnam- 530 003	Shri D. Jayaprasad, IFS Director, IFB Phone: 040-66309500(O) E-mail: director_ifb@icfre.org	Dr. GRS Reddy Scientist -G, IFB, Hyderabad Phone: 040-66309505 Email: grsreddy@icfre.org	All matters related to FRC-CE, Visakhaptnam

ANNEXURE – II

Information on Vigilance Cases

A Chief Vigilance Officer is functioning at ICFRE, Dehradun. During the year 2019-20, the cases handled were as follows:

Vigilance cases carried forward from previous years	Vigilance cases initiated in the year	Vigilance cases disposed	Vigilance cases pending	Nature of such cases
04	04	01	07	Violation of conduct rules

Name and address of Chief Vigilance Officer, ICFRE is as follows:

Shri Anurag Bhardwaj, IFS
Chief Vigilance Officer
PO New Forest, Dehradun – 248 006
Phone: 0135-2224856

ANNEXURE – III

Information on Audit Objections

An Internal Audit Cell is functioning at ICFRE, Dehradun under the Head, Internal Audit, ICFRE. During the year 2019-20, the audit objections handled were as follows:

Information on the Audit Objections raised by Principal Director of Audit (Scientific Department), New Delhi

Audit objections carried forward from previous year	Audit objections initiated in the year	Audit objections disposed	Audit objections pending	Nature of Audit objections	Remarks, if any
88	Nil	15	73	Para's on Research/ Projects/ Admin/Accounts	Reply of the all Audit Para's have been submitted

Name and address of Head, Internal Audit, ICFRE is as follows:

Shri N. C. Saravanan, IFS
Head, Internal Audit
PO New Forest, Dehradun – 248 006
Phone: 0135-2224860/ 2753290
Email: head_iac@icfre.org

ANNEXURE – IV

E-mail and Postal addresses of ICFRE and its Institutes

Director General
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: dg@icfre.org
Phone: 0135-2759382; 2224333/2224855

Deputy Director General (Research)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: ddg_res@icfre.org
Phone: 0135- 2757775, 2224836

Deputy Director General (Administration)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: ddg_admin@icfre.org
Phone: 0135- 2758295, 2224856

Deputy Director General (Extension)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: ddg_extn@icfre.org
Phone: 0135- 2750693, 2224830

Deputy Director General (Education)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: ddg_edu@icfre.org
Phone: 0135- 2758571, 2224832

Director (International Cooperation)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: dir_pic@icfre.og
Phone: 0135- 2756497, 2224831

Secretary, ICFRE
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: sec@icfre.org
Phone: 0135- 2758614, 2224867

Assistant Director General (Administration)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_admin@icfre.org
Phone: 0135- 2750297, 2224869

Assistant Director General
(Biodiversity & Climate Change)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_bcc@icfre.org
Phone: 0135- 2755399, 2224823

Assistant Director General
(Education & Recruitment Board)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_edu@icfre.org
Phone: 0135- 2758348, 2224850

Assistant Director General
(Media and Extension)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_mx@icfre.org
Phone: 0135- 2755221, 2224814

Assistant Director General
(External Project)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_pf@icfre.org
Phone: 0135- 2754882, 2224827

Assistant Director General
(Environment Management)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_eia@icfre.org
Phone: 0135- 2753882, 2224813

Assistant Director General
(Research Planning)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_rp@icfre.org
Phone: 0135- 2753290, 2224807

Assistant Director General
(Monitoring and Evaluation)
Indian Council of Forestry Research and Education,
P.O. New Forest, Dehradun-248 006
E-mail: adg_me@icfre.org
Phone: 0135- 2757485, 2224810

Director
Forest Research Institute, Dehradun
P.O. New Forest
Dehradun-248006
E-mail: dir_fri@icfre.org
Phone: 0135- 2224444, 2755277
Fax: 0135-2756865

Director
Institute of Forest Genetics and Tree Breeding, Coimbatore
Forest Campus,
P.B.No. 1061, R.S. Puram,
Coimbatore - 641 002.
E-mail : dir_ifgtb@icfre.org
Phone: - 0422–2431540, 2484100 (O)
Fax : 0422–2430549

Director,
Institute of Wood Science and Technology, Bengaluru
P.O. Malleswaram,
Bengaluru-560 003
E-mail: dir_iwst@icfre.org
Phone: 080-23347131
Fax: 080- 23340529

Tropical Forest Research Institute, Jabalpur
P.O. – R.F.R.C, Mandla Road,
Jabalpur – 482 021 (M.P)
E-mail: dir_tfri@icfre.org
Phones: 0761 – 2840483(O)
Fax : 0761 – 2840484,4044002

Director
Rain Forest Research Institute, Jorhat
P. Box – 136, Deovan, Sotai, A. T. Road
Jorhat – 785 001 (Assam)
E-mail: dir_rfri@icfre.org
Phone: 0376-2305101 (O)
Fax: 0376-2305130

Director
Arid Forest Research Institute, Jodhpur
P.O. Krishi Upaz Mandi
New Pali Road, Jodhpur 342 005
E-mail : dir_afri@icfre.org
Phone : 0291-2742549 (O)
Fax : 0291-2722764

Director,
Himalayan Forest Research Institute, Shimla
Conifer Campus, Panthaghati,
Shimla– 171 009 (HP)
E-mail: dir_hfri@icfre.org
Phone :0177-2626778 (O)
Fax : 0177-2626779 (O)

Director
Institute of Forest Productivity, Ranchi
Main Road Hinoo
Ranchi-834 002
E-mail: dir_ifp@icfre.org
Phone: 0651-2948505 (O)

Director
Institute of Forest Biodiversity
Dulapally, Kompally, Post
Hyderabad- 500 100
E-mail: director_ifb@icfre.org
Phone: 040- 66309501 (O)
Fax : 040- 66309521

Head
Forest Research Centre for Skill Development (FRC-SD)
P.O. Kundalikala, Poama
Chhindwara (M.P.)-480 001
E-mail : head_cfrhrd@icfre.org
Phone: 07162-292061 (O)

Head
Forest Research Centre for Eco-Rehabilitation (FRC-ER),
3/1, Lajpath Rai Road, New Katra
Prayagraj- 211 002
E-mail: dir_csfer@icfre.org
Phone: 0532-2440437

Head
Forest Research Centre for Coastal Ecosystem, (FRC-CE),
HPCL Colony,
Panduranga Puram
Visakhapatnam - 530 003
E-mail: director_ifb@icfre.org
Phone: 040- 66309500 (O)

Head
Forest Research Centre for Livelihoods Extension (FRC-LE)
Sal Bagan Forest Campus,
PO- Gandhigram
Agartala- 799 012
E-mail: head_frcle@icfre.org
Phone/ Fax: 0381-2397097

Head
Forest Research Centre for Bamboo & Rattan (FRC-BR)
P.O. Box 171,
Kulikawn Aizwal-796001
(Mizoram)
E-mail: mzs@icfre.org
Phone: 0389- 2301157
Fax: 0389-2301159

LIST OF ABBREVIATIONS

ABTS	-	2,2^{l}-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)
ADG	-	Assistant Director General
AFRI	-	Arid Forest Research Institute
AICRP	-	All India Research Coordinated Project
AM Fungi	-	Arbuscular Mycorrhizal Fungi
APCCF	-	Additional Principal Chief Conservator of Forest
APMC	-	Agricultural Produce Marketing Committee
APTI	-	Air Pollution Tolerance Index
ATSC	-	Austrailian Tree Seed Centre
BAP	-	Benzyl aminoparine
BCCL	-	Bharat Coking Coal Ltd.
BD	-	Bulk Density
BNP	-	Betla National Park
BoG	-	Board of Governers
BSI	-	Botanical Survey of India
BTSG	-	Bamboo Training Support Group
CAF	-	Compensatory Afforestation fund
CAF	-	Chinese Academy of Forestry
CAMP	-	Conservation Assessment and Management Prioritizations
CAMPA	-	Compensatory Afforestation Fund Management and Planning Authority
CAZRI	-	Central Arid Zone Research Institute
CCB	-	Copper Chrome Boron
CCF	-	Chief Conservation of Forests
CF	-	Conservator of Forests
CIB & RC	-	Central Insecticides Board and Registration Committee
CIL	-	Coal India Ltd.
CLT	-	Cross Laminated Timber
CoFGR	-	Centre of Excellence on Forest Genetic Resources
COP	-	Conference of Parties
CPT	-	Candidate Plus Trees

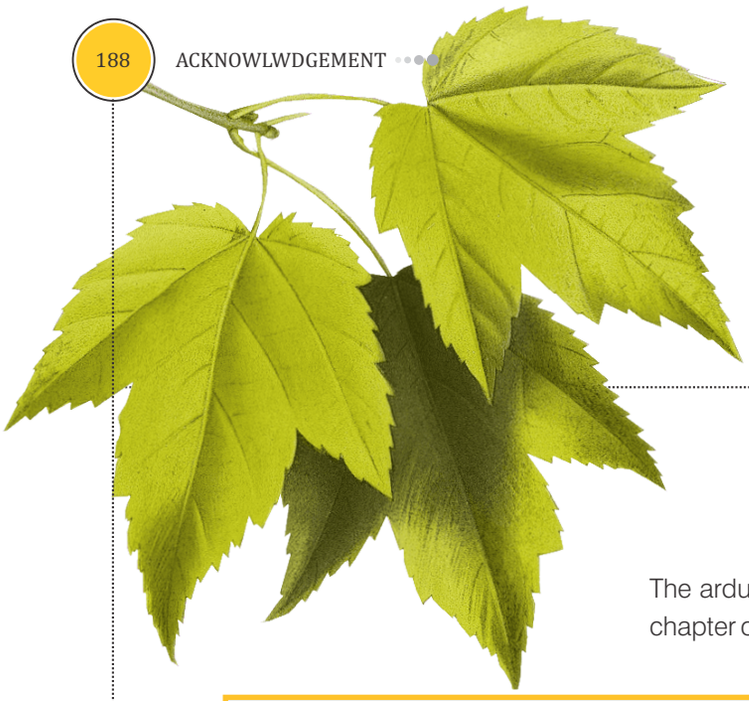
CSIR	-	Council of Scientific and Industrial Research
CSIRO	-	Commonwealth Scientific and Industrial Research Organisation
CSOs	-	Clonal Seed Orchards
CTO	-	Chief Technical Officer
DBH	-	Diameter at Breast Height
DBT	-	Department of Biotechnology
DCF	-	Deputy Conservator of Forest
DDG	-	Deputy Director General
DG	-	Director General
DNA	-	Deoxyribose Nucleic Acid
DPPH	-	1,1-diphenyl- 2 – picrylhydrazyl radical
DPR	-	Detailed Project Report
DST	-	Department of Science and Technology
DTC	-	Direct to Consumer
DUS	-	Distinctness, Uniformity and Stability
DVs	-	Demo Village
DWLS	-	Dalma Wildlife Sanctuary
EAPs	-	Externally Aided Projects
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
ENVIS	-	Environmental Information System
ESIP	-	Earth Science Information Partners
FAO	-	Food and Agriculture Organization
FGB	-	Field Gene Bank
FGR	-	Forest Genetic Resources
FMS Div.	-	Forest Management &Silviculture Division
FOERDIA	-	Forestry and Environment Research, Development and Innovation Agency
FRAP	-	Ferric Reducing Ability of Plasma
FRC	-	Forest Research Centre
FRCCE	-	Forest Research Centre - Coastal Ecosystem
FRCSD	-	Forestry Research Centre - Skill Development
FRI	-	Forest Research Institute
FRI&C	-	Forest Research Institutes and Colleges

FRS	-	Field Research Station
FSI	-	Forest Survey of India
FT	-	Forest Type
FYM	-	Farm Yard Manure
GBH	-	Girth at Breast Height
GBPNIHE	-	Govind Ballabh Pant National Institute of Himalayan Environment
GC-MS	-	Gas Chromatography – Mass Spectrometry
GIGW	-	Guidelines of Indian Government Websites
GIS	-	Geographical Information System
GSDP	-	Green Skill Development Programme
HFRI	-	Himalayan Forest Research Institute
HoFF	-	Head of Forest Force
HPLC	-	High Performance Liquid Chrometography
HPTLC	-	High Performance Thin Layer Chrometography
IBA	-	Indole Butyric Acid
ICAR	-	Indian Council of Agricultural Research
ICFRE	-	Indian Council of Forestry Research and Education
ICIMOD	-	International Centre for Integrated Mountain Development
ICRAF	-	International Council for Resrach on Agroforestry
ICT	-	Information and Communications Technology
IFB	-	Institute of Forest Biodiversity
IFGTB	-	Institute of Forest Genetics and Tree Breeding
IFP	-	Institute of Forest Productivity
IFRIS	-	Indian Forestry Research Information System
IFS	-	Indian Forest Service
IGNP	-	Indira Gandhi Naher Pariyojana
IISWC	-	Indian Institute of Soil and Water Conservation
IPR	-	Intellectual Property Rights
ISB	-	Indian School of Business
ISSR-PCR	-	Inter Simple Sequence Repeat-Polymerase Chain Reaction
IT	-	Information Technology
ITBP	-	Indo Tibetan Boarder Police
IUCN	-	International Union for Conservation of Nature and Natural Resources

IUFRO	-	International Union of Forestry Research Organisation
IVI	-	Importance Value Index
IWST	-	Institute of Wood Science and Technology
J&KUT	-	Jammu & Kashmir Union Territory
JFMC	-	Joint Forest Management Committee
JNV	-	Jawahar Navodaya Vidhyalaya
KVK	-	Krishi Vigyan Kendra
KVS	-	Kendriya Vidhyalaya Sangthan
LAMPS	-	Large Scale Adivasi Multipurpose Society
LAN	-	Local Area Network
LULC	-	Land Use Land Cover
MBDB	-	Maharashtra Bamboo Development Board
MEP	-	Methyl erythritol 4-phosphate
Mg	-	Mega Gram (10^6 g)
MLT	-	Multi Location Trial
MoE	-	Modulus of Elasticity
MoEFCC	-	Ministry of Environment, Forest and Climate Change
MOR	-	Modulus of Rupture
MoUs	-	Memorandum of Understanding
MPCA	-	Medicinal Plant Conservation Area
MS	-	Murashige and Skoog
MTA	-	Material Transfer Agreement
MVA	-	Mevalonate
NABARD	-	National Bank of Agriculture and Rural Development
NAEB	-	National Afforestation and Eco-Development Board
NCR	-	National Capital Region
NDVI	-	Normalize Difference Vegetation Index
NFIC	-	National Forest Insect Collection
NFLIC	-	National Forest Library and Information Center
NFRP	-	National Forestry Research Plan
NGOs	-	Non Governmental Organizations
NIESBUD	-	National Institute for Entrepreneurship and Small Business Development
NMDC	-	National Mineral Development Corporation

NMPB	-	National Medicinal Plants Board
NMR	-	Nuclear Magnetic Resonance
NPV	-	Net Present Value
NTFP	-	Non-Timber Forest Product
NTPC	-	National Thermal Power Corporation
NVS	-	Navodaya Vidyalaya Samiti
NWC	-	Nano-Wood-Composites
NWFP	-	Non-Wood Forest Products
OC	-	Organic Carbon
PBR	-	Peoples Biodiversity Register
PCCF	-	Principal Chief Conservation of Forest
PCR	-	Polymerase Chain Reaction
PGPR	-	Plant Growth Promoting Rhizo bacteria
PSB	-	Phosphate solubilizing bacteria
RAPD	-	Random Amplified Polymorphic DNA
RBD	-	Randomized Block Design
RCPs	-	Representative Concentration Pathways
REDD+	-	Reducing Emissions from Deforestation and Forest Degradation
RET	-	Rare Endangered and Threatened Species
RHS	-	Royal Horticulture Society
RRC	-	Regional Research Conference
SCI	-	Selection-cum- Improvement
SECL	-	South Eastern Coalfields Limited
SFDs	-	State Forest Department
SFM	-	Sustainable Forest Management
SHG	-	Self Help Group
SLEM	-	Sustainable Land and Ecosystem Management
SNP	-	Single Neucleotide Polymorphism
SOC	-	Soil Organic Carbon
SPAs	-	Seed Production Areas
SSOs	-	Seedling Seed Orchards
SWC	-	Soil Water Content
TAFCORN	-	Tamilnadu Forest Plantation Corporation

TFRI	-	Tropical Forest Research Institute
TGM	-	Tree Growers Mela
THM	-	Thermo Hygco Mechanical
TNFD	-	Tamil Nadu Forest Department
TNPL	-	Tamilnadu News print Ltd.
UF	-	Urea Formaldehyde
UK	-	Uttarakhand
UKFD	-	Uttarakhand Forest Department
UNCCD	-	United Nations Convention to Combat Desertification
UNEP	-	United Nation Environment Programme
UNFCCC	-	United Nations Framework Convention on Climate Change
USA	-	United States of America
USAC	-	Uttarakhand Space Application Centre
UT	-	Union Territory
UV	-	Ultra Violet
VAM	-	Vesicular Arbuscular Mycorrhiza
VFPC	-	Village Forest Protection Committee
VFPMC	-	Village Forest Protection & Management Committee
VMG	-	Vegetative Multiplication Garden
VVK	-	Van Vigyan Kendra
WAN	-	Wide Area Network
WHC	-	Water Holding Capacity
WII	-	Wildlife Institute of India
WIMCO	-	Western India Match Company
WLS	-	Wildlife Sanctuary
WP	-	Working Plan
WPC	-	Wood Polymer Composite
WSHG	-	Women Self Help Group
ZSI	-	Zoological Survey of India



ACKNOWLEDGEMENT

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S.No.	Name of the Chapter	Chapter Editors
1.	Ecosystem Conservation and Management	Dr. R.S. Rawat, Scientist (I/C), BCC, ICFRE, Dehradun Dr. Sanjay Singh, Scientist-D, ICFRE, Dehradun
2.	Forest Productivity	Dr. V.K. Varshney Scientist –G, FRI, Dehradun Dr. Y.C. Tripathi, Scientist-F, FRI, Dehradun
3.	Genetic Improvement	Dr. Ajay Thakur, Scientist-F, FRI, Dehradun Dr. Santan Barthwal, Scientist-F, FRI, Dehradun
4.	Forest Management	Dr. Jawaid Ashraf, Scientist, ICFRE, Dehradun
5.	Wood Products	Dr. N.K. Upreti, Scientist- G, FRI, Dehradun
6.	Non-wood and Forest Products (NWFPs)	Dr. B.P. Tamta, Scientist-F, FRI, Dehradun
7.	Forest Protection	Dr. Amit Pandey, Scientist-G, FRI, Dehradun Dr. Sudhir Singh, Scientist-G, FRI, Dehradun
8.	Education Vistas/ Activities	Dr. V.S. Senthil Kumar, ADG (Edu. & RB), ICFRE
9.	Extension Panorama/Activities	Dr. A.K. Pandey, ADG (M & Extn.), ICFRE, Dehradun
10.	Administration and Information Technology	Shri Raj Kumar Bajpai, ADG (Admin,), ICFRE, Dehradun Shri A.K. Sinha, Head (IT), ICFRE, Dehradun

Media and Extension Division, Directorate of Extension
Indian Council of Forestry Research and Education
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P.O. New Forest, Dehradun-248006, Uttarakhand, INDIA