Proposal for the Establishment of

Centre of Excellence on Forest Fire (CoEFF)

Submitted to

Forest Protection Division
Ministry of Environment, Forest and Climate Change
Government of India
New Delhi-110003

by

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Forest Research Institute

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BACKGROUND

Forest fires have become an issue of global concern. In many other countries, wildfires are burning larger areas, and fire seasons are growing longer due to a warming climate. With growing populations in and around the edges of forests, more lives and property are now at risk from fire. Despite the staggered research done in the management of forest fires in India, field-verified data on the extent and severity of fires are lacking and understanding of the longer-term impacts of forest fires on the health of India's forests remains weak.

A joint report was submitted by the Ministry of Environment, Forest and Climate Change, Government of India, and the World Bank in June 2018 on the subject of 'STRENGTHENING FOREST FIRE MANAGEMENT IN INDIA'. The aim of the study was to strengthen knowledge on forest fires by documenting current management systems, identifying gaps in implementation, and making recommendations on how these systems can be improved. Consequent to the recommendations of the joint report, MoEF&CC & World Bank (2018) recognized ICFRE in coordination with FSI as lead implementer for National Centre of Excellence on Forest Fire.

According to joint report by MoEF&CC & World Bank (2018) there is no dearth of excellent research organizations in India that have been working on various aspects of Forest Fire Prevention and Management (FFPM). The Forest Survey of India (FSI) and Indian Council of Forestry Research and Education (ICFRE), both headquartered in Dehradun, Uttarakhand, stand out as potential host institutions for a centre of excellence that can provide guidance to SFDs and develop new methods for preventing and managing forest fires. Stronger collaboration of the SFDs with research entities would enable the states to conduct experiments and provide data to these institutes for

further developing and refining their research in the field, ultimately leading to better fire management outcomes on the ground. Indeed, FSI and FRI are already active in providing training and technical support to the state forest departments.

Research organizations and others are also important sources of knowledge on the long-term impacts of fire, which can help inform and guide the FFPM planning process in the country. Strengthening the collaboration between forest departments and researchers working on FFPM is critical for efficiently addressing the challenge of frequent, unwanted fires in India's forests, especially in the context of a changing climate. The opportunities for training forest officials must also be tapped into for improving FFPM outcomes on the ground (MoEF&CC & World Bank, 2018).

Following activities are envisaged under the proposed Centre of Excellence on Forest Fire-

a. Improvement in research and development facilities:
   i. Procurement of Goods (equipment & software), components, sub systems and minor infrastructure for improvement in research and development facilities.
   ii. Engagement of experts & part-time consultants.
   iii. Testing and Prototype development of upgraded and modern firefighting equipment.
   iv. Data collection, dissemination and documentation.
b. Coordinated work with other research institutes in India,
c. Capacity building of stakeholders, managers, team leaders etc.
d. Seminars, conferences workshops, and IEC activities (information, education and communication),
e. Project grant: Project grant to researchers to venture into new directions within the specified theme.

Joint report by MoEF&CC & World Bank (2018) highlighted that the creation of a Centre of Excellence should advance policy relevant research with a focus on FFPM. Such a centre should bring together other agencies and institutes with a stake in FFPM and disaster management, including FSI and NDMA. ICFRE, with data and technology support from FSI, could develop such a centre of excellence.

This document proposes establishment of *Centre of Excellence on Forest Fire* at the *Forest Research Institute, Dehradun*. The mandate for this unit, outlined in this Proposal, has been developed through a collaborative process during the past few

months, including meeting with the major partner organisations such as Forest Survey of India, Dehradun & Directorate of Forestry Education, MoEF&CC. This document provides the rationale for establishment of the Centre as an important enabling mechanism for achieving the goals outlined in the National Action Plan on Forest Fire (NAPFF) to undertake data collection and analysis, frontline research in all aspects of forest fires, and development of fire-fighting equipment and tools. It outlines the Centre's functions in the context of institutional priorities and its substantial experience with the research & training activities in this field, combined with the collaboration potential in terms of intra- and inter-institutional connections.

INTRODUCTION

Fire has been a part of India's landscape since time immemorial and can play a vital role in healthy forests, recycling nutrients, helping tree species regenerate, removing invasive weeds and pathogens, and maintaining habitat for some wildlife. Occasional fires can also keep down fuel loads that feed larger, more destructive conflagrations. But as population and demands on forest resources have grown, the cycle of fire has spun out of balance. Large areas of degraded forest are now subjected to burning on an annual or semi-annual basis. As these fires are no longer beneficial to forest health, India is increasingly wrestling with how to improve the prevention and management of unwanted forest fires (MoEF&CC & World Bank, 2018).

In India, one estimate shows that nearly 49,000 square kilometer of forests - an area larger than the size of Haryana – were burned in 2014 alone (a mild year compared to others in the recent past). Apart from the damage, forest fires pose a serious threat to India's ability to expand its forest and tree cover by 2030 to create an additional carbon sink of 2.5 to 3 billion tons of CO_2 equivalent, in keeping with the country's Nationally Determined Contribution (INDC). Indeed, India's Ministry of Environment, Forest and Climate Change (MoEF&CC) has identified forest fires as a major driver of forest degradation, and noted that the lack of a comprehensive assessment of what drives forest fires, and the best way to manage them, hinders effective action (MoEF&CC & World Bank, 2018).

According to joint report by MoEF&CC & World Bank (2018) post-fire management is not being treated as part of the FFPM process and is probably the weakest link. Post-fire data collection is an essential part of the fire management process and crucial to producing informed FFPM plans and policies. However, this part of the management process is given little priority and is often performed solely for the sake of fulfilling administrative requirements. Field reporting and the investigation of fire

causes may be hindered by insufficient field staff, difficult terrain, and a lack of communication infrastructure in more remote areas. A lack of standard protocols for collecting and reporting information on fires, including their causes, has made it impossible to aggregate data across states. The greater issue, though, are the institutional disincentives for accurate and complete reporting. Fires larger than a few hectares trigger extra work for field staff to report and investigate offenses, and the department and its officers may be held responsible for reported monetary damages due to fires. The states will need help from MoEF&CC and the research community in developing standard methods and protocols for assessing ecological impacts and economic damages from fire.

The NRSC scientists have also found evidence of fires affecting forests in areas of significant ecological value, especially for biodiversity conservation (Reddy et al. 2017a). Between 2006 and 2015, the authors report that forest fires were detected in just under half (281 of 614) of the protected areas in India. In the year 2014, fires burned about 8.6 percent of forest cover in protected areas.

State forestry policies recognize that fires are taking a toll on forests. The Assam Forest Policy (2004) points to forest fires as a cause of considerable damage in plantation and regeneration areas, and the State Afforestation Policy of Tripura also mentions that plantations and natural forests are severely damaged by forest fires. The Himachal Pradesh Forest Sector Policy (2005) recognizes that forest fires cause irreparable damage to forests, biodiversity, wildlife, water resources, forest-based livelihoods and well being. The Andhra Pradesh State Forest Policy (2002) also notes the deleterious impact of forest fires, especially on the young plantations.

According to the Fifth Assessment Report of the Inter-Governmental Panel on Climate Change, exposure to smoke from landscape fires (including forest fires) is estimated to cause 260,000 to 600,000 premature deaths annually world-wide.

RESEARCH/ KNOWLEDGE GAPS

According to the joint report by MoEF&CC and World Bank (2018) the long-term impacts of the current pattern of forest fires on India's forest ecology and the wider economy are still poorly understood; however, the available scientific evidence supports that fires are having a degrading effect. Repeated fires in short succession are reducing species richness and harming natural regeneration, in combination with other pressures such as intense grazing and browsing. Reductions in biomass, species

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diversity, and natural regeneration due to fire may pose a risk to policy goals for enhancing India's forest carbon sinks.

Current estimates of the economic costs of forest fires in India, at around INR 1,101 crore (US$ 164 million, 2016 prices) per year, are almost certainly under estimates. Monetary damages due to forest fires are generally assessed only for the loss of standing trees (natural or planted) in terms of their timber value, which are usually minimal in the event of low intensity surface fires such as those that commonly occur in India. Estimates could be improved by including the direct and indirect impacts on other sectors including e.g. transportation, infrastructure, loss of environmental services, etc. Without credible empirically based estimates of the costs of forest fires, it is unlikely that Forest Fire Prevention and Management (FFPM) will be made more of a policy priority (MoEF&CC & World Bank, 2018).

There is limited literature on impacts of forest fire in India, as assessed through field research. As the National Forest Commission noted in 2006: "The nature and severity of damage depends on the type of forest, availability of fuel and climatic factors. However, the damage to forest ecosystem due to fire has not been scientifically studied" (NFC 2006: 94-95). Much of the existing research has focused on seasonally dry tropical forests (including dry and moist deciduous forests) in Central and Southern India and subtropical pine or mixed-broadleaf forests in the hill states of the Western Himalayas.

NEED FOR FOREST FIRE DISASTER MANAGEMENT

The incidence of forest fires in the country is on the rise and burnt areas are increasing each year. There has been a piecemeal approach to the problem, so far. Gradually the national focus is shifting towards holistic approach to control this hazard. At present, the technical resources required for sustaining a systematic forest fire management programme are lacking in the country in large. Taking into consideration the serious nature of the problem, it is necessary to make some major improvements in the forest fire management strategy for the country. The Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India, has prepared a National Master Plan for Forest Fire Control. This Plan proposes to introduce a well-coordinated and integrated fire-management programme that includes the following components:

- Prevention of human-caused fires through education and environmental modification. It will include Silvicultural activities, engineering works, people's

- participation, and education & enforcement. It is proposed that more emphasis be given to people participation through Joint Forest Management for fire prevention.

- Prompt detection of fires through a well-coordinated network of observation points, efficient ground patrolling, and communication networks. Remote sensing technology is to be given due importance in fire detection. For successful fire management and administration, a National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be developed in the country.

- Fast initial control measures and follow up action.

- Introducing a forest fuel modification system at strategic points.

- Strengthening and augmentation of fire-fighting resources.

Southern India have found that repeated fires over short intervals are having a deleterious effect on forest composition, structure, and species diversity. In the Nilgiri Biosphere Reserve in the Western Ghats, Kondandapani et al. (2009) find fires "drastically altered" species structure and diversity and reduced seedling density in areas of dry deciduous forest with the shortest fire return intervals compared to forest patches with lower fire frequency. Jhariya et al. (2014) observe a similar pattern in the dry deciduous forests of the Bhoramdeo Wildlife Sanctuary in Chhattisgarh. Damage to Sal seedlings from low-intensity surface fires and negative effects on regeneration of trees forming the top canopy layer has also been observed in the Plain's forests of Uttarakhand by Maithani et al. (1986).

Singh et al. (1984) commented that oak forests in Uttarakhand are gradually being converted into pine forest because of human pressures such as fire, lopping, grazing, and leaf litter collection; fires promote the expansion of pine forests dominated by Chir. According to Chandra and Bhardwaj (2015) higher-intensity fires can severely deplete soils and strip them of organic matter and nutrients.

Forest fires contribute to climate change by releasing carbon stored in trees, undergrowth, litter, and soils into the atmosphere. Forest fires also emit heat trapping gases such as N_2O and other aerosols that influence the regional and global climate (MoEF&CC & World Bank, 2018).

Scientific research on the contribution of forest fires to climate change in India has so far been limited to estimates of direct emissions from the burning of above-ground biomass and have not considered the impact on regeneration. Nation-wide estimates have ranged from 6.34 million tons (Mt) CO_2 per year to as much as 123.84 Mt

CO_2 per year. The wide range of estimates reflect not only the inter-annual variability in fires, but also significant differences in assumed parameters (Badarinath and Vadrevu, 2011).

JUSTIFICATION FOR THE PROPOSED CENTRE

Sustainable development of natural vegetation systems, land-use systems and rural populations in the country are at risk due to forest fires that devastate valuable vegetation resources (*forests and other natural ecosystems, farmlands, pastures, plantations, etc.*), in both the short-term (*disruption of ecosystem processes, economic losses, humanitarian problems due to destruction of crops and other values at risk, including human health due to impacts of smoke*) and the long-term (*degradation of stability and productivity of ecosystems and land-use systems*). These fires often occur as a consequence of extreme weather situations and inter-annual climatic variability, e.g. droughts caused by El Niño during which land-use fires escape control, or after precipitation-rich periods (e.g. La Niña) that result in rich growth of vegetation and an increased availability of fuels (combustible material). The underlying causes of damaging wildfires and excessive application of fire in land-use systems are deeply rooted in the problems of rural societies that are undergoing rapid demographic changes and are experiencing the loss of traditional knowledge and skills due to globalization, and confrontation with external pressure on limited vegetation resources. Secondary effects of destructive wildfires include the loss of vegetation that protects the soil. As a consequence, the fire-affected sites are often degraded by high winds and rainfall. Increased surface runoff also leads to disastrous floods and landslides, affecting drinking water availability and quality, or even leading to siltation of reservoirs.

Apart from other natural hazards like landslides and earthquakes, forest fire is one of the major disasters in diverse forests of India, particularly in the Himalayas and North-East India. However, the comprehensive vital information to establish forest fire linkages with human habitation, road network, drainage network, distance to fire station, forest composition and density, slope, aspect, altitude, fuel type etc. is lacking. Hence, to bridge this knowledge gap it is imperative to establish *Centre of Excellence on Forest Fire* to address the issues and to develop research based strategies to combat forest fires. The proposed *Centre of Excellence on Forest Fire* will generate knowledge and carry out capacity building to minimize the devastating impact of forest fires.

WORK DONE BY THE FOREST RESEARCH INSTITUTE, DEHRADUN ON FOREST FIRE MANAGEMENT

The importance of taking up systematic research in the field of forest fire protection was realized as early as in 1956 when the first Expert Committee of FRI headed by Prof. Champion made very specific recommendations regarding the need to study and monitor forest fires in the country. Accordingly, a scheme was formulated in 1959 but it could not be sanctioned. Moreover, the ninth and tenth Silviculture Conferences held in 1956 and 1961 at FRI, Dehradun, recommended that FRI should take up research and development studies to strengthen knowledge related to forest fire management in India.

The Forest Research Institute, a Centre of Excellence with multi-disciplinary strength has played significant role in conservation and management of forests throughout the spatial extent of the country. Additionally, FRI has carried out several activities with respect to forest fire management and some of the major initiatives are summarized below: -

(i) **Capacity Building of Forest Department(s) and other Stakeholders:** As an important mandate, FRI has been conducting several workshops and imparting trainings to enhance capacity of the Forest Department(s) for science based management of forests and conservation of biodiversity. These training programmes have appropriate modules with respect to forest fire mitigation. Furthermore, training programmes on "Forest Fire Disaster Mitigation" for Forest officials of various States/ UTs, officers of paramilitary forces were organized by the Forest Research Institute, Dehradun, for last 8 to 9 years in collaboration with the National Institute of Disaster Management, New Delhi.

(ii) **Research and Development for Better Management of Forests While Combating Forest Fires:** FRI has taken up several projects/ studies covering different thematic areas to enhance knowledge about the different ecological processes, forest management issues and developed technologies for better management of forest resources of the country. FRI has also carried out few specific studies related to forest fire ecology and fire management. The institute has experience in developing tools and techniques to combat forest fires etc. The Institute has developed an in-house forest fire extinguishing kit which has been given to Forest Department personnel for controlling forest fires in difficult terrains. The Institute has capability to develop such types of technologies and is in the process to acquire advanced scientific and modern techniques.

VISION

The Centre will strive to provide leadership for deriving global solutions to issues related to forest fires across the world. The Centre aims to excel in Prevention, Detection & Suppression and Post Fire management including assessment of losses & restoration by providing leadership, best practices, research and support. The Centre will serve as "think tank" for MOEF&CC, Government of India and play advocacy role, provide inputs on technical knowledge on different aspects of Forest Fires in the country to improve the strategy for forest fire prevention and management through Research and Development initiatives.

MISSION

The Centre will work towards generating a Knowledge Management System so as to develop models for forecasting the forest fires; and to develop Standard Operating Procedures for combating forest fire in different landscapes. In this endeavour, mission of the Centre is:

1. To arrange global cooperation towards prevention of forest fires and to build a network of continuous information exchange with global partners in the arena of forest fire fighting; and for use of updated latest modern technology for monitoring the detection, suppression and mitigation activities in the country.
2. To strengthen the forest fire prevention, detection, suppression and mitigation activities in the country.
3. To undertake research projects on forest fire research issues.
4. To provide inputs to the State Forest Departments (SFDs) for better management of forest fire in the country.
5. To augment the capacity building of forest managers and stakeholders with latest techniques and tools for better management of forest fire.

OBJECTIVES

The broad objectives can be summed up as below-

✓ To develop long term international cooperation in designing strategies for preventing, and managing the forest fires so as to tackle the forest fires in the most effective manner for reducing the ecological losses due to forest fires in the long run.

✓ **Development of National Web Portal for Database Management and Knowledge Dissemination:** To strengthen and manage knowledge with respect to forest fires in India, a web-based portal will be developed at the Centre. The online portal will provide scientific information on forest fire

management issues, baseline information, scientific publications, other publications for dissemination and awareness creation. It will also provide a dashboard for the SFDs for reporting of management activities undertaken on forest fire with complete loop for reporting forest fire. It will also provide linkages with district level agencies involved in rapid response in case of emergency situation of forest fire to enable better coordination and clarity of chain of command in case of such eventualities. It will enhance responsiveness through workflows automation and availability of real time information. It will provide a platform for public access and helps for maintaining better transparency and efficiency in the working environment and minimizing the processing delay. Additionally, the web based portal will host training modules and webinars. It will also provide list of different stakeholders such as forest management agencies, NGOs, societies, scientific institutions, forestry resources, and subject experts on forest fire ecology and forest fire management.

✓ To carry out Research & Development activities on ecological aspects of forest fires and to develop forecasting models for forest fire prediction based on variable parameters such as fuel load, distance from habitation, temperature, rainfall, relative humidity etc.

✓ To meet the operational needs of the forest managers across the country in following areas –

▪ Forest Fire Monitoring	▪ Fire Safety Tools & Equipment
▪ Fire Danger Rating System	▪ Post Fire Damage Assessment
▪ Fire Combat Training	▪ Rehabilitation/ Reclamation Strategy
▪ Incident Command/ Response System	▪ Annual Calendar of Activities
▪ Any other	

✓ To carry out Research & Development activities for improving the Forest Fire Fighting Tools and Equipment *(including the Fire Uniform)* being used by forest departments as well as communities and to make them more user friendly.

✓ To develop SOPs to prevent or combat fire; provide technical support to SFDs on Forest fire management; capacity building for different levels of field functionaries. identify best practices & upscale them.

✓ To identify the need for policy interventions for better management of forest fire, wildlife habitat and other natural resources in the country affected by fire; and also conduct research on the same through collaborative research projects.

✓ To provide the appropriate tools and resources to the various forest departments for involving and empowering the local communities in the

prevention, suppression of forest fires and the restoration of fire affected areas.

✓ To develop the Centre of Excellence as 'State of the Art' resource centre having complete database of information on forest fire and best practices adopted across the globe for its efficient handling and effective management.

Composition of CoEFF: -

The Centre will be created at ICFRE whereas; all the administrative setup will be in Forest Research Institute, Dehradun with Forest Survey of India and Directorate of Forestry Education as two major partner institutes. The Director, FRI will act as Head of the Centre. Head Silviculture will act as member secretary of advisory board and will facilitate the meetings and coordination for the forest fire research undertaken by the Centre with the assistance of scientists, Officers working in the institute and other administrative staff.

For field visit and research/ administrative assistance staff will be hired on contract basis depending on the work load.

The Centre will have an **Advisory board** headed by the Director General, ICFRE Dehradun and comprising of the following: -

i. Director General, ICFRE Dehradun -Chairperson
ii. Fulltime members
    a) Director, Forest Research Institute, Dehradun -Head of the Centre
    b) DG, Forest Survey of India, Dehradun -Member
    c) Director, Directorate of Forestry Education, Dehradun -Member
    d) PCCF & HoFF, States/ UTs / Nodal officers of SFDs -Members
    e) Directors, ICFRE Institutes -Members
    f) Head, Silviculture& Forest Management Division, Forest Research Institute, Dehradun -Member Secretary
iii. Experts and Specialists from other organisations working in the field of Forest Fire (NIDM, NDMA, IIRS/ISRO, IMD etc.) -nominated members
iv. Subject experts from leading Universities -nominated members

The term of members nominated by the chairperson will be for two years.

The terms of reference for the advisory board are given below: -

i. To prioritize, approve/ outline the Annual Plan of Operation for each year for carrying out the activities to achieve the objectives of the Centre of Excellence.

ii. The board will meet twice in a year (once during & Pre fire season and once Post fire season) to review the activities & provide feedback on the R&D initiatives giving suggestions for improving and sharing of knowledge.

iii. The board will also review the progress of the projects periodically.

The board will support the Centre's leadership team in strategic planning, expanding to new initiatives, and in collaborating with other units across country for finding the problem areas in the relevant field for undertaking focussed research to arrive at practical solutions in the matter.

In its inaugural year, the board will be required to:

i. Finalize basic infrastructure required & activities for initiation of the Centre of Excellence

ii. Work out the permanent and temporary staff requirement for the roles assigned for works proposed by partner institutes/ organisations.

iii. Develop a Road map for the next 5 years by prioritising the research needs.

iv. Proposing funds for different activities for the 5 Year Plan period and for working out the annual requirement also.

v. Recommend the financial assistance required for operationalising the Centre of Excellence for a minimum period of 5 years to begin with.

In addition to above, the Centre will also have **Experts/Working Groups** of National and international Organisations/ Institutes/ Universities/Experts who will be sharing their technical expertise for guiding policy interventions for better management of forest fire, wildlife habitat and other natural resources in the country affected by fire.

The Composition of Working Group will include National and International Institutes/Organisations/ Universities of repute having expertise and experience in the field of forest fire management. The National and International members of the Working Group are proposed in **Annexure-I & II** respectively.The members of the Group will also be individual collaborating partners for the implementation of the research needs in identified thrust areas based on their area of expertise.The working group will consist of domain experts in the thrust areas such as Real Time Detection and monitoring of Forest Fire; Early warning system; Forest Fire vulnerability and

Climate Change; Economic and Ecological impact of Forest Fire; Post-fire restoration and rehabilitation etc.

The Working Group will be providing technical direction to the research needs placed before it so as to propose appropriate action for taking it forward. The suggestions of the Working Group will be placed before the Advisory Board for according necessary approvals for taking up research on the specified topics in project mode. The recommendations of the Working Group may also form a basis for advocating amendments to existing policy framework.

Activities of CoEFF: -

The activities of the Centre may be categorized into 'Pre-Fire, During-Fire and Post-Fire management' in forest areas. In this endeavor Centre will take up the following activities.

I. Activities to be undertaken by FSI, Dehradun

As per the role defined by MoEF&CC in National Action Plan on Forest Fires para 8.1 (i) FSI may develop a national level database on burnt area assessment on a yearly basis. There are many activities which are part of mandate of FSI, which will continue to be done by FSI, however Centre will coordinate with FSI for sharing information and providing assistance to FSI as and when required. Following activities will be done by FSI: -

PRE-FIRE ACTIVITIES

A. **Near Real Time monitoring of Forest Fire and alert system**
   Forest Survey of India has been using spatial information (MODIS and SNPPVIIRS) to find and report forest fires in the nascent stage and provide quick and reliable signals to SFDs and general public to initiate preventive measures at their end. It has been undertaking activities *viz.* Large Forest Fire Monitoring Programme, forest fire 'Geo-portal', use of Novel platforms such as Drones, thermal imagery etc. and continuous R&D to enhance the robustness of system.

B. **Development of national level database on forest fire**
   The Centre will work in close coordination with FSI (*in association with IMD)* for developing national database network on-

   ✓ Information about climate, weather, etc.

- ✓ Historical documentation of forest fires, including location, type of vegetation, history, causes and other details.
- ✓ Number of forest fires, the area burnt and other adverse impact on type of vegetation burnt, the flora and fauna of the area.
- ✓ Resources, including human resource available with the state govt. to detect and combat forest fire,
- ✓ Other area specific relevant information.

The database will also capture information on fire lines, controlled burning, watch towers, fire-fighting assets (and their locations), and communications infrastructure. Such a database will be instrumental for assessing longer-term trends across states and regions and for planning fireprevention and response. As noted by the National Forest Commission (2006), creating a database would include establishing a mechanism for ensuring data quality and cross-checking figures reported by local field staff. Field-level officers in the state-level forest departments should have access to the database as well.

C. Identification of fire vulnerable landscape across country based on ecological models

Centre will give input to FSI in identification and mapping of Fire vulnerable areas using historical fire data along with following parameters:

Climatic: Temperature, precipitation, microclimatic parameters, Aridity Index, Evapo-transpiration
Topographical: Slope, aspect, Elevation, drainage
Anthropogenic: Distance to habitation, Road etc.
Socioeconomic factors/aspects/status: Cattle population, fodder dependency
Fuel Characteristics: Fuel type, moisture, depth, load
Forest characteristics: Forest type, canopy density

D. Mapping and monitoring of fuel load at country level

The Centre will work with FSI to carry out this activity. Fuel load varies across forest types, density, composition, and structure. Fuel load map of country will be developed using National Forest Inventory (NFI) data and field survey. This map will be used to calculate the threshold level of fuel load in different forest types. Additionally, moisture content, fineness, depth, compactness, and orientation (vertical or horizontal) of these fuels will be studied and monitored as Fire potential and behaviour is affected by these factors.

E. Development and deployment of Fire Danger Rating System (FDRS)

The Centre will work with FSI to carry out this activity. Fire Danger Systems (FDRS) warn of short-term fire potential and allow fire agencies to quantify different aspects of fire behaviour, for example, how fast fires are likely to spread, how intensely they may burn under current conditions, and how difficult they may be to control. FDRS are intended to inform fire managers and other responsible agencies about hazardous fire weather conditions so that they can ensure an appropriate state of readiness, alert the public of the danger, and take actions to prevent or mitigate damaging fires (e.g., by putting in place restrictions on the use of fire). As a decision-support tool, FDRS may enable fire managers to allocate their resources for FFPM in a more efficient and cost-effective way (Taylor and Alexander 2006). It will be developed by international cooperation with scientists from Canada, US or other European countries.

F. Establishment of experimental lab for fire behaviour and spread study

This proposed lab is aimed to understand the fire behaviour, particularly the ignition, mechanisms of flame propagation, spreading, flame front velocity and fuel consumption rates in different forest types, fuel types and topography. Impacts of surface fires on crown fuels will also be studied together with the effects of winds, humidity, environmental temperature and fuel moisture content. This lab will be established with the collaboration of expert agencies in other countries such as Fire Sciences Laboratory of US Forest Service (USFS), Australia, South Korea etc.

POST-FIRE ACTIVITIES

G. Survey and mapping of fire affected areas (Burnt Area Assessment)

Burnt area assessment using Remote Sensing (RS) and Geographic Information System (GIS) techniques and classification of damage level based on the intensity of forest fire in association with State Forest Departments (SFDs) will be carried out by FSI. It will facilitate to assess the ecological and economic losses due to forest fire. Standard reporting protocols, and standard methods for assessing burnt area will also facilitate the creation of a national forest fire information database incorporating field reported data.

II. Activities to be undertaken by FRI, Dehradun

There are many activities which are part of mandate of FRI, those activities will continue to be done by FRI. In view of the expertise the following activities will be done by FRI: -

PRE-FIRE ACTIVITIES

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

To strengthen and manage knowledge with respect to forest fires in India, a web based portal will be developed at the Centre. The online portal will provide scientific information on forest fire management issues, baseline information, scientific publications, other publications for dissemination and awareness creation. It will also provide a dashboard for the forest officers for reporting of management activities undertaken on forest fire with complete loop for reporting forest fire. It will enhance responsiveness through workflows automation and availability of real time information.It will provide a platform for public access and helps for maintaining better transparency and efficiency in the working environment and minimizing the processing delay. Additionally, the web based portal will host training modules and webinars. It will also provide list of different stakeholders such as forest management agencies, NGOs, societies, scientific institutions, forestry resources, and subject experts on forest fire ecology and forest fire management.

B. Development of forest fire knowledge network

The centre will strive to become nodal for **South/ SE Asia and West/ East Africa**. It will act as an umbrella to establish regional forest fire knowledge networks through different/ individual origins and their mandates. It will work on reducing the negative impacts of landscape fires on the environment and humanity. The centre will advance the knowledge and application of the ecologically and environmentally benign role of natural fire in fire-dependent ecosystems, and sustainable application of fire in land-use systems.

The broad structure for executing this activity will be headed by Board of Governors, which will consist of one representative from each of South/ SE Asia and West/East African countries and independent members will be nominated by the chairperson advisory board (DG, ICFRE) in consultation with MoEF&CC based on their recognized professional expertise and experience.

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REGIONAL BOARD MEMBERS		
i.	**Secretary/ DGF&SS, MoEF&CC**	**Overall governance**
ii.	Director General, ICFRE Dehradun	Permanent Members
iii	Director, Forest Research Institute, Dehradun	
iv	DG, Forest Survey of India, Dehradun	
v.	Director, Directorate of Forestry Education, Dehradun	
vi.	Representative from South Asia (6 countries)	Nepal, Bhutan, Sri Lanka, Maldives, Bangladesh, Afghanistan
vii.	Representative from South East Asia (11 countries)	Cambodia, Brunei, Vietnam, Thailand, Indonesia, Laos, Malaysia, Philippines, Singapore, Myanmar, Timor Leste
viii.	Representative from West Africa (14 countries)	Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Niger, Senegal, Togo, Liberia
ix.	Representative from East Africa (19 countries)	Burundi, Botswana, Dijibouti, Ertrea Ethiopia, Kenya, Malawi, Mauritius, Rawanda, Seychelles, Swaziland, Somalia, Madagascar, Mozambique, Sudan, Tanzania, Uganda, Zambia and Zimbabwe
x.	Nominated independent members	National/ International experts

The Centre will work also in close coordination with FRI for developing national forest fire knowledge network.

A national forest fire knowledge network will be established to cover all dimensions of forest fire in the country. Such network will be tuned to the felt need of all stakeholders, including forest fire managers, policy makers and planners, decision makers, community etc.

Necessary steps to be taken in this regard will include -
- ✓ Knowledge scattered in research institutions, universities etc. related to fire management must be compiled and form part of the network.

- ✓ Projects will be sanctioned to universities/research institutesto enrich the forest fire knowledge.

- ✓ Networking of knowledge on all spheres of forest fire management withnational and international organisations.

C. Development of Standard Operating Procedures (SOPs)

The Centre will develop SOPs. Issuing a SOP is a standard management practice and an effective method of communicating the objectives, principles, and actions for FFPM to field staff in the state forest departments. The SOPs also provide a medium for the states to consolidate the various orders, instructions, and letters they have issued from timeto time on different aspects of FFPM. Based on the findings of study and feedback from SFDs. SOPs will be developed for different fire vulnerable landscape.

D. Study on impact of future Climate change scenario on Forest Fire vulnerability

The Regional Climate Projections (RCPs) data released by Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report (AR5) will be used to study the impact of future climate change scenario on forest fire vulnerability. In the future, under a warmer climate, we expect more severe fire weather, more area burned, more ignitions and a longer fire season. Although there will be large spatial and temporal variation in the fire activity response to climate change. This field of research allows us to better understand the interactions and feedbacks between fire, climate, vegetation and humans and to identify vulnerable regions. The projections of fire activity for this century can be used to explore options for mitigation and adaptation.

DURING-FIRE ACTIVITIES

As per the role defined by MoEF&CC in National Action Plan on Forest Fires para 7.2 (iii) The ICFRE should focus on development of user-friendly fire fighting equipment, tools and protective clothing suitable for various regions of the country.

E. Strengthening of SFDs and communities by Fire suppression tools and techniques

Development of protective clothing and equipment and modification of existing hand tools developed by FRI & their improvement

Fire-fighters' personal protective clothing is the only source of protection for fire-fighters during fire-fighting. The protective clothing should provide adequate protection as well as should be comfortable to wear. The protection and comfort requirements are always the contradicting fact in several protective clothing including fire-fighters'. Appropriate material selection, clothing design and final

evaluation of the results play a critical role in predicting the clothing performance and comfort.

Forest Fire Fighting Tools developed by Forest Research Institute, Dehradun which are being used by the frontline staff of various forest departments of the country. Forest departments sent feedback to FRI in difficulties of using the hand tools in the field. Therefore, hand tools will be modified in collaboration with DRDO, IIT and CSIR keeping in view of the comments received from the state forest departments and communities.

POST-FIRE ACTIVITIES

As per the role defined by MoEF&CC in National Action Plan on Forest Fires para 8.1 (ii) MoEF&CC may assign ICFRE the responsibility of developing and standardizing methodologies for assessing losses due to forest fire including loss of intangibles such as ecosystem services & (iii) Based on standardized methodologies, the ICFRE may further standardize protocols for estimating area affected and losses due to forest fire and reporting the same at successive levels.

F. Assessment of damage and economic losses due to forest fire

The forest fire losses (i.e., tangible and intangible) will be identified using Ecosystem Services (ES) framework following the Economics of Ecosystems and Biodiversity Approach of Millennium Ecosystem Assessment (TEEB, 2010*). The forest fire loss estimation is essentially an exercise in estimating the potential damage or losses caused and thus the methodology will consist of collection and use of simple and uniform physical indictors to assess ecosystem services in terms of provisioning (Floral part / timber/ wood, Food, fibre, fuel wood and non-wood products etc. Faunal part /including trade (NWFP), regeneration), Supporting (Soil, Hydrology, erosion, sediment etc. for protection, Faunal Habitat, IUCN – critical biodiversity, Flora, Fauna), Regulating (hydrological regulation, Carbon stock/ and sequestration) and cultural (recreation and ecotourism etc. forest dependency on forest flora, fauna, water and other) for the damage assessment due to forest fire.

G. Post fire restoration and rehabilitation strategy in fire affected areas

Forest restoration is necessary to re-establish structure and function; protect and restore critical habitat, riparian areas, watersheds and many other attributes. Restoration and rehabilitation strategy for different forest types and burnt severity will be developed to recover the burnt area. Silvicultural interventions to be

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*TEEB (2010): The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

developed to restore the area and also reduce erosion by moisture conservation, by growing fire hardy species, reducing fuel load by thinning operations.

H. Community based Forest Fire management

Community based forest fire management approaches can play a significant role in fire management, especially in most parts of the world where human-based ignitions are the primary source of wildfires that affect livelihood, health and security of people. They include planning and supervision of activities, joint action for prescribed fire and fire monitoring and response, applying sanctions, and providing support to individuals to enhance their fire management tasks. Community based Fire management will include activities such as: early warning, detection, mobilization and suppression of unwanted fires; in addition also restoration and rehabilitation of burned areas.

III. Activities to be undertaken by DFE, Dehradun

As per the role defined by MoEF&CC in National Action Plan on Forest Fires para 7.1 (i) A modern and standardized training curriculum should be developed by the SFDs with the guidance of Directorate of Forest Education (DFE). DFE will facilitate the following capacity building activities to disseminate the knowledge available with the Centre to different stakeholders: -

A. Training of trainers (ToTs) and capacity building of forestry personnel, JFMCs, EDCs and other stakeholders (Training in fire suppression, prevention, detection, and post-fire reporting for field staff)

A number of Training of Trainers (ToTs) and training workshops will be organised in consultation with the State Forest Department on various themes related to forest fire for different target groups. The trainings programs will be attended by trainers/mentors/faculty members representing State Forest Training Institutes (SFTIs), NDRF, NIDM, University scientists/ academicians and School Teachers. The Centre will also provide financial support for conducting training programs by the partner organizations besides SFTIs in states. The Centre will develop training modules which will be provided to the participants.

<u>**Thrust Areas for Forest Fire Research: -**</u>

An indicative list of thrust areas for forest fire Research are as given below: -

1.   **Real time Detection and monitoring of Forest Fire**
2.   **Early warning system**
3.   **Forest Fire vulnerability and Climate Change**
4.   **Economic and Ecological impact of Forest Fire**
5.   **Forest fire and biodiversity**
6.   **Forest fire and weed**
7.   **Forest fire and livelihood**
8.   **Post-fire restoration and rehabilitation**
9.   **Training and capacity building**

Apart from the above suggested thrust areas, the Advisory board may recommend any other issue for forest fire Research arising in future.

<u>**Key Institutions for the Collaboration: -**</u>

The Centre will closely work with Forest Survey of India, Dehradun as it is the nodal Institute on Forest Fire monitoring and collection, compilation, storage and dissemination of spatial database on forest firein the country. It also intends to work closely with other subordinate organizations of MoEF&CC, such as, Directorate of Forestry Education, Dehradun and Wildlife Institute of India.

The Centre will also utilize the expertise of national and international Institutes/ Organizations/ Universitiesmentioned in **Annexure-I & II**, which will be associated with the Centre in the form of experts/Working Groups. The members of the Group will act as individual collaborating partners of the Centre and will provide technical guidance.

In addition to the above, the Centre will also work in unison with State Governments, State Forest Departments and their research wings, NGOs/Civil Societies Organizations, Practitioners, Experts, etc. to understand the different perspectives in having different fire management prescriptions in different forest types.

<u>**Modalities of Working and Source of Funding**</u>

The Centre will take up research studies/ invite project proposals in the identified thrust areas. Depending on the thrust area of research, the Centre will identify experts

having adequate experience and expertise in dealing with the research issues and preparation of project document, execution of research work and finalization of report. Outside domain experts/consultants will be engaged as per the standard procedures/guidelines of GOI for the engagement of consultants.The data/ information generated by the Centre will be shared with stakeholders & others, on request, for general purpose.

The research studies will be taken up in project mode primarily depending upon the requirement of the stakeholders/ ministries/departments/organizations. In this regard, the Centre will require basic permanent setup of research labs and other technical infrastructure for which an initial amount will be required. The studies will be undertaken from the funds received under Grant-in-aid from MoEF&CC or through other funding agencies.

PROPOSED LIST OF NATIONAL INSTITUTES/ UNIVERSITIES FOR COLLABORATION WITH CENTRE OF EXCELLENCE ON FOREST FIRE

S. N.	Name & Address	Email
1.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Tal. Dapoli, Dist. Ratnagiri Maharashtra- 415712	**vcdbskkv-mh@gov.in**
2.	Kerala Agricultural University KAU Main Campus P.O., Vellanikkara, Thrissur, Kerala - 680656	**vc@kau.in**
3.	Dr. Panjabrao Deshmukh Krishi Vidyapeeth P.O. Krishi Nagar Akola- 444104 Maharashtra	**vc@pdkv.ac.in**
4.	Tamil Nadu Agricultural University, Lawley Road, Coimbatore- 641003	**tpo@tnau.ac.in**
5.	University of Agricultural Sciences, Dharwad Dharwad- 580005 Karnataka	**vc_uasd@rediffmail.com**
6.	Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan- 173230, Himachal Pradesh	**vcuhf@yspuniversity.ac.in**
7.	H.N.B. Garhwal University Srinagar – 246174 Dist. Garhwal (Uttarakhand)	**hnbguvc@gmail.com**
8.	University of Petroleum and Energy Studies (UPES) Energy Acres, UPES, Bidholi, via, Prem Nagar, Dehradun, Uttarakhand 248007	**chancellor@upes.ac.in**
9.	North Eastern Regional Institute of Science and Technology (NERIST) Nirjuli, Itanagar- 791109 Arunachal Pradesh	director@nerist.ac.in
10.	G.B. Pant National Institute of Himalayan Environment Kosi-Katarmal, Almora- 263643, Uttarakhand	psdir@gbpihed.nic.in
11.	Indian Institute of Science CV Raman Road, Bengaluru, Karnataka 560012	office.director@iisc.ac.in
12.	India Meteorological Department, MausamBhawan, Lodhi Road New Delhi - 110003	m.mohapatra@imd.gov.in
13.	Indian Space Research Organisation Antariksh Bhavan, New BEL Road Bengaluru - 560231	chairman@isro.gov.in
14.	National Institute of Hydrology Roorkee - 247667 Uttarakhand	tyagi.nihr@gov.in
15.	Wildlife Institute of India, Post Box # 18, Chandrabani Dehradun - 248001 Uttarakhand	dwii@wii.gov.in
16.	Centre for Fire, Explosive & Environment Safety (CFEES) DRDO Ministry of Defence Brig. S.K. Mazumdar Marg, Timarpur, Delhi-110054	director@cfees.drdo.in

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Proposal for Establishment of Centre of Excellence on Forest Fire

S. N.	Name & Address	Email
17.	The Institute of Indian Foundrymen 67, Tughlakabad Institutional Area, New Delhi - 110 062	fic@indianfoundry.org
18.	National Institute of Foundry and Forge Technology (NIFFT), Near Kanchnatoli, Hatia, Ranchi (Jharkhand), Pin No - 834 003	director.nifft@gov.in
19.	Indian Institute of Forest Management PO Box 357, Nehru Nagar Bhopal- 462003, Madhya Pradesh	director@iifm.ac.in
20.	Indian Institute of Metals (IIM) "Metal House" Plot 13/4,Block AQ,Sector V, Salt Lake, Kolkata-700091	secretarygeneral.iim@gmail.com
21.	Indian Institute of Technology Roorkee Roorkee, Uttarakhand India - 247667	director@iitr.ac.in
22.	Indian Academy of fire and safety (IAFS) 2nd floor sheo mansion Next SBI bank, opp. Jatra hotel, Sagar Village, Nashik, Maharashtra 422003	info@iafsindia.com
23.	MSME Tool Room (Indo-Danish Tool Room) Ministry of MSME, Govt. of India Society M-4 (Part), Phase VI Tata Kandra Road, Gamharia Jamshedpur 832 108	reach@idtr.gov.in
24.	National Academy of Fire and Safety Engineering (NAFS) NAFS House, P. N. 101, Near Sakkardara Flyover, Reshimbagh Layout, Reshimbagh, Nagpur- 440024 (MH)	info@nafsindia.com
25.	National Disaster Management Authority NDMA Bhawan, A-1, Safdarjung Enclave New Delhi - 110029	secretary@ndma.gov.in
26.	National Institute of Disaster Management, (Ministry of Home Affairs, Government of India), A-wing, 4th floor, NDCC-II Building, Jai Singh Road, New Delhi - 110001	**Already in MoU with FRI**
27.	National Institute of Fire & Safety Engineering (NIFSE) Mecosabagh Methodist Church, Kadbichowk, Mecosabagh, Nagpur-440004	nifsengp@gmail.com

PROPOSED LIST OF INTERNATIONAL INSTITUTES/ UNIVERSITIES FOR COLLABORATION WITH CENTRE OF EXCELLENCE ON FOREST FIRE

S. N.	Name & Address/ Email
1.	**University of British Columbia (UBC)** 2424 Main Mall, Vancouver, BC, V6T 1Z4 Canada Tel: +1 604-822-2807 Fax: +1 604-822-8645 Email: jorma.neuvonen@ubc.ca
2.	**Swedish University of Agricultural Sciences (SLU)** Phone: +46 222 34953, mobile: +46 70 373 43 40 Email: esbjorn.andersson@slu.se
3.	**University of Montana** Office of the President University Hall 109 Missoula, Montana 59812 Phone: (406) 243-2311 Fax: (406) 243-2797 Email:thepresident@umontana.edu
4.	**Korea Forest Service** GOVERNMENT COMPLEX-DAEJEON BLDG. 1, 189 CHEONGSA-RO, SEO-GU, DAEJEON, REPUBLIC OF KOREA Email: globalkfs@korea.kr TEL +82-42-481-4080
5.	**Global fire Monitoring Centre (GFMC)** Fire Ecology Research Group Max Planck Institute for Chemistry and Freiburg University Georges-Köhler-Allee 75 79110 Freiburg Tel: +49-761-808011, Fax: +49-761-808012 Email: fire@fire.uni-freiburg.de
6.	**Fire Centre** Fire Centre Research Hub, The University of Tasmania, Private Bag 55 Hobart TAS 7001, Australia, Email: contact@firecentre.org.au
7.	**United State Forest Service (USFS)** 1 Thomas Circle, NW Suite 400, Washington D.C., 20005, U.S.A. Tel: 1-202-644-4600, Fax:1-202-644-4603 Email: val.mezainis@usda.gov
8.	**Canadian Forest Service** 580 Booth Street Ottawa, Ontario, K1A 0E4 Tel.: (343) 292-8555 beth.macneil2@canada.ca

9.	**The Center for Fire Research and Outreach at Berkeley Forests** 2200 Bancroft Way Berkeley, CA 94720-4204 University of California, Berkeley Email: sstephens@berkeley.edu Tel :(510) 642-7304
10.	**Stanford University** 450 Jane Stanford Way, Building 10 Stanford University Stanford, CA 94305 **Phone:** (650) 723-2481 **Fax:** (650) 725-6847 **Email:** president@stanford.edu

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<table>
<tr><td colspan="12" align="center">ACTION PLAN for Establishment of CoEFF</td></tr>
<tr><td colspan="12">To undertake research, capacity building activities, development of national guidelines for forest fire management, development of the national level awareness campaign on forest fires, a team of scientific and management personnel need to be engaged at the proposed Centre. The overall activities of the Centre will be supervised by the team leader and Director of the Centre (Director, FRI, Dehradun).The Director will be supported by the Coordinator (Head, Silviculture Division) who in turn will be supported by a Scientist (Consultant) - Forest Fire Ecology and management on a full time basis. For the smooth conduct of the activities the proposed Centre will be supported by one Office Manager (Administrative and Finance) and two MTS personnel.</td></tr>
<tr><td colspan="12" align="center">Proposed budget for centre of excellence on Forest Fire (FRI component) (Rupees in Lakhs)</td></tr>
</table>

	Type of Expenses	FY 2021-22		FY 2022-23		FY 2023-24		FY 2024-25		Timeline
		Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	
Establishment Cost of Centre (Basic Infrastructure)										
Scientist/ Forest Officer (Serving/ Retired) @90,000 per month	R	1	0	1	0	1	0	1	0	The total amount of **Rs. 86.4 lakhs** towards salary of Scientist/ Forest Officer/ Office Manager/ MTS will be met from FRI on completion of recruitment & posting of adequate regular manpower at FRI.
Office manager (Administrative and Finance) @40,000 per month (Consolidated)		1	0	1	0	1	0	1	0	
MTS @25,000 per month (Consolidated)		2	0	2	0	2	0	2	0	
Basic Infrastructure (Renovation, Furnishing, Office set-up) at FRI campus	NR	LS	40	LS	5	LS	5	LS	3	
Vehicle		1	18	0	0	0	0	0	0	
Vehicle maintainance	R	0	0	LS	1	LS	1	LS	1.5	
Miscellaneous expenditure	NR	LS	4	LS	2	LS	2	LS	2	
Sub-Total			62		8		8		6.5	84.5
A. Development of National Web Portal for Database Management and Knowledge Dissemination										
Database Manager @50,000+HRA per month	R	1	6.96	1	6.96	1	6.96	1	6.96	1. Three months for development of website homepage. 2. Annual updation with database generation. 3. Maintainance will be continuous.
Maintenance Cost		LS	2	LS	1	LS	1	LS	1	
Web Portal Development	NR	LS	3	LS	0	LS	0	LS	0	
Purchase of Server for Database		LS	8	LS	1	LS	1	LS	1	
Infrastructure Development		LS	5	LS	0.5	LS	0.5	LS	0.5	
Sub-Total			24.96		9.46		9.46		9.46	53.34
B. Development of national forest fire knowledge network										
Project Scientist @78,000+HRA per month		1	10.86	1	10.86	1	10.86	1	10.86	5 years to cover the entire country based on the availabilty of Forest Fire knowledge with the states/ national and international sources like Universities/ Institutes/ NGOs
JRF @35000+ HRA per month		1	4.87	1	4.87	1	4.87	1	4.87	
International Collaboration/ Travel	R	LS	15	LS	20	LS	20	LS	20	
Travel Cost (within country)		LS	5	LS	5	LS	5	LS	5	
Webinar/ Training/ Meeting		2	10	2	10	2	10	2	10	
Special Project Grant	NR	LS	10	LS	10	LS	10	LS	10	
Sub-Total			55.73		60.73		60.73		60.73	237.92
C. Development of Standard Operating Procedures (SOPs)										
Brainstorming meeting/ consultation/ workshop	R	0	0	2	12	2	12	2	12	5 Years to develop SOPs covering the entire landscape in the country
Field visits		LS	10	LS	10	LS	7.5	LS	7.5	
Publication Cost		LS	5	LS	5	LS	5	LS	5	
Sub-Total			15		27		24.5		24.5	91
D. Study on impact of future Climate change scenario on Forest Fire vulnerability										
Project Scientist @78,000+HRA per month		1	10.86	1	10.86	1	10.86	1	10.86	This will be done on annual project basis for fire vulnerable landscapes on pilot basis
JRF @35000+ HRA per month	R	1	4.87	1	4.87	1	4.87	1	4.87	
Publication Cost		LS	5	LS	5	LS	5	LS	5	
Field Visits		LS	10	LS	10	LS	10	LS	10	
Hardware Cost (Workstation, IT equipment)	NR	LS	20	LS	15	LS	10	LS	5	
Software Cost (GIS software)		LS	15	LS	5	LS	2	LS	1	
Sub-Total			65.73		50.73		42.73		36.73	195.92

	Type of Expenses	FY 2021-22		FY 2022-23		FY 2023-24		FY 2024-25		
Proposed budget for centre of excellence on Forest Fire (FRI component) (Rupees in Lakhs)										
		Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Timeline
E. Strengthening of SFDs by Fire suppression tools and techniques										
This activity is being undertaken through AICRP-14 Forest Fire Research and Knowledge Management (2020-25)										
F. Assessment of damage and economic losses due to forest fire										
This activity is being undertaken through AICRP-14 Forest Fire Research and Knowledge Management (2020-25) on pilot basis in 5 forest types and 15 states for 8 parameters only (Timber, Fuelwood, Fodder, NTFP, Biodiversity (floral), Carbon storage. carbon sequestration, soil nutrients)										
G. Post fire restoration and rehabilitation strategy in fire affected areas										
Project Scientist @78,000+HRA per month	R	1	10.86	1	10.86	1	10.86	1	10.86	This will be done on annual project basis in fire affected landscapes on pilot basis
RA @50,000 + HRA per month		1	6.96	1	6.96	1	6.96	1	6.96	
JRF @35000+ HRA per month		1	4.87	1	4.87	1	4.87	1	4.87	
Field Assistant @20.000 per month		2	4.8	2	4.8	2	4.8	2	4.8	
FRE		LS	10	LS	10	LS	10	LS	10	
TRAVEL		LS	15	LS	15	LS	15	LS	15	
Sub-Total			52.49		52.49		52.49		52.49	209.96
Total FRI Component			275.91		208.41		197.91		190.41	872.64
	R		152.91		169.91		167.41		167.91	
	NR		123		38.5		30.5		22.5	
		FY 2021-22		**FY 2022-23**		**FY 2023-24**		**FY 2024-25**		
FY TOTAL		275.91		208.41		197.91		190.41		
Total (A)		**872.64**								
Proposed budget for centre of excellence on Forest Fire DEF component) (Rupees in Lakhs)										
H. CAPACITY BUILDING AND TRAINING										
Training to frontline staff	R	10	20	10	20	10	20	10	20	
Training to ACF/ RFOs	R	3	6.15	3	6.15	3	6.15	3	6.15	
Sub-Total			**26.15**		**26.15**		**26.15**		**26.15**	
Total (B)					**104.6**					

	Type of Expenses	FY 2021-2022		FY 2022-2023		FY 2023-2024		FY 2024-2025		
Proposed budget for centre of excellence on Forest Fire (FSI component) (Rupees in Lakhs)										
		Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Remarks
Manpower										
Project Scientist @ Rs 78,000+HRA per month	R	2	21.72	2	21.72	2	21.72	2	21.72	Technical Manpower will be engaged as per DST guideline approved for FSI
Sr. Project Associate/RA @ Rs 50,000+HRA per month	R	3	20.88	3	20.88	3	20.88	3	20.88	
TA/STA @ Rs 35,000+HRA per month	R	5	24.36	5	24.36	5	24.36	5	24.36	
Infrastructure										
Construction of Forest Fire Monitoring RS/GIS Lab	NR	LS	150	-	-	-	-	-	-	Setting up of lab for forest fire studies
Maintenance of Lab	R	-	-	LS	20	LS	20	LS	20	Maintenance of Lab
Procurement of Hardware, Software, other equipments, etc.	NR	LS	100	-	-	-	-	-	-	Procurement of high end workstations, softwares,servers and AMC, etc.
Maintenance of Hardware, Software and other equipments	R	-	-	LS	10	LS	10	LS	10	AMC of Hardware, Software and other equipments
Novel Studies Procurement of Drones, applications software etc	NR	2	35	-	-	-	-	-	-	Procurement of Drone, Software, etc.
Maintenance of Drone, software etc	R	-	-	LS	5	LS	5	LS	5	AMC of Drone, software etc
Data Acquisition	R	LS	30	LS	25	LS	25	LS	25	Satellite data procurment from NRSC
Special Studies on Forest Fire (lumpsum)	NR	LS	15	LS	15	LS	15	LS	15	Special studies on different aspects of forest fire will be undertaken in collaboration with academic institutions/ research organization such as IIT
Procurement of Vehicle (@ 9 lakh) and maintenance	NR	2	18	-	-	-	-	-	-	Procurement of vehicle for field work including ground truthing
Maintenance of Vehicle	R	-	-	LS	5	LS	5	LS	5	Maintenance of Vehicle

	Type of Expenses	FY 2021-22		FY 2022-23		FY 2023-24		FY 2024-25		Timeline
		Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	
Proposed budget for centre of excellence on Forest Fire (FRI component) (Rupees in Lakhs)										
Miscellaneous (Travel, Ground Truthing, Report Printing, Consultancy fee, honorarium etc.)	R	LS	17	LS	15	LS	15	LS	15	
Contigency Charges (10%)	R		43.196		16.196		16.196		16.196	
Sub-Total	R		157.156		163.156		163.156		163.156	
	NR		318		15		15		15	
FY TOTAL			475.156		178.156		178.156		178.156	
Total (C)						1009.624				
Forest Fire Risk Zonation mapping										
Manpower										
Technical Associate @ 31000+HRA per month	R	8	34.52	8	34.52					Technical Manpower will be engaged as per DST guideline approved for FSI
Procurement of Hardware and Software										
Procurement of one server and seven Workstation & Maintenance	NR	LS	32	LS	2	LS	2			Procurement of high end workstations, remote sensing & GIS Softwares, Satellite and meteorological data & AMC, etc.
Procurement of eight digital image processing/GIS Software licenses & maintenance		LS	80	LS	2	LS	2			
Procurement of satellite data, Meteorological data		LS	5	LS	10	LS	2			
Mobile application development		LS	8	-						
Miscellaneous										
Ground truthing, report printing, honorarium,expert consultation, travel etc.	R	LS	0.5	LS	4	LS	4			
Contingencies charges (10%)	R		16		5.25		1			
Sub-Total	R		51.02		43.77		5			
	NR		125		14		6			
FY TOTAL			176.02		57.77		11			
Total (D)					244.79			TOTAL		
Grand Total (A+B+C+D)	R		387.236		402.986		361.716		357.216	1509.154
	NR		566		67.5		51.5		37.5	722.5
	TOTAL		953.24		470.49		413.22		394.72	2231.654

R= RECURRING, NR= NON RECURRING, LS= LUMPSUM

S. N.	Activity	Financial Requirement (Rs. In Lakhs)				Total
	Abstract of Action Plan					
	FOREST RESEARCH INSTITUTE	FY 2021-22	FY 2022-23	FY 2023-24	FY 2024-25	
1	Establishment Cost of Centre (Basic Infrastructure)	62	8	8	6.5	**84.5**
2	A. Development of National Web Portal for Database Management and Knowledge Dissemination	24.96	9.46	9.46	9.46	**53.34**
3	B. Development of national forest fire knowledge network	55.73	60.73	60.73	60.73	**237.92**
4	C. Development of Standard Operating Procedures (SOPs)	15	27	24.5	24.5	**91**
5	D. Study on impact of future Climate change scenario on Forest Fire vulnerability	65.73	50.73	42.73	36.73	**195.92**
6	E. Strengthening of SFDs and communities by Fire suppression tools and techniques	This activity is being undertaken through AICRP-14 Forest Fire Research and Knowledge Management (2020-25)				
7	F. Assessment of damage and economic losses due to forest fire	This activity is being undertaken through AICRP-14 Forest Fire Research and Knowledge Management (2020-25) on pilot basis in 5 forest types and 15 states for 8 parameters only (Timber, Fuelwood, Fodder, NTFP, Biodiversity (floral), Carbon storage. carbon sequestration, soil nutrients)				
8	G. Post fire restoration and rehabilitation strategy in fire affected areas	52.49	52.49	52.49	52.49	**209.96**
9	H. Community based Forest Fire management	NIL	NIL	NIL	NIL	
	TOTAL (FRI COMPONENT)	**275.91**	**208.41**	**197.91**	**190.41**	**872.64**

438546/2021/FP

S. N.	Activity	Financial Requirement (Rs. In Lakhs)				Total
	DIRECTORATE OF FORESTRY EDUCATION	FY 2021-22	FY 2022-23	FY 2023-24	FY 2024-25	
10	A. Training of trainers (ToTs) and capacity building of forestry personnel, JFMCs, EDCs and other stakeholders (Training in fire suppression, prevention, detection, and post-fire reporting for field staff)	26.15	26.15	26.15	26.15	**104.6**
	TOTAL (DFE COMPONENT)	**26.15**	**26.15**	**26.15**	**26.15**	**104.6**
	FOREST SURVEY OF INDIA					
11	Establishment of lab	150	20	20	20	**210**
12	Procurement of hardware, software and other equipment	100	10	10	10	**130**
13	Novel studies, data acquisition and special studies	80	45	45	45	**215**
14	Procurement and maintenance of vehicle, HR support	84.96	71.96	71.96	71.96	**300.84**
15	Travel, GT, Report printing and contingency charges	60.196	31.196	31.196	31.196	**153.784**
	Sub-Total	**475.156**	**178.156**	**178.156**	**178.156**	**1009.624**
16	Forest Fire Risk Zonation Mapping	176.02	57.77	11	NIL	**244.79**
	TOTAL (FSI COMPONENT)	**651.176**	**235.926**	**189.156**	**178.156**	**1254.414**
	GRAND TOTAL (FRI, DFE, FSI)	*953.236*	*470.486*	*413.216*	*394.716*	*2231.654*