Annexure-1

Progress report of ICFRE-Forest Research Institute, Dehradun in respect National Collaborative Scheme on Forest fire Management

A) Physical Progress of Scheme

The basic infrastructure to run the scheme along with procurement of office equipment/ peripherals has been completed. The recruitment of man power for the project namely Project Scientist, Database Manager, Junior Research Fellows and Field Assistant has been carried out. Field visits under different components have been initiated for data collection after selection of landscapes on the basis of different forest types.

First meeting of Scheme Implementation Unit (SIU) was conducted on 21st July 2023 and Annual Plan of Operations (APOs) of FRI, FSI and DFE for the year 2023-24 were approved by SIU (Proceeding attached, Appendix - A).

First meeting of Scheme Implementation Unit held on 21st July, 2023

A Consultation Workshop with representatives of State Forest Departments & research organizations has also been conducted on 29th November, 2023 to discuss sites selection, research activities and methodology of various components.

Group photograph of Consultation workshop held on 29th November, 2023

Photograph of Consultation Workshop held on 29th November, 2023

Component wise Progress

A. Development of National Web Portal for Database Management and Knowledge Dissemination

1. Architecture of web-portal on National Collaborative Scheme on Forest Fire Management has been prepared.
2. Methodology to integrate various Application Programming Interface (APIs) at National Collaborative Scheme on Forest Fire Management portal has been identified.
3. Software Requirement Specification (SRS) for web-portal has been finalized.
4. Designing of dashboard for forest fire management is under progress.
5. List of stakeholders related to forest fire management prepared.

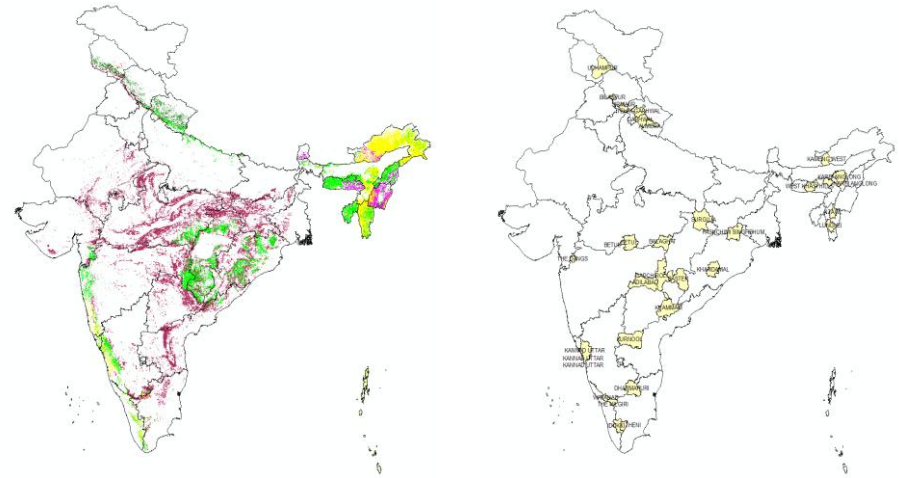
B. Development of National Forest Fire Knowledge Network

1. Collaborative partner organizations/ stakeholders for forest fire management identified.
2. Literature review of Forest fire articles carried out.
3. Mechanism for networking on Forest Fire Management with national organizations (including SFDs) through intervention of web portal is being developed.
4. Charter for signing of MoU/ MoA with SFDs, Research institutes, Universities has been prepared. The same has been presented during consultation workshop for comments and suggestions and approved.

C. Development of Standard Operating Procedures (SOPs)

1. Fire vulnerable landscapes which are prone to forest fire have been identified namely Tropical Dry Deciduous Forests, Tropical Moist Deciduous Forests, Sub Tropical

Pine Forests, Sub Tropical Broad Leaf Forest, Sub Tropical Dry Evergreen Forests. These have been discussed with the State Forest Department during the consultative workshop and feedback on the same obtained.



Group 2- Tropical Semi-Evergreen Forests
Group 3- Tropical Moist Deciduous Forests
Group 5- Tropical Dry Deciduous Forests
Group 8- Subtropical Broadleaved Hill Forests
Group 9- Subtropical Pine Forests
Group 10- Subtropical Dry Evergreen Forests

2. Data collection formats has been finalized and shared in the consultation workshop.
3. The structure of SOP has been discussed during consultation workshop and expert comments received.

D. Study on Impact of Future Climate Change Scenario on Forest Fire Vulnerability

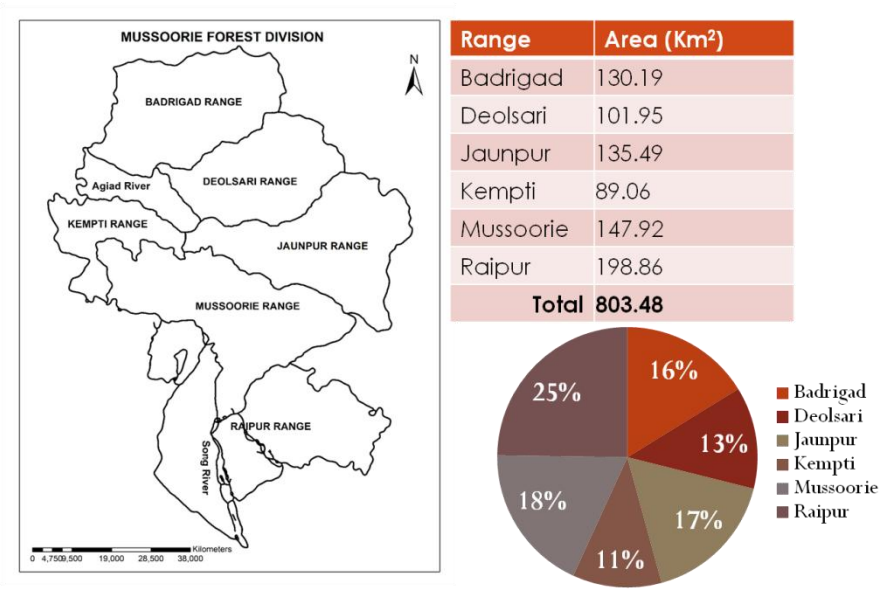
1. Identification and site selection

Identification and selection of fire prone forest in different climatic gradients from North to South and East to West including Central India.

2. Methodology for the component has been developed and a pilot study has been conducted in Mussoorie Forest Division and fire vulnerable areas has been identified under current and future climate scenarios. This was validated through Field visit of Mussoorie Forest Division.

Filed survey was conducted to the Mussoorie Forest Division (Fig. 1, 2, 3, 4, and 5) for collecting fire occurrence points for further use in developing current fire severity map of the division. Before, visiting filed, a meeting was held with Divisional Forest Officer at Divisional Forest Office, Mussoorie. During meeting project's requirements and necessary assistance were discussed thoroughly. Subsequently, a tour was conducted to various fire-prone areas within the Mussoorie range, Jaunpur range, Kempty range, and Raipur range. Before these field visits, comprehensive discussions were held with the respective range officers of each forest range within the Mussoorie Forest Division. During filed visit, geo-coordinates of fire occurrence points were recorded. Further, the information on the causes of

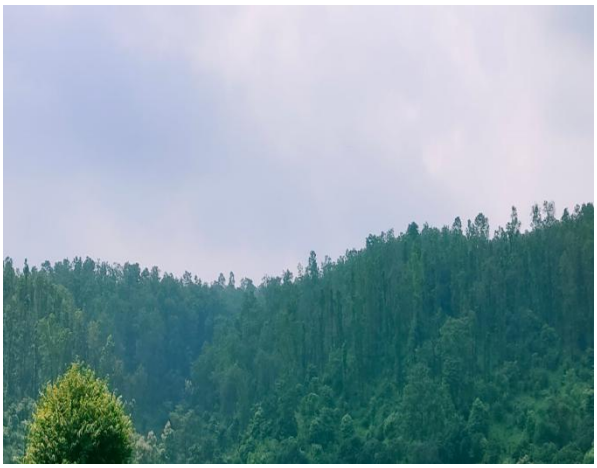
forest fire occurrences in respective ranges was gathered from the forest officials during our fieldwork.



Range	Area (Km²)
Badrigad	130.19
Deolsari	101.95
Jaunpur	135.49
Kempti	89.06
Mussoorie	147.92
Raipur	198.86
Total	**803.48**

Map of Mussoorie Forest Division showing area of each forest range.

Field visit to Jaunpur Forest Range of Mussoorie Forest Division.

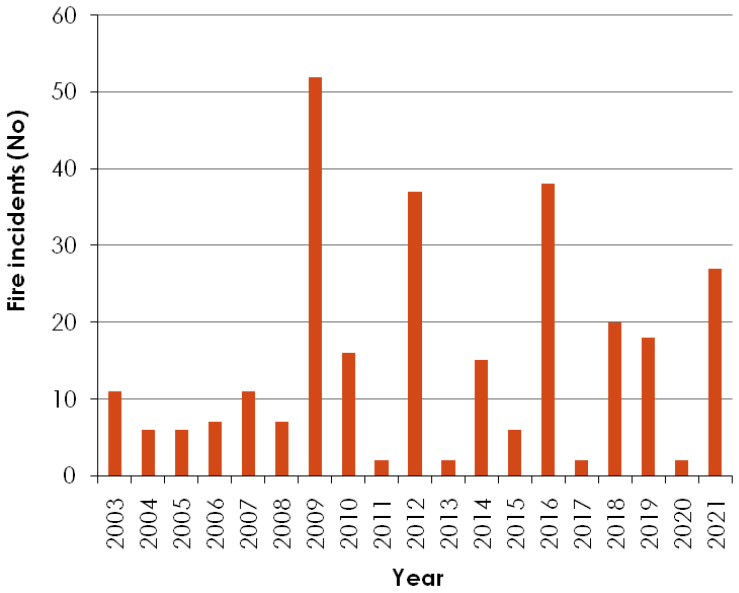


Field visit to Raipur Forest Range of Mussoorie Forest Division. Right figure shows the fire affected canopy of the forest ecosystem.

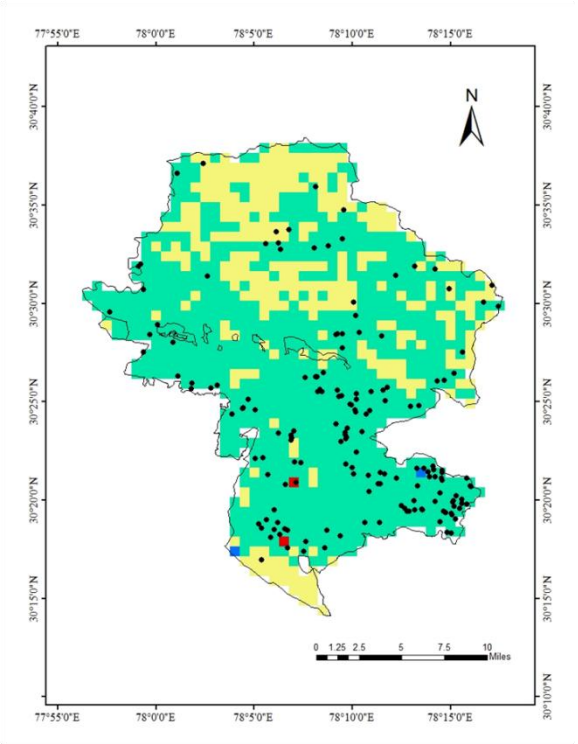
Field visit to Mussoorie Forest Range of Mussoorie Forest Division.

Field visit to Kempti Forest Range of Mussoorie Forest Division.

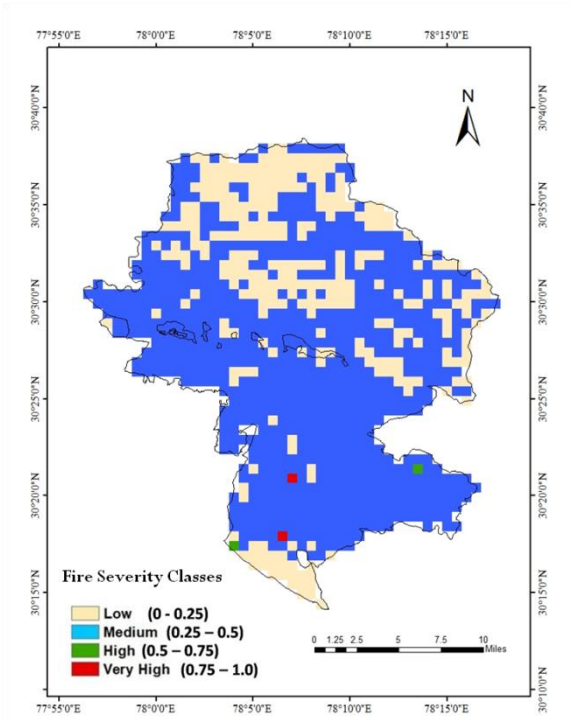
The data on forest fire occurrence for last 20 years (Fig. 2) in the division was retrieved from the FIRMS (Fire Information for Resource Management System; https://firms.modaps.eosdis.nasa.gov) (Fig. 3).



Temporal variation in forest fire incidents for last two decades.



Forest fire occurrence in Mussoorie Forest Division during last 20 years after processing the data retrieved from the FRIMS.



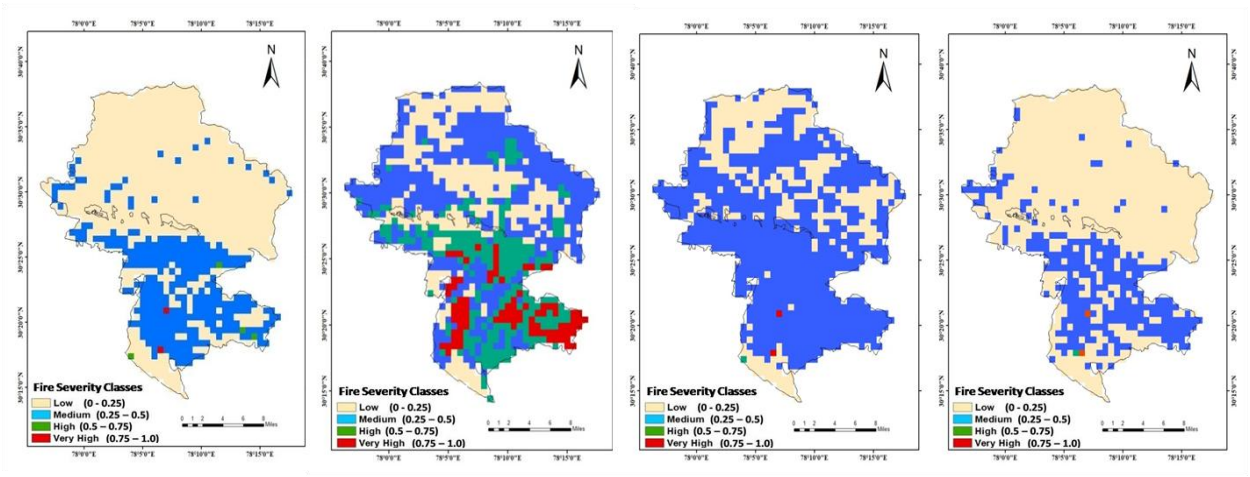
Forest fire occurrence in Mussoorie Forest Division in current climatic conditions.

Further, the fire severity map of Mussoorie Forest Division in the current climatic conditions was prepared which was further used in predicting impacts on future climate change on forest fire spread in the same division (Fig. 7). Besides, probable area in each severity classes was computed to understand the fire severity area in the division (Table 1).

Impacts of climate change on forest fire spread under various future climatic conditions (SSP 1, SSP 2, SSP 3, and SSP 5) by 2040, 2060, 2080, and 2100 were predicted using Maxent model. The project area under each fire severity classes is presented in the figures and tables.

Severity	Area (Km²)	Area (%)
Low	652.30	69.56
Moderate	282.87	30.17
High	1.71	0.18
Very High	0.86	0.1

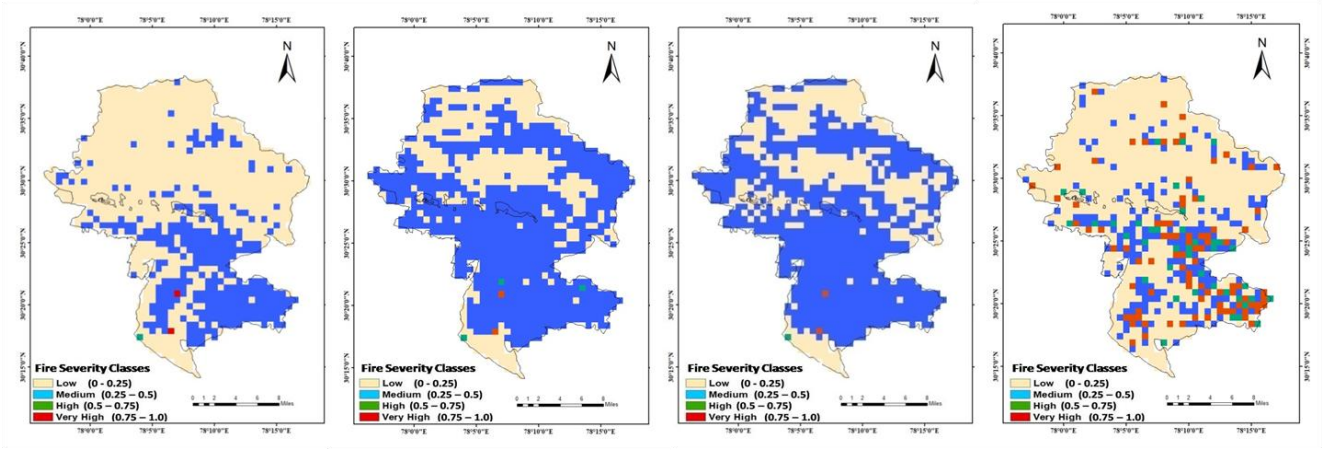
Forest fire area against each fire severity class in Mussoorie Forest Division.



Predicted impact of future climate change scenario (SSP 1-2.26) on probability of forest fire spread by 2040, 2060, 2080 and 2100.

Severity Classes	2040 (Km²)	2060 (Km²)	2080 (Km²)	2100 (Km²)
Low	666.02	261.44	263.15	689.16
Moderate	266.58	396.87	672.02	246.01
High	3.43	201.43	0.86	0.86
Very High	1.71	78.00	1.71	1.71

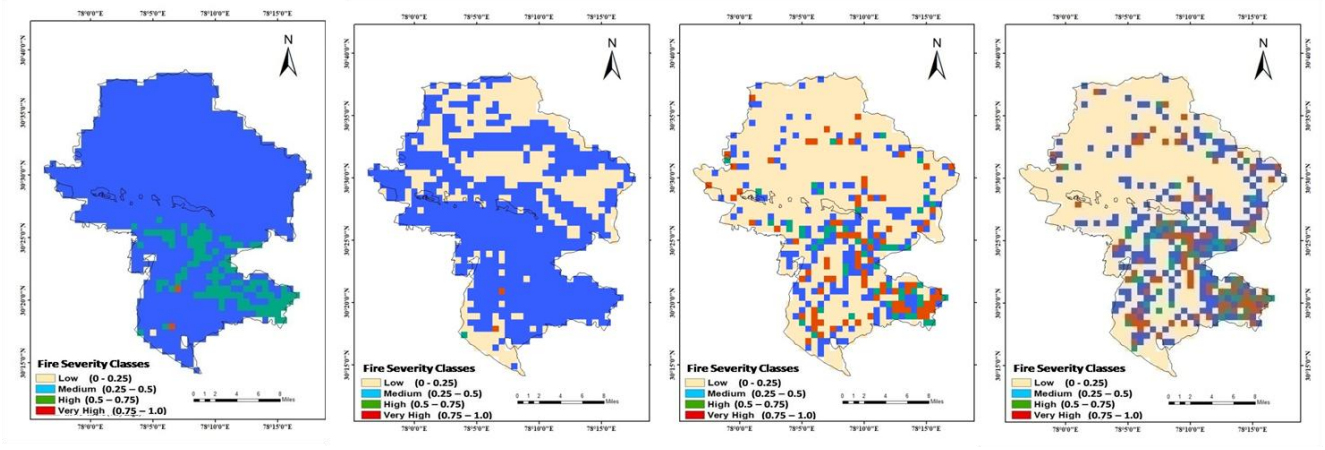
Predicted probable area against each fire severity classes under future climate change by 2040, 2060, 2080 and 2100.



Predicted impact of future climate change scenario (SSP 2-4.5) on probability of forest fire spread by 2040, 2060, 2080 and 2100.

Severity Classes	2040 (Km²)	2060 (Km²)	2080 (Km²)	2100 (Km²)
Low	663.45	298.29	672.88	669.45
Moderate	271.72	635.16	263.15	157.72
High	0.86	2.57	0.86	35.14
Very High	1.71	1.71	0.86	75.43

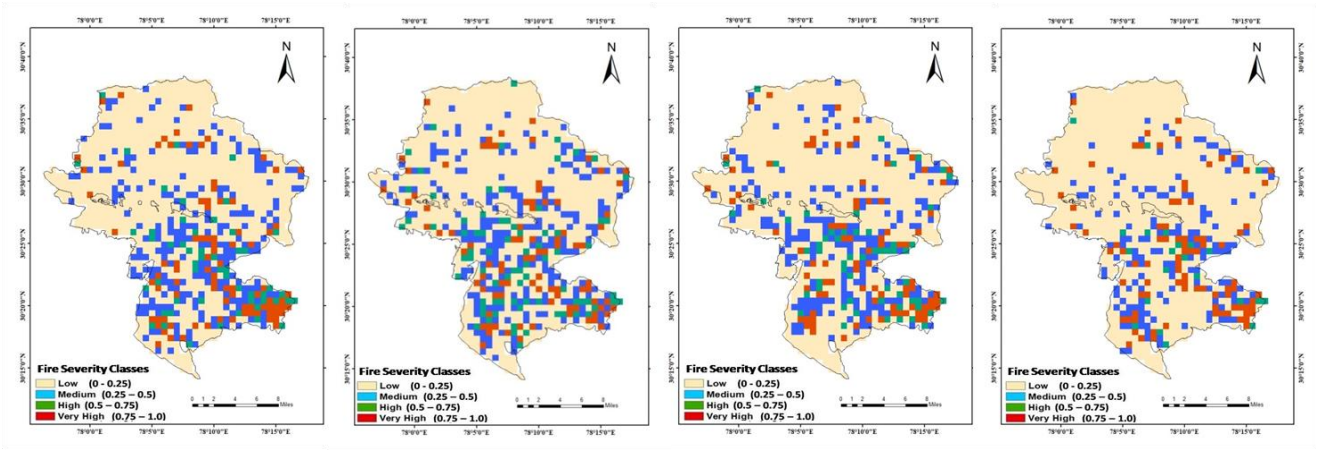
Predicted probable area against each fire severity classes under future climate change (SSP 2-4.5) by 2040, 2060, 2080 and 2100.



Predicted impact of future climate change scenario (SSP 3-7.0) on probability of forest fire spread by 2040, 2060, 2080 and 2100.

Severity Classes	2040 (Km²)	2060 (Km²)	2080 (Km²)	2100 (Km²)
Low	0.86	576.02	683.16	654.88
Moderate	842.60	303.44	138.86	165.43
High	92.57	57.43	46.18	42.86
Very High	1.71	0.86	70.52	74.57

Predicted probable area against each fire severity classes under future climate change (SSP 3-7.0) by 2040, 2060, 2080 and 2100.



Predicted impact of future climate change scenario (SSP 3-7.0) on probability of forest fire spread by 2040, 2060, 2080 and 2100.

Severity Classes	2040 (Km²)	2060 (Km²)	2080 (Km²)	2100 (Km²)
Low	636.02	624.88	683.16	647.16
Moderate	183.43	175.72	138.86	155.15
High	40.72	58.55	40.19	57.00
Very High	77.57	78.59	75.52	78.43

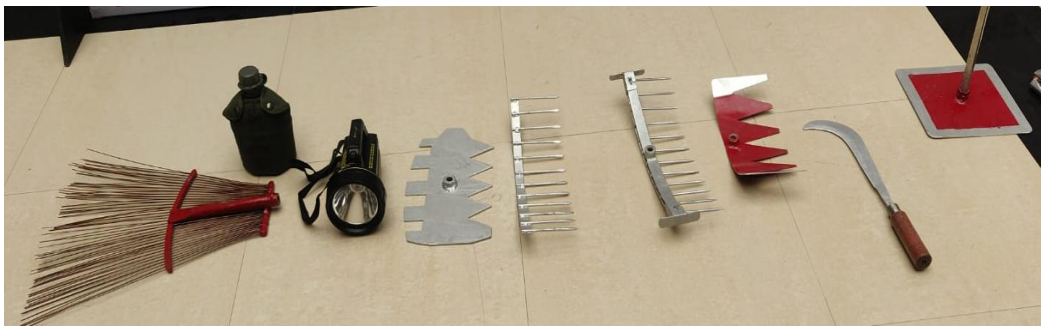
Predicted probable area against each fire severity classes under future climate change (SSP 5-8.5) by 2040, 2060, 2080 and 2100.

The learning from this would be upscaled in other identified landscapes.

E. Strengthening of SFDs by Fire Suppression Tools and Techniques

Under Forest Fire Research and Knowledge Management project (AICRP-14)ICFRE-FRI has collaborated with expert institutes like UPES Dehradun, IIT Roorkee and CFEES, DRDO, New Delhi for designing and developing firefighting equipment/ tools, safety gears. UPES Dehradun has developed modified hand tools: Rake (Arrow type, Nail Type, Peg tooth type/ multi-function), Fire beater, Fire broom (Jhapa), Torch, Water bottle, Pathal (modified sickle), Tool kit bag, Adjustable rod. Feedback on tools has been received from Uttarakhand,

Odisha and Kerala State Forest Departments and sent to UPES for further modifications of tools.



Fire-fighting hand tools developed in collaboration with UPES, Dehradun

Fire safety clothing developed in collaboration with UPES, Dehradun

Under AICRP-14 project ICFRE-FRI has collaborated with IIT, Roorkee for design and development of fire-fighting tool kit.

- Work order has been given to IIT Roorkee for design and development of fire-fighting tools kit in consultancy mode.
- A total of 15 sets of fire-fighting hand tools along with tool kit bag is being developed by IIT, Roorkee

List of hand tools along with tool kit bag

S. No.	Item
1.	Rake: arrow type, nail type, peg tooth type
2.	Fire beater
3.	Adjustable rod
4.	Fire broom
5.	Pathal (modified sickle)
6.	Tool kit bag

- A meeting to review the progress of "Design and Development of Fire-fighting Tools was held on 09.10.2023 with IIT, Roorkee at ICFRE-FRI.

- Physical prototype of sickle was presented by IIT, Roorkee.
- High density carbon steel has been used for manufacturing of the prototype. Three radium strips were also added on the sickle handle to help locate the fire fighters during night time fire-fighting operations.

Under AICRP-14 project ICFRE-FRI has collaborated with CFEES, DRDO for design and development of fire-safety gears.

- Work order has been given to CFEES, DRDO for design and development of fire-safety gears.
- A total of 6 sets of fire-safety gearsis being developed by CFEES, DRDO

S.No.	Particulars	Specifications
1.	Protective Clothing	Thermal protection as well as flexible and comfortable As per ISO 16073-3:2021 In lower-bottom style
2.	Hand gloves	Heat resistant and flexible to hold fire-fighting equipment
3.	Firefighting helmets	Helmets to protect from falling objects, heat Face shield as an attachment can be provided
4.	Firefighting Footwear	As per ISO 16073-6:2021

Component wise progress status is given below

Component	Status
Protective Clothing	• Design finalised as per Indian built • Fabric using indigenous fibers developed • Testing under progress *Job contract* initiated for fabrication of coat and trousers (Date of bid opening): 29.11.23
Hand Gloves	• Design finalised as per Indian built ➢ Style of gloves: 5-finger gloves with wristlet ➢ Lock-Stitch Sewn with para-aramid thread ➢ Double-layered construction ➢ Outer layer: ❖ Inside of Palm: Neoprene coated para-aramid ❖ Back-side of Palm: Inherently flame-retardant fabric *Job contract* initiated for fabrication of Hand Gloves (Date of bid opening): 29.11.23
Helmets	• Exploring the following materials for helmet fabrication ❖Polycarbonate Fiber reinforced plastic (FRP)
Footwear	• Questionnaire prepared and shared with Fire Services pan India, to arrive at the boot design for Indian built. Inputs being analysed *Development contract* initiated for footwear development (Date of bid opening): 13.12.23

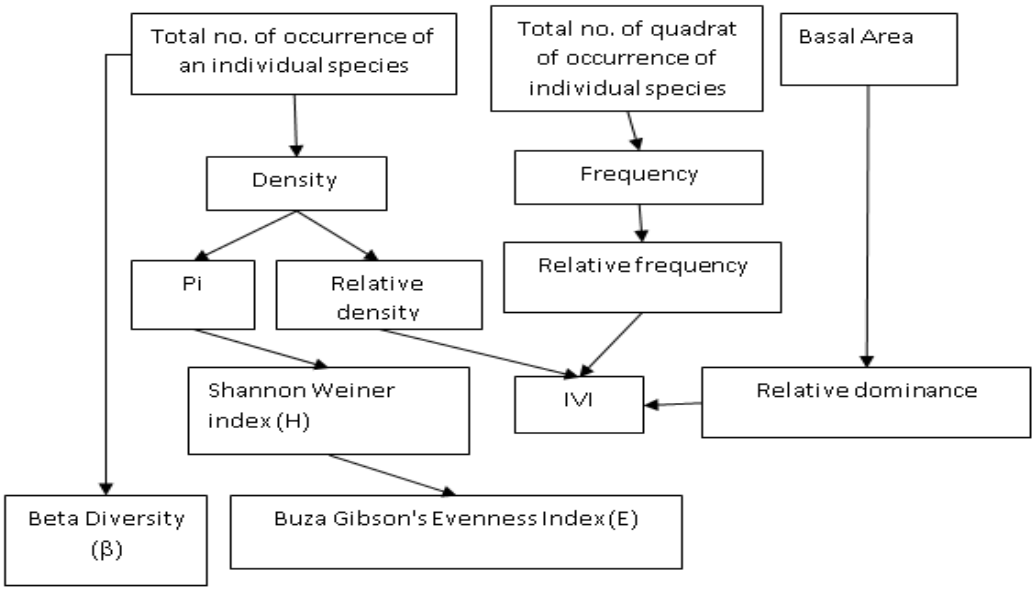
F. Assessment of Damage and Economic Losses due to Forest Fire

Under Forest Fire Research and Knowledge Management project (AICRP-14) baseline data on timber, fuelwood, fodder, NTFP, floral biodiversity (including Invasive alien species), carbon storage, carbon sequestration, soil nutrients from 170 burnt and 170 unburnt sites have been collected from five forest types viz., Tropical Semi Evergreen Forest, Tropical Wet Evergreen Forest, Tropical Moist Deciduous Forest, Tropical Dry Deciduous Forest, Sub-Tropical Pine Forest covering 15 States viz., Uttarakhand, Himachal Pradesh, Madhya Pradesh, Maharashtra, Chhattisgarh, Odisha, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Kerala, Assam, Meghalaya, Mizoram, Nagaland. Data analysis is in progress.

G. Post Fire Restoration and Rehabilitation Strategy in Fire Affected areas

The objective of this component is to develop restoration and rehabilitation strategy to recover the burnt areas in different forest types. Silvicultural interventions to be developed to restore the area and also to reduce soil erosion by SMC measures, etc. The work flow of methodology has been developed and mentioned below.

1. Reconnaissance survey of sites (site selection on the basis of frequency, intensity and impact of forest fire)
2. Categorizing the affected site into high/ moderate/ low degraded sites
3. Collection of data on soil properties, phytosociology, NTFPs, fire hardy species and soil seed bank (from burnt and unburnt sites)
4. Collection of secondary data from SFDs
5. Observation of site characteristics (drainage pattern, slope, soil depth and all above observations) to find scope of restoration measures



Flow chart depicting methodology for calculation of Biodiversity indices

H. Community based Forest Fire management

IEC has already been collected from the states and best practices will be collected from the states.

B) Financial Progress (till November, 2023)

Institute	Budget (Rs. In lakh)	Expenditure Incurred (Rs. In lakh)	Expenditure Committed (Rs. In lakh)	Total Expenditure (Rs. In lakh)
ICFRE-FRI	110.07	54.72 (49.71%)	7.30 (6.63%)	62.02 (56.35%)

Annexure-2

Progress report of Forest Survey of India, Dehradun in respect National Collaborative Scheme on Forest fire Management

Detailed Progress Report

A. Physical Progress Report:

Under the project "National Collaborative Scheme on Forest Fire Management" the following activities is being carried out by Forest Survey of India (FSI) till 31st Oct., 2023.

A.1 Technical Achievement:

1. Forest Fire alert dissemination to the SFDs: The near real-time and large forest fire alerts have been disseminated to the PCCF(HoFF) & Forest Fire Nodal Officer of the State Forest Department. In addition,sms alerts have been sent to the registered subscribers during the fire season. For this work, 05 resource persons under one Senior Technical Asst. have been engaged.
2. A national level database on forest fire detections is being prepared and the data on near real-time forest fire detections and large forest fire detections is available on FSI website.
3. The Forest Fire Danger Rating (FFDR) of India is being regularly updated on every Thursday of a week, which is valid for the ensuing week. Based on the meteorological conditions and forest fire archival data, the Fire Danger Rating is categorized into five classes, which are Extreme Risk, Very High Risk, High Risk, Moderate Risk & Low Risk and uploaded as WMS in the Van Agni Geo-portal. For this work, 02 resource persons have been engaged.
4. FSI Van Agni Geo-portal serves as a centralized hub for information regarding forest fires across India. Users can visualize the detection of near real-time forest fires through MODIS and SNPP-VIIRS sensors over the past three days, displayed in distinct pixels. Information about large forest fire events, displaying both active and inactive fire pixels, along with the Forest Fire Danger Rating processed for the ensuing week. For this work, 02 resource persons have been engaged.
5. A study based on spatial analysis of forest fire detections by FSI in the last 17 years (2004- 2021) to identify fire prone forest areas in the country. Extent of forest cover under different fire prone classes has also been determined for each State/UT. Analysis of the detected forest fire hotspot in GIS framework along with a grid coverage of 5 km X 5 km and latest forest cover has been carried out for the whole country. For this work, 02 resource persons have been engaged.
6. During fire season 2022-2023, the assessment of fire affected forest areas for the State of Manipur has been carried out. The finalised methodology for the assessment will be helpful in carrying of assessment at national level. For this work, 04 resource persons have been engaged.
7. A pilot study has been carried out for the West Himalayan States/UTs comprising Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and Ladakh to identify Fire Risk Zones and categorize them into different risk classes using suitable variables. The plot-level field inventory data collected under National Forestry

Inventory has been used to find out the causative factors responsible for the spread of forest fires. On the basis of the analysis of forest fire archival data, different weights have been assigned to causative layer and forest fire risk zones has been prepared. For this work, 02 resource persons have been engaged.

A.2 Procurement:

1. Procurement of ArcGIS DesktopLicenses
2. Procurement ofWorkstations
3. Procurement ofServers

B. Financial ProgressReport:

- Vide letter Dt. 03rdJan. 2023, Rs. 260.47 lakhs (Rupees Two crore sixty lakhs and forty-seven thousand only) has been received in FSI. The expenditure incurred till date is describedbelow:

S.No.	Particulars	Amount
1	Total amount received	2,60,47,000
2	Expenditure incurred • (Workstations installed for an amount of Rs. 39,35,358/-. Payment committed to be made to theFirm) • Procurement of Servers (order placed) (Committed expenditure – Rs. 42,00,000/- approx.)	2,09,30,930
	Balance Amount	**51,16,070**

- Approx. 80.36% of the funds released has been utilized till date and the remaining will also be spent asplanned.

Annexure-3

Progress report of Directorate of Forest Education, Dehradun in respect National Collaborative Scheme on Forest fire Management

A. Physical Progress Report

Budget has been released to 4 state forest academies for conducting training.

1. Five days training course on National Collaborative Scheme on Forest Fire management for Deputy Rangers/ Rangers/ Foresters/ Forest Guard has been conducted at Chandrapur Forest Academy, Maharashtra from 06.11.2023 to 10.11.2023.
2. Five days training course on National Collaborative Scheme on Forest Fire management for Deputy Rangers/ Foresters/ Forest Guard has been conducted at Odisha Forest Rangers College, Angul (Odisha) from 06.11.2023 to 10.11.2023.
3. Five days training course on National Collaborative Scheme on Forest Fire management for Deputy Rangers/ Foresters/ Forest Guard has been conducted at Tamil Nadu Forest Academy, Coimbatore from 20.11.2023 to 24.11.2023.
4. Five days training course on National Collaborative Scheme on Forest Fire management for Deputy Rangers/ Rangers/ Foresters/ Forest Guard of Himachal Pradesh Forest Department at Himachal Pradesh Forest Academy, Sundernagar (H.P.) from 04.12.2023 to 08.12.2023 is proposed.

B. Financial Progress

Institute	**Budget (Rs. In lakh)**	**Expenditure Committed (Rs. In lakh)**	**Total Expenditure (Rs. In lakh)**
DFE	10.46	8.20 (78.39%)	8.20(78.39%)