

FOREST –FIRES– IN INDIA


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–FIRES–
IN INDIA

© Forest Research Institute

Published by

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CONTENTS

Forest Fire 01

Forest Fire & Forest Health 04

Types of Forest Fire 06

Causes of Forest Fire 09

Damage & Benefits of Forest Fire 12

Forest Fire Statistics in India (2001-2016) 15

Forest Fire Prevention & Management in India 23

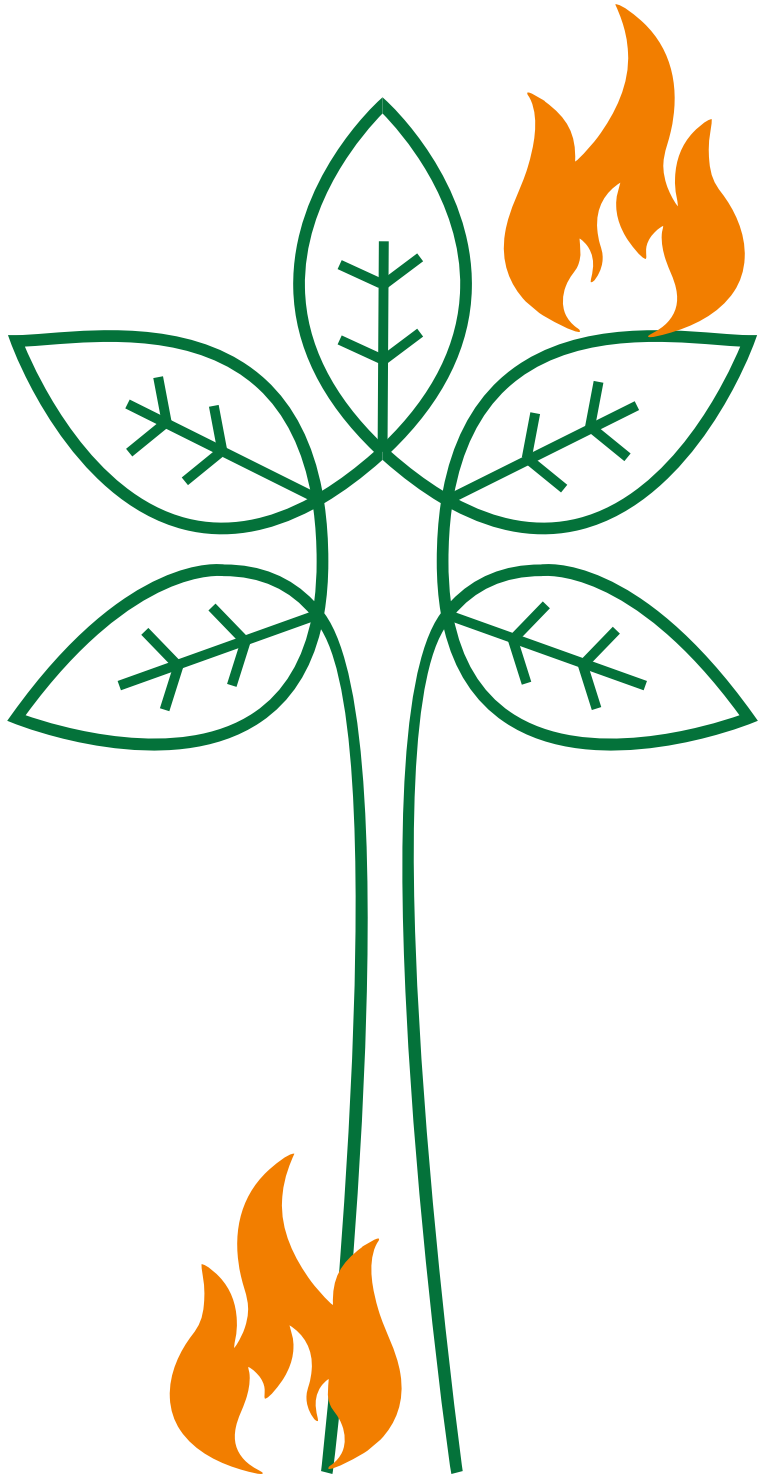
Fire Fighting Tools and Equipments 31

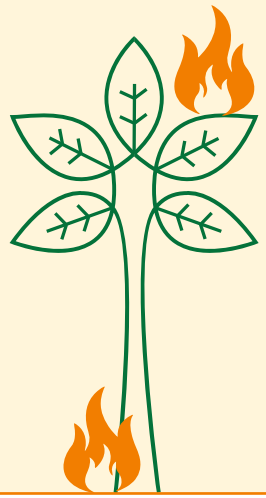
Modern Tools and Equipments 37

Fire Safety Equipments 42

Legal Provisions of Forest Fire 50

Glossary of Common Terms 52





1

FOREST FIRE

A forest fire is an uncontrolled fire occurring in nature. Forest fires are a challenge across many countries and also a ubiquitous feature of India's forest landscape. Globally forest fire has been recognized as major driver of degradation of forests. Forest fires are considered to be a potential hazard with physical, biological, ecological and environmental consequences. In India, forests fires are the most significant and steadily increasing factor in the degradation process, although the extent of total damage is widely disputed. However, it is estimated that the proportion of forest areas prone to fire annually ranges from 33% in some states to over 90% in others. The Forest Survey of India (FSI) estimated that about 50% of the forest area of the country is fire prone. It is estimated that about 3.73 million ha. of forest area is annually affected by forest fires where very heavy, heavy and frequent forest fire damages are noticed over 0.87%, 0.14% and 5.16% of forest areas, respectively.

Fire is one of nature's oldest phenomena, probably developing simultaneously with terrestrial vegetation and the evolution of the atmosphere. Fire is a vital and natural part of the functioning of numerous forest ecosystems. Human have used fire for thousands of years as a land management tool. However, in the latter part of the twentieth century, changes in the human fire dynamics and an increase in El Nino frequency have led to a situation where fires are now a major threat to many forests and the biodiversity therein. Tropical rain forests and cloud forests, which typically do not burn on a large scale, were devastated by wildfires during the 1980s & 1990s.

Technically, fire is defined as the rapid combustion of fuel, heat and oxygen. All these three elements are in some proportion to start and spread fire. It is a chemical reaction of any substance that will ignite and burn to release a lot of energy in the form of heat and light. Fire is a chemical reaction, called combustion. This involves the rapid oxidation of combustible materials-any substance which will ignite and burn-accompanied by a release of energy in the form of heat and light. An external source of heat generally is needed to start a fire.

The three-sided fire triangle below shows that oxygen, heat and fuel in the proper proportions are necessary to create a fire. If any one of these three elements is removed, a fire cannot exist. Air supporting a fire must be at least 16 % oxygen. The air that surrounds us contains about 21 % oxygen. Heat and temperature are closely related. Heat is a type of energy in disorder, whereas temperature is a measure of the degree of that disorder. The final component of the fire triangle is fuel. Fuel is considered any material capable of burning. This would include living vegetation, branches, needles, standing dead snags, leaves, human-built wooden structures, etc.



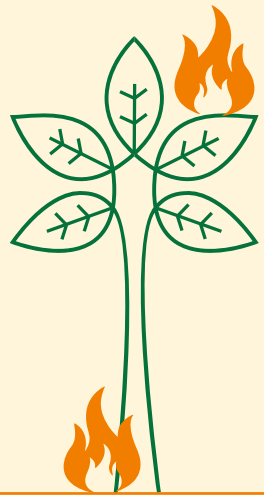
Forest fires have been identified as accidental disasters which are largely man-made. It is one of the most common disasters which recurrently occur throughout the spatial coverage of forests in the country. The forest fire phenomena are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime of flora and fauna seriously disturbing the biodiversity, ecosystem services and the ecology and environment of the region.



Broadly, four forest fire clusters have been recognized in India. These are: (a) North-Western Himalayas, (b) North-East India, (c) Central India, and (d) Western Ghats and Eastern Ghats. Forest fires in the North-Western Himalayas are primarily due to the preponderance of pine forests and accumulation of thick flammable litter. Traditionally, graziers follow transhumance and they often lit forest fires for promoting new flush of grass. The Himalayan forests, particularly in Uttarakhand and Himachal Pradesh are highly prone to forest fires in summer months due to accumulation of large quantity of pine needles on the forest floor which are very vulnerable to fire. Majority forests in the North-East India are community owned and traditionally, local communities have been practicing slash and burn or shifting cultivation causing wide spread annual forest fires. Extensive forest tracts dominated by dry deciduous and moist deciduous Teak and Sal forests in central India get annually burned owing to use of fire for promoting collection of non-timber forest produces. In spite longer wet season and higher moisture regime, moist deciduous forests and semi-evergreen forests in Western Ghats and Eastern Ghats get burned frequently due to various biotic activities. Most forest fires in India are low-intensity surface fires, although crown fires do occur in the mountain pine forests. Country wide, the menace of forest fires has been aggravating with rising human and cattle populations and the consequent increase in demand for forest produces by individuals and communities. Rugged terrain, inaccessibility, and thinly stretched resources compound the challenge of preventing and managing fires in the hill regions such as in the western Himalaya and the Northeast.

2

FOREST FIRE & FOREST HEALTH



"Fire is a good servant but a bad master" the saying is true for forest fire too. Limited and controlled forest fires have been very useful and essential for healthy forest growth. But uncontrolled forest fire may engulf and destroy healthy thick forest cover within no time. Besides direct loss to forest cover, forest fire also kills wildlife, damages environment, degrade soil quality and retrogrades forest regeneration. Fires remove dead trees and litter from the forest floor. Shrubs and trees invading grasslands also are killed by fires. In each example, new healthy re-growth occurs. Fire does not imply death, but rather change. As fire was associated with rebirth and renewal in mythology, so fire is now recognized as an instrument of change and a catalyst for promoting biological diversity and healthy ecosystems. People often mistakenly consider all fires to be negative and destructive forces. However, properly managed, fire can be an effective natural resource management tool. Initially, lightning was the spark that ignited fires. Later, once human learned to initiate fire, its occurrence became much more widespread. As many as 95 % of forest fires in India are caused by humans. Some human-caused fires result from campfires left unattended, the burning of debris, negligently discarded cigarettes and intentional acts of arson. The remaining 5 % are started by stone rolling, bamboo rubbing or lightning. As fire destroys the greenery of the forest, it destroys its recreational and aesthetic value. Forest no longer remains a fit place for recreation, as the ground is littered with ash and blackened stems of shrubs and poles of trees making the entire place desolate. Fire reduces the moisture level and leads to ecological degradation of the site.

The current pattern of fire is no longer beneficial to forest health, yet the extent to which fires are having a long-term impact on India's forest ecology and its wider economy are still poorly understood. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During water stressed months of summer, the forests accumulate or built huge amount of fuel in the form of forest litter comprising of dry senescent leaves, branches, twigs, shrubs and grasses, which is most vulnerable to fire and can cause a devastating flame ignited by the slightest spark. The Himalayan forests, particularly, Garhwal Himalayas have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region. Forest fire causes imbalances in nature and endangers biodiversity by reducing faunal and floral wealth.

The ecological impacts of forest fires are specific to the different types of forests, situated in different climates and geographies, and subject to other disturbances, particularly from people. Forests that are affected by fire may also be affected by agriculture, grazing, harvesting fuel-wood and other NTFPs, encroachment or fragmentation from road building and construction, illicit felling, invasive species, and numerous other pressures. The ability of forests to withstand and recover from fires will depend largely on how these other pressures are managed. However, there is a limited literature on impacts of forest fire.

The available scientific evidence supports that fires are having a degrading effect on India's forests. Repeated fires in short succession are reducing species richness and harming natural regeneration, in combination with other pressures such as intense grazing and browsing. In some forests, fire may be used in a controlled way to manage fuel loads, check invasive weeds, and eliminate pathogens. In other forests that are less adapted to fire, it should be excluded. Reductions in biomass, species diversity, and natural regeneration due to fire may pose a risk to policy goals for enhancing India's forest carbon sinks.

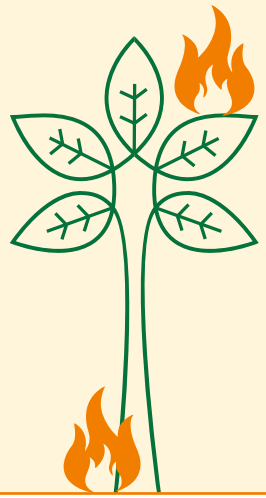
There is no scientific method to assess the loss caused by forest fire. In most cases, it is limited to the loss of timber / wood, if any, which is very low compared to the actual loss. Method to assess loss in terms of damage to other vegetation, soil, micro flora / fauna, loss of habitat, impact on ecosystem services etc. to be developed and then put to use. Reporting the actual loss through such an assessment will convey the seriousness of the issue to all concerned and will immediately stir the system to quick response.

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. Forest clearing and persistent changes in vegetation composition and structure after a fire may result in net emissions. However, 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 has not considered the impact on regeneration.



3

TYPES OF FOREST FIRE



Forest fire can broadly be classified into three categories;

- Natural or controlled forest fire.
- Forest fires caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect) and
- Forest fires purposely caused by local inhabitants.

There are three types of forest fire i) Surface Fire ii) Ground Fire and iii) Crown Fire.

3.1

Surface fire

which spread with a flaming front and burn leaf litter, fallen branches and other fuels located at ground level.

3.2

Ground fire

which burn organic matter in the soil beneath surface litter and are sustained by glowing combustion.

3.3

Crown fire

which burn through the top layer of foliage on a tree, known as the canopy or crown fires. Crown fires, the most intense type of fire and often the most difficult to contain, need strong winds, steep slopes and a heavy fuel load to continue burning.

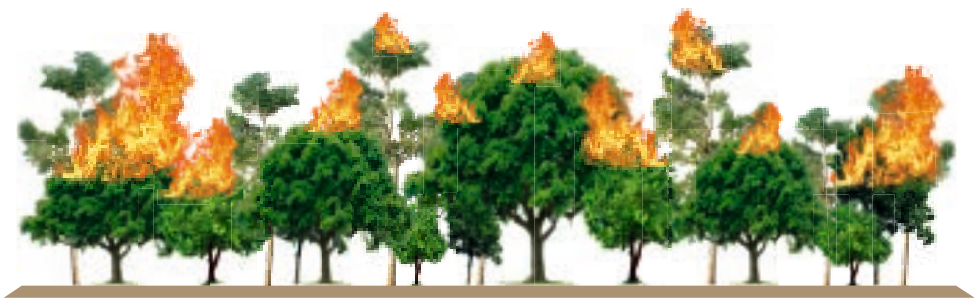
TYPES OF FOREST FIRE



SURFACE FIRE



GROUND FIRE



CROWN FIRE

There are two main kinds of forest fires, ground fires and canopy fires. In a ground fire the burn stays down near the ground, burning underbrush and smaller trees. It leaves the soil in good condition. Canopy fires burn the entire forest including the tops of big trees. They burn so hot that they sterilize everything both above the ground and down perhaps a foot into the soil.

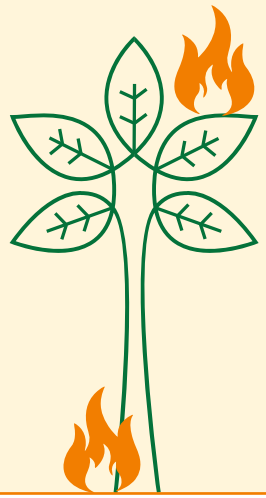
Canopy fires also send out balls of superheated gases that can jump half a mile as a cloud of smoke and then burst into flame when they get to oxygen. These fireballs ignite new patches of forest. They can trap fire fighters between two walls of flame.

When the fuel load is high and the weather is supporting it, nothing in the path of a canopy fire can be saved except by running away or a change in the weather. There must be a better way to manage our forests than to set up the conditions for canopy fires. To prevent catastrophic canopy fires, overcrowded forests with excessive understory fuel loads need to be thinned. The understory needs to be cleared out.

Controlled burning is any fire intentionally ignited to meet specific land management objectives, such as to reduce flammable fuels, restore ecosystem health, recycle nutrients, or prepare an area for new trees or vegetation. Controlled burning is a management tool that when used under specifically controlled conditions will help land stewards manages forests and rangelands for multiple uses.

Ground fires and surface fires can be managed by controlled burning of fuel load before the onset of fire season.





4

CAUSES OF FOREST FIRE

4.1

Forest fires are caused by Natural causes as well as Man - made causes

- **Natural causes**- Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.
- **Man made causes**- Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material.

Traditionally Indian forests have been affected by fires. The menace has been aggravated with rising human and cattle population and the consequent increase in demand for Forest products by individuals and communities.

Causes of forest fires can be divided into two broad categories: environmental (which are beyond control) and human related (which are controllable).

Fire is influenced by many factors, like geography, climate, weather, and topography.

4.1.1

Fire season

The time of year influences the effects of fire. The normal fire season in India is from the month of February to mid June. In the plains of northern and central India, most of the forest fires occur between February and June. In the hills of northern India fire season starts later and most of the fires are reported between April and June. In the southern part of the country, fire season extends from January to May. In the Himalayan region, fires are common in May and June. During some seasons, more moisture is present than in other seasons, thus reducing fire threat, this varies by geographic region. India witnessed the most severe forest fires in the recent time during the summer of 2016 in the hills of Uttarakhand and Himachal Pradesh. The fires were very severe and attracted the attention of whole nation.

4.1.2

Fuel

A fuel's composition, including moisture level, chemical makeup and density, determines its degree of flammability. Moisture level is the most important consideration. Live trees usually contain a great deal of moisture while dead logs contain very little. The moisture content and distribution of these fuels define how quickly a fire can spread and how intense or hot a fire may become. High moisture content will slow the burning process since heat from the fire must first eliminate moisture.

In addition to moisture, a fuel's chemical makeup determines how readily it will burn. Some plants, shrubs and trees contain oils or resins that promote combustion, causing them to burn more easily, quickly or intensely than those without such oils for example in Himalayas pine trees have resin canals, which makes the forest highly vulnerable to fire. Finally, density of a fuel influences its flammability. If fuel particles are close together, they will ignite each other, causing the fuel to burn readily. But, if fuel particles are so close that air cannot circulate easily, the fuel will not burn freely.

Soil types also must be considered because fire affects the environment above and below the surface. Soil moisture content, the amount of organic matter present and the duration of the fire determine to what extent soil will be affected by fire.

4.1.3

Weather

Weather conditions such as wind, temperature and humidity also contribute to fire behavior. Wind is one of the most important factors because it can bring a fresh supply of oxygen to the fire as well as push the fire toward a new fuel source.

Temperature of fuels is determined by the ambient temperature since fuels attain their heat by absorbing surrounding solar radiation. The temperature of a fuel influences its susceptibility to ignition. In general, fuels will ignite more readily at high temperatures than at low temperatures.

Humidity, the amount of water vapour in the air, affects the moisture level of a fuel. At low humidity levels, fuels become dry and, therefore, catch fire more easily and burn more quickly than when humidity levels are high.

4.2

Forest fires are also result from a combination of natural and social factors. The forest fire triangle in figure 4.2.1 illustrates how these factors are interrelated. As shown by the triangle, topography, weather, and fuel-the corners of the triangle-influence the potential for intensive fire behavior and spread. At the center of the triangle are people.



As in other parts of the world, people are the main driver of fires in India. Population pressures, current and historic land management practices, demand for forest resources, the use of fire as a tool, negligence, and anthropogenic climate change all influence the other elements in the triangle and shape the forest fire regime today.

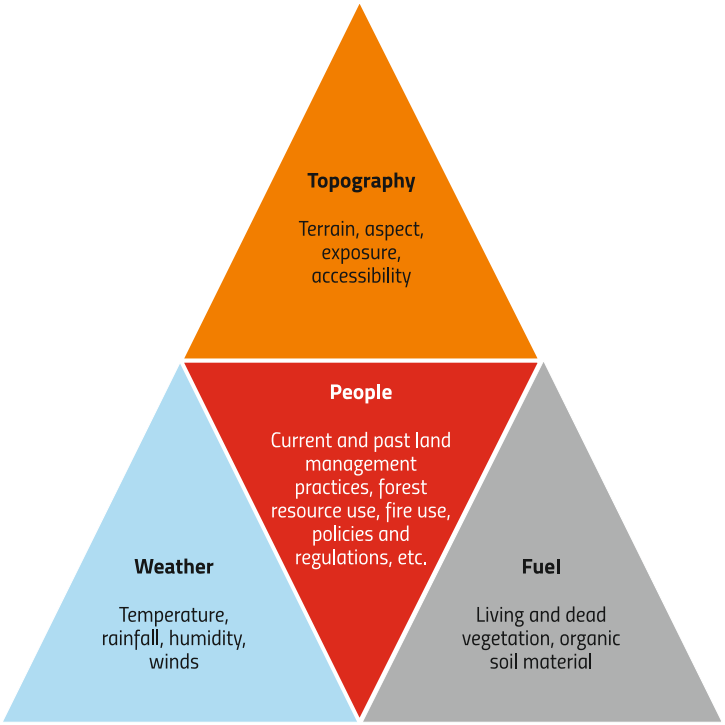
Another cause of forest fires was burning to deter wildlife. To keep away wild boars, birds, and leopards, people burn pine needles, cones, weeds, and so on during the dry season. Households grazing their livestock in the forests may also burn away undergrowth and forest litter to remove cover for wild animals that might threaten their herds.

Some invasive species in India's forests are fire-assisted. Forest fragmentation, coupled with intensified anthropogenic disturbances-especially fires-have resulted in degradation of ecosystems, making them more vulnerable to invasion by

alien species; some invasive species (e.g., lantana), in turn, fuel further fires.

In North-Eastern India, the shortening of fire-associated jhum cycles has also had a detrimental effect on soil fertility. Shorter jhum cycles reduce fallow biomass available for burning and gives soil fertility less time to recover, resulting in lower economic yields and efficiency.

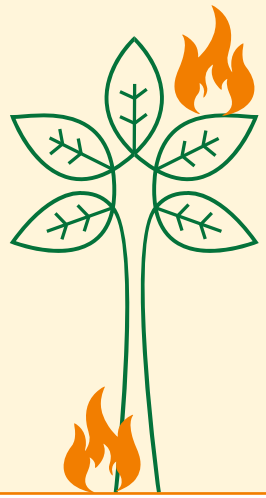
Figure 4.2.1: The Wildfire Triangle



Source: Authors, adapted from Roy (2004) and Schnepf et al (2010)

5

DAMAGE & BENEFITS OF FOREST FIRE



5.1

Damages

Forest fire destroys all life forms at different levels of organization for examples ground fire destroys the organic matter which is needed to maintain an optimum level of humus in the soil, saplings and seedlings gets completely destroys hence impacting regeneration process and severe fire sometimes destroys ladder fuel as well as crown of fully grown tree species. Several million hectares of forest land are burnt worldwide annually which is having varied impact on countries economics, environment, safety, human health and wildlife. It has also become a common feature in the Indian forest every year, causing immeasurable damage to the forest wealth and ecosystem. The major change in the microclimate of the region in term of soil moisture balance and increased evaporation is also attributed to the fire. It ordinarily upset natural cycles, destroyed native plant communities, and encouraged the growth of fire intolerant vegetation and non native weeds. It generates ash, destroy available organic nutrients, and cause an increase in water run-off, eroding other nutrients.

5.1.1

Damages to the Tree

- Damage caused to the trees varies with species, age of trees, their condition and season.
- Species, which have thick corky bark, are comparatively less affected by forest fires than the species with thin bark.
- The board-leaved trees are less affected by forest fires than the conifers, though Chir on account of its thick bark is comparatively hardy.
- The age of the trees also affects the damage due to fire. Pole crops get damaged because of fire but the bigger diameter trees are relatively less affected.

- If the tree is very old dry and hollow, then it becomes more susceptible to fire, because once it catches fire, it burns very fast and for long.
- If the tree is very green it is less susceptible to fire than the dry tree.
- Season also affects the damage by fire. Fires generally do not occur during rainy season. During the cold season fire does not occur in snow-covered areas.
- Resin tapping procedures affect the occurrence of fire. Chir forests become more prone to fire in resin tapping season.
- Fires in summers are common as well as destructive because of high temperature, strong wind, dry undergrowth and ground cover and thick layer of dry fallen leaves.



5.1.2

Damage to Regeneration

- Fire damages the regeneration completely, even in ordinary ground or surface fire.
- If the species possesses coppicing power, regeneration in the form of seedling coppice may appear again but even then, loss of growth does take place.
- In repeated fires regeneration may be lost completely.
- Fire in artificial regeneration areas or plantations, not only destroys the plantations but also results in wastage of resources used in raising them.

5.1.3

Damage to Soil

- Forest fires leaves the soils bare to the action of natural elements i.e. sun, wind and rain; consequently soil erosion starts, resulting in loss of top fertile soil.
- Destruction of soil organic matter affects the soil structure adversely. Nitrogen reserves of the soil are depleted.
- Fire also destroys humus and soil micro-flora, which in turn affects the forest growth.

5.1.4

Damage to the Productive power of the Forests

- Repeated fires degenerate a valuable evergreen forests into an inferior deciduous forest or even grassland.
- Valuable species disappear and their place is taken by other fire hardy species.

5.1.5

Damage to the protective power of the Forest

- Even ordinary fire burns down the ground cover and undergrowth completely and therefore affects the protective power of the forest.
- Fire increases the flood havoc as it destroys the protective cover of the forest. Heavy rains on newly denuded slopes results into devastating floods.

5.1.6

Damage to Wild animals

- Forest fire results into enormous loss to wildlife and birds. Not only eggs and young ones, but sometimes bigger animals are also burnt to death.
- Forest fires cause loss of habitat for the wild fauna making them susceptible to death due to poaching, adverse weather conditions or killing by predator species.

- As destruction of wild animals destroys a valuable component of environment, natural equilibrium is seriously affected with consequent adverse effect on vegetation itself.

- **The Bandipur forest fire destroyed more than thousand hectares of the forest, also, claiming the life of a forest guard and injuring four others. It had spread through most of the north-western part of the reserve, also posing danger to the adjoining Wayanad Wildlife Sanctuary in Kerala.**
- **2016 year's dreadful and destructive forest fire of Uttarakhand burnt down more than 4,000 hectares of forest and claimed seven lives. The fire was finally doused using IAF helicopter fitted with Bambi buckets. This brings us to one of the most alarming challenges of our times-forest fires. According to a report by Parliamentary Standing Committee on Science and Technology, India, the country has seen a 55% rise in the number of forest fires as on December 2016.**

5.2

Benefits

Forest fires are as old the forests themselves and are mostly good for the ecology as well as for regeneration. They are a driving factor in shaping forest vegetation and landscape in many parts of India. Fire has been a part of India's landscape since time immemorial and can play a vital role in healthy forests. Many of India's forests have evolved with fire and rely on fire to regenerate. Occasional fires can also keep down fuel loads that feed larger, more destructive conflagrations. Forest fires, often, helping the forests to get rid of its natural wastes like dry grass, tree needles, and thick bushes. Today, however, large areas of degraded forest are subject to burning on an annual or even semi-annual basis.

Among the other benefits of prescribed burning are:

- Insect pest control.
- Removal of exotic, or non-native, species that compete with native species for nutrients and other needs.
- Addition of nutrients for trees and other vegetation provided by ashes that remain after a fire.
- Removal of undergrowth, thereby allowing sunlight to reach the forest floor to encourage growth of native species.
- Encourage the growth of fire-dependent species.



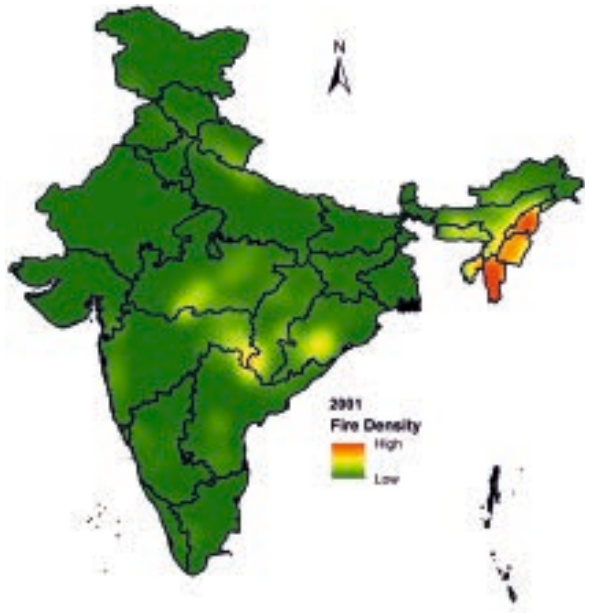
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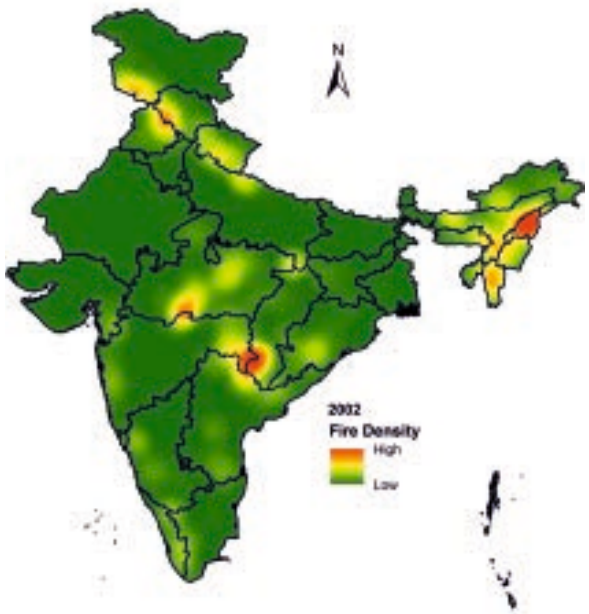
FOREST FIRE STATISTICS IN INDIA (2001-2016)

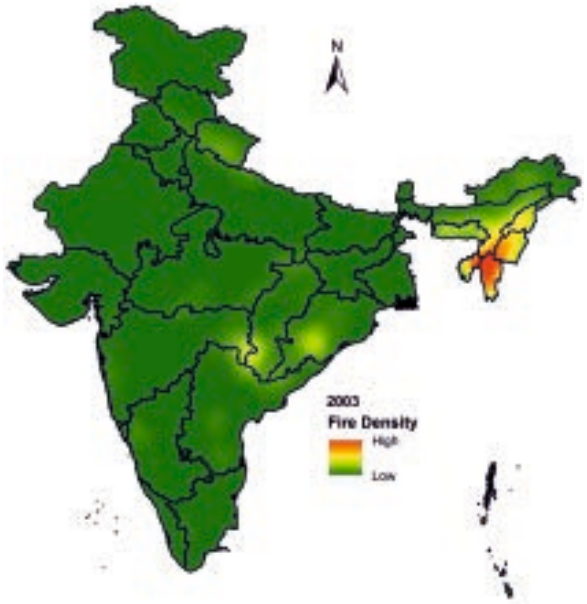
Each year, fires affect forests across much of India. According to satellite detections of forest fires by the Moderate Resolution Imaging Spectrometer (MODIS), from 2003 to 2016 as few as 380 and as many as 445 of the country's 647 districts experienced fires each year (that is at least in 59%, but as many as 69% of districts). The following Forest Fire Statistics in India (2001-2016) has been generated from MODIS data.

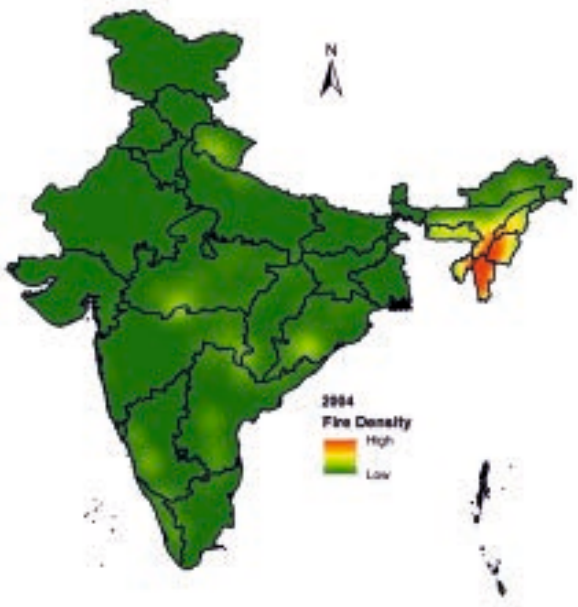
6.1

Forest Fire Density Map of India (2001-2016)

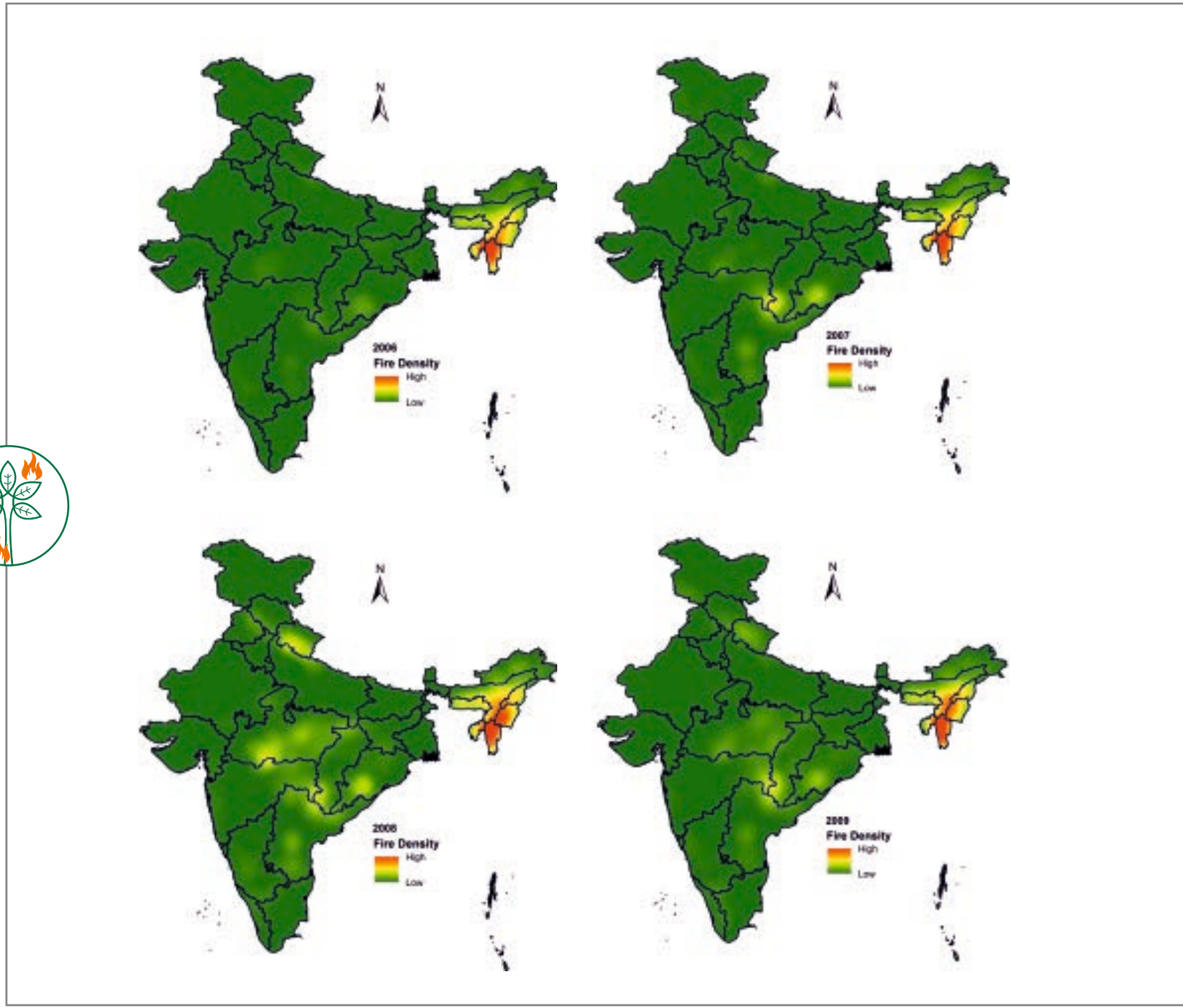


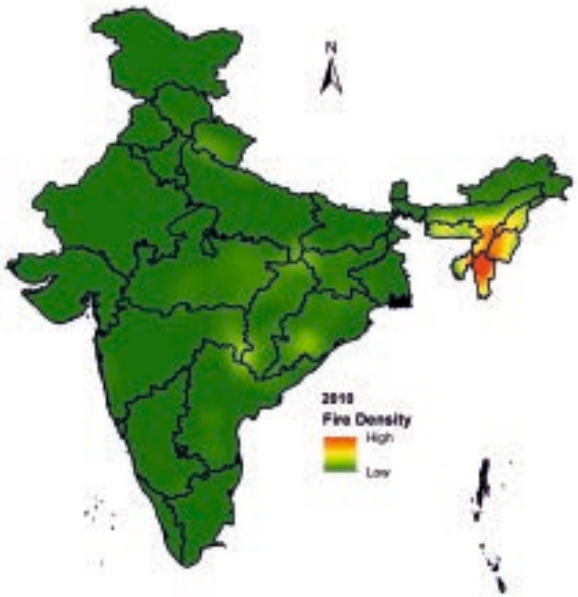

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2002
Fire Density
High
Low

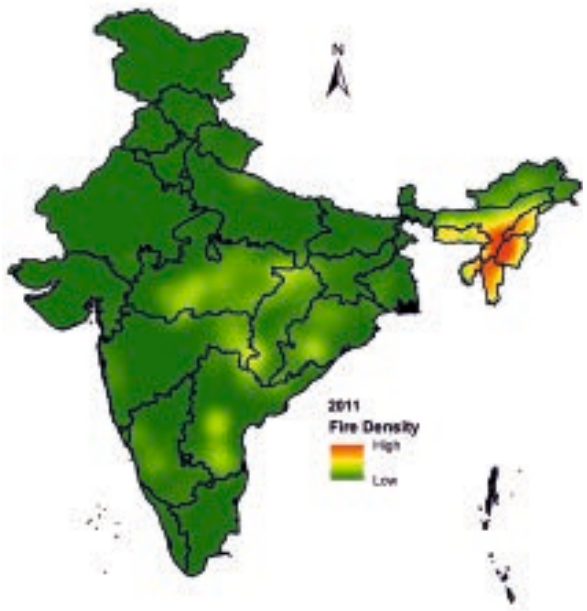

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2003
Fire Density
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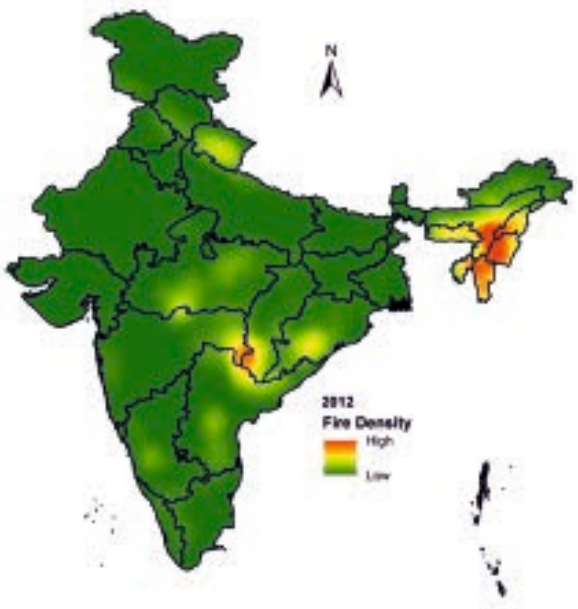

N
2004
Fire Density
High
Low

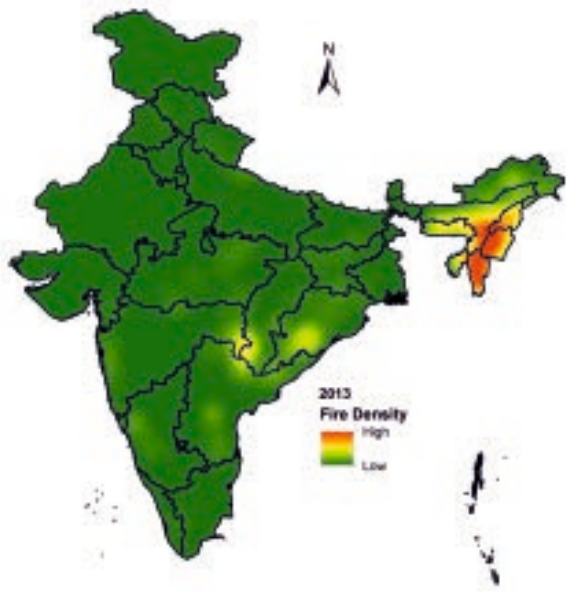

N
2005
Fire Density
High
Low

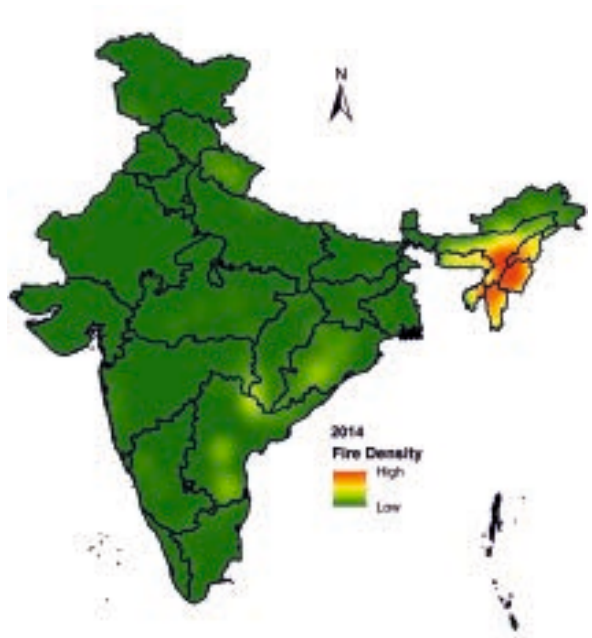

N
2006
Fire Density
High
Low
N
2007
Fire Density
High
Low
N
2008
Fire Density
High
Low
N
2009
Fire Density
High
Low

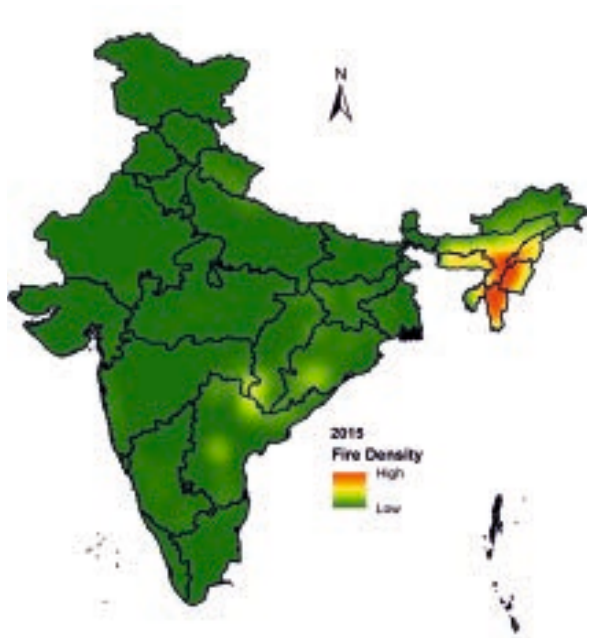

N
2010
Fire Density
High
Low

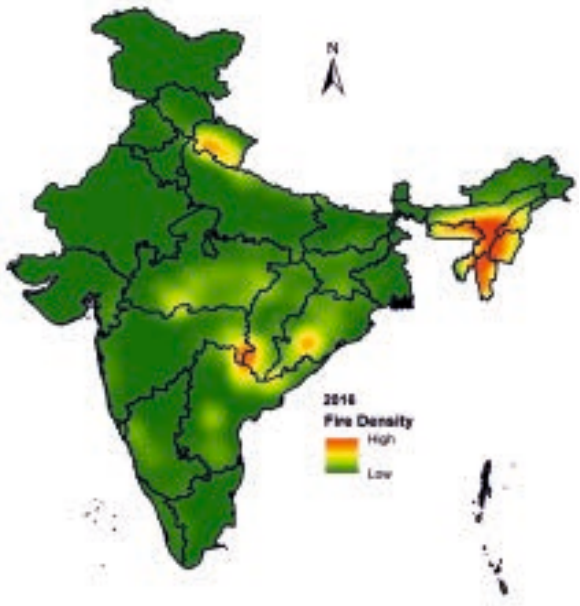

N
2011
Fire Density
High
Low


N
2012
Fire Density
High
Low


N
2013
Fire Density
High
Low

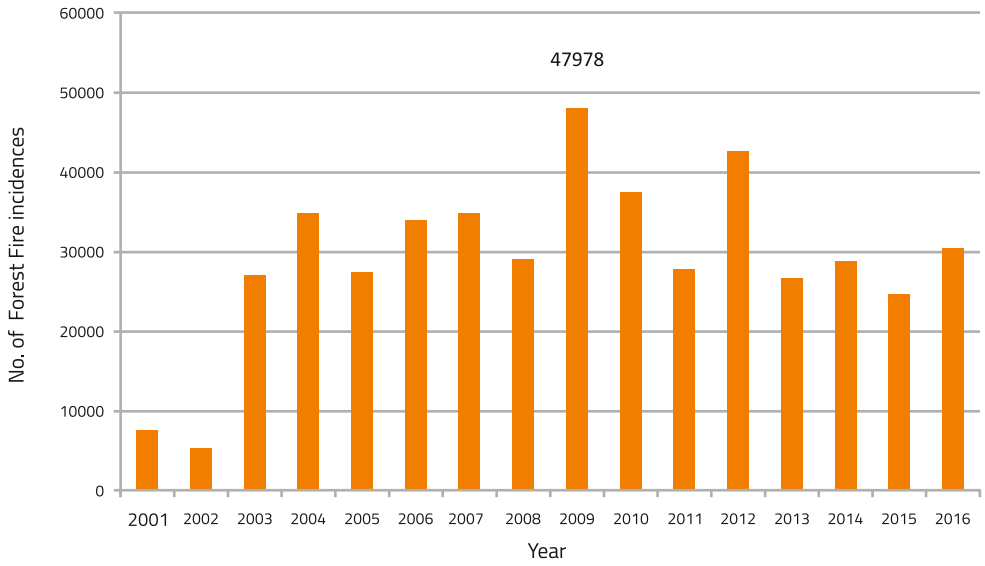

N
2014
Fire Density
High
Low


N
2015
Fire Density
High
Low


N
2016
Fire Density
High
Low

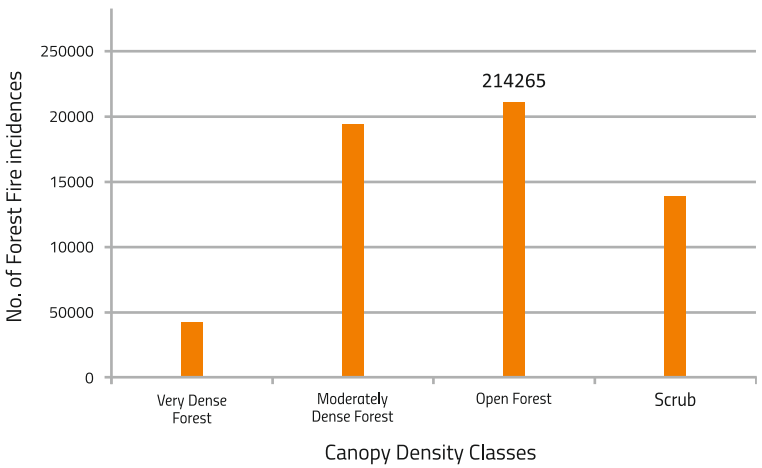
6.2

Annual Trend of Forest Fire Incidences in India (2001-2016)



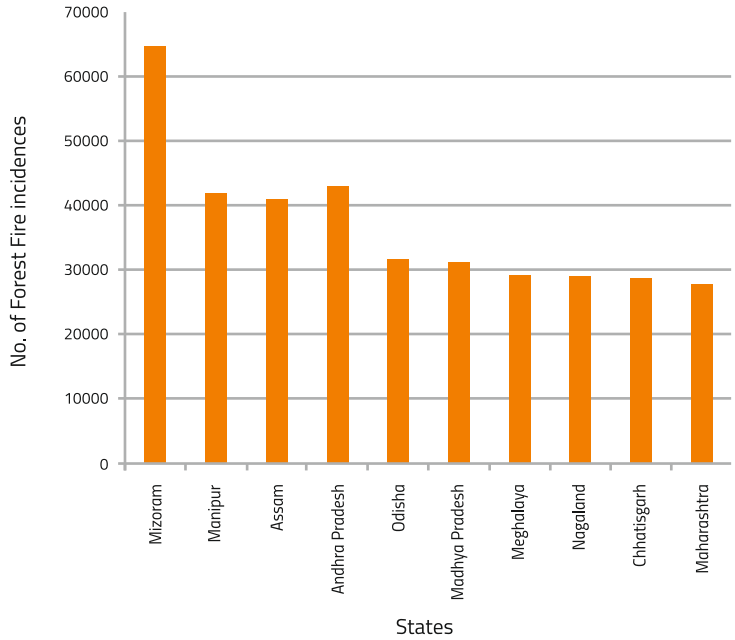
6.3

Number of Forest Fire Incidences in Different Canopy Density Classes (2001-2016)



6.4

Number of Forest Fire Incidences in Top Ten Fire Impacted States of India (2001-2016)





6.5

Peak Fire Occurrence Season in different states of the country

State/U.T.	Months of Occurrence											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Assam	×	✓✓	✓✓	✓✓	×	×	×	×	×	×	×	✓
Andaman & Nicobar Islands	✓✓	✓✓	✓✓	✓	✓	×	×	×	×	×	×	✓
Andhra Pradesh	×	✓	✓✓	✓✓	✓✓	✓	×	×	×	×	×	×
Bihar	×	✓	✓✓	✓✓	✓	×	×	×	×	×	×	×
Dadra & Nagarhaveli	✓	✓	✓✓	✓✓	✓✓	✓	×	×	×	×	×	×
Gujarat	✓	✓	✓✓	✓✓	✓✓	✓✓	×	×	×	×	×	×
Goa	×	✓	✓✓	✓✓	✓✓	×	×	×	×	×	×	×
Daman & Diu	×	✓	✓✓	✓✓	✓✓	×	×	×	×	×	×	×
Haryana	✓	✓	✓	✓✓	✓✓	✓✓	×	×	×	×	×	×
Himachal Pradesh	✓	✓	✓	✓✓	✓✓	✓✓	×	×	×	✓	✓	✓
Karnataka	✓	✓	✓✓	✓✓	✓	✓	×	×	×	×	✓	✓
Kerala	✓	✓	✓✓	✓✓	✓✓	✓✓	×	×	×	×	×	✓
Maharashtra	×	✓	✓✓	✓✓	✓✓	×✓	×	×	×	✓	✓	×
Madhya Pradesh	✓	✓	✓✓	✓✓	✓✓	×	×	×	×	✓	✓	✓
Nagaland	×	✓	✓✓	✓	×	×	×	×	×	×	×	×
Punjab	×	✓	✓✓	✓✓	✓✓	✓✓	×	×	×	×	×	×
Rajasthan	✓	✓	✓✓	✓✓	✓✓	✓	×	×	×	×	×	×
Sikkim	✓	✓	✓✓	✓✓	✓	×	×	×	×	×	×	
Tamil Nadu	✓	✓✓	✓✓	✓✓	✓✓	✓	×	×	×	×	×	✓
Uttar Pradesh	✓	✓✓	✓✓	✓✓	✓✓	✓	×	×	×	×	×	✓
Uttarakhand	✓	✓✓	✓✓	✓✓	✓✓	✓	×	×	×	×	×	✓

✓✓ Peak fire Season

✓ Additional months of Fire occurrence

× No fire





7

FOREST FIRE PREVENTION & MANAGEMENT IN INDIA

- Fire prevention, detection and suppression activities are state subjects. The Central Government has been formulating policy, planning and financing the states from time to time. Forest Protection Division of Ministry of Forests headed by DIG of Forests is responsible for the forest fire management at the central level.
- In India, Joint Forest Management (JFM) Committees have been established at the village level to involve local people in forest protection and conservation.
- The Government of India has issued national forest fire prevention and control guidelines. It includes identification of vulnerable areas on maps, creation of a data bank on forest fires, evolving fire dangers, fire forecasting system, provisions for a crisis management group, involvement of JFM committees, and efficient enforcement of legal provisions.

7.1

National Plan for Forest Fire Management

- Ministry of Environment, Forests and Climate Change, Government of India has made essential provisions in National Forest Policy. The modified National Forest Policy has addressed a systematic plan for Forest Fire Management, according to which special precautions need to be taken during the fire season in addition to improved and modern management practices to deal with forest fires.
- Number of initiatives have been undertaken in the plan to strengthen the forest fire management system in the country. A strong central component for the development of an Early Warning Fire Forecasting System using satellite data and Fire Danger Rating System for early detection of forest fire has been introduced. Forest Survey of India (FSI) is working in collaboration with the National

Centre for Medium Range Weather Forecasting (NCMRWF) for this project.

- National working plan code has been prepared by FRI.
- A national policy should also include guidelines for the development of standard operating procedures (SOPs) by the states for various aspects of FFPM, such as requirements for post-fire data collection and reporting. SOPs are an excellent way for the states to communicate the objectives, principles, and required actions for effective FFPM down 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 time to time on different aspects of FFPM. Guidelines issued by MoEFCC should include requirements for state forest departments to regularly update their SOPs. Each district should prepare a comprehensive Forest Fire Management Plan, which inter alia comprises:

i) Details of Different Type of Forest Areas,
ii) Strategy for Fire Management,
iii) Resources Available,
iv) Logistics
v) Establishment of Master Control Room & Crew Stations,
vi) Communication System,
vii) Details of Fire Sensitive Areas,
viii) Formation of Committees,
ix) Assignment of Roles and Responsibilities at Different Levels,
x) Requirement of Financial Resources etc.
xi) The Plan should be discussed and approved by a multi-departmental Committee, headed by District Magistrate.
xii) On the basis of all district plans, a state level Crisis Management Plan has been prepared and to be approved by Govt. of India for implementation.

The aim of effective prevention is not to entirely exclude fires from forest, but rather to avoid damaging and unwanted fires, thus maximizing the environmental benefits of fire while minimizing the adverse impacts. The most common methods of prevention employed by forest departments in India include the clearance of fire lines and conducting controlled burning to limit fuel loads. Other methods may include silvicultural practices such as selective thinning and planting fire-adapted tree species in fire-prone areas. Early warning and fire danger rating systems are also part of the prevention process, and allow fire managers to put in place an appropriate state of readiness when hazardous conditions develop that could lead to more severe fire behavior. Forest-using communities play a pivotal role in fire prevention in India.



7.2

Organizations working on Fire Emergency Response

7.2.1

Fire Hotspot Monitoring

A variety of space-borne sensors are used to map fires on a global scale. Fire hotspots can be detected by using several remote sensing data, i.e., NOAA-AVHRR, European Space Agency (ESA) Along Track Scanning Radiometer (ATSR) and the National Aeronautics and Space Administration (NASA) MODIS.

Fire detection from satellite-based sensors is determined by sensor characteristics such as spectral bands, data processing chains, detection algorithms and revisit frequency. Fire detection also depends on fire regimes as these results in different spatial and temporal patterns of burning (Stolle et al., 2004).

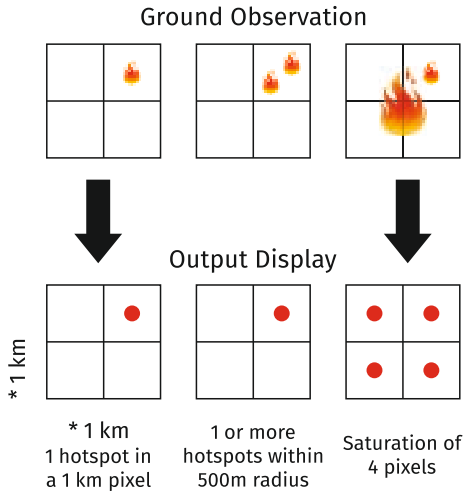


Figure I. Illustration of how fire hotspots represent fire

Global active fire detection is performed using a hotspot algorithm based on the band information of mid and thermal infrared sensors from NOAA-AVHRR, ESA-ATSR and NASA-MODIS.

The fire hotspot algorithm of MODIS from Justice et al. (2002) is developed from heritage algorithms which are based on AVHRR and Tropical Rainfall Measuring Mission (TRMM) Visible and Infrared Scanner (VIRS). The algorithm uses brightness temperatures derived from the MODIS 4 and 11 m channels, denoted by T4 and T11, respectively.

The MODIS instrument has two 4- m channels, numbered 21 and 22, both of which are used by the detection algorithm.

Channel 21 saturates at nearly 500 K; channel 22 saturates at 331 K. Since the low-saturation channel is less noisy and has a smaller quantization error, T4 is derived from this channel whenever possible. However, when channel 22 saturates, or has missing data, it is replaced with the high saturation channel to derive T4. T11 is computed from the 11- m channel (channel 31), which saturates at approximately 400 K. The 250-m near-infrared band (0.86 m), averaged to 1-km resolution, is also used to identify highly reflective surfaces those are more likely to cause false alarms. This reflectance is denoted by 2.

Stolle et al. (2004) attempted to verify the fire hotspot by using multisource satellite data.

The AVHRR, ATSR, Defense Meteorological Satellite Program-Operational Linescan System (DMSP-OLS) and MODIS fire datasets for Indonesia were compared with each other and with burnscar maps derived from high spatial resolution data. Results show that each dataset detects different fires. More than two-thirds of the fires detected by one dataset are not detected by any other datasets. None of the datasets detect all fires in test areas. Fire datasets were not complementing each other as they all had commission as well as omission errors. The detection of fires is determined by fire regime, sensor characteristics and the fire detection algorithm used.

Several organisations provide fire hotspot information on their websites for free. The following are some web addresses that provides hotspot data:

Institution		Data Source Web Address
LAPAN	MODIS, VIIRS	http://modis-catalog.lapan.go.id/
FIRMS NASA	MODIS	https://earthdata.nasa.gov/data/near-real-time-data/firms
GIC - AIT	MODIS	http://www.geoinfo.ait.ac.th/modis/
ASMC	NOAA/AVHRR	http://asmc.asean.org/home/

7.2.2

Forest Survey of India

Forest Survey of India (FSI) working under Ministry of Environment, Forests and Climate Change, is involved in forest fire studies involving real time monitoring of forest fires, burnt area assessment and related studies. FSI has been carrying out forest fire monitoring at national level since 2004 using Remote Sensing and GIS technology with the objective of detection of active forest fires at nascent stage and to inform State Forest Departments about the forest fire incidences on near real time basis. From year 2012, the time duration between satellite pass and the time of dissemination of forest fire signals by FSI has been reduced to nearly 2 hours, thus making the mechanism of signal reception, processing and dissemination on a real time mode. This has considerably minimized the reaction time towards remedial and preventive measures on ground by the state forest departments.

Forest Survey of India (FSI) has been using Moderate Resolution Imaging Spectro-radiometer (MODIS) data having on-board Terra and Aqua satellites providing data at every 6 hours thus helping in close period monitoring of forest fire.

The active fire spots or hotspots are the locations of fires irrespective of forest or agricultural land. These coordinates are projected on the forest cover map of India prepared by the Forest Survey of India to select active fire locations within forest cover called forest fire locations. Attributes like state, district, Survey of India toposheet's numbers are then attached with each coordinate of the forest fire locations so as to enrich the information carried forward by each fire location.

The entire processing at FSI takes approximately 1 hour's time. The processed forest fire information is then converted into .kml (Keyhole Markup Language) file format which is Google Earth software compatible format and emailed to the appointed nodal officers of each state.

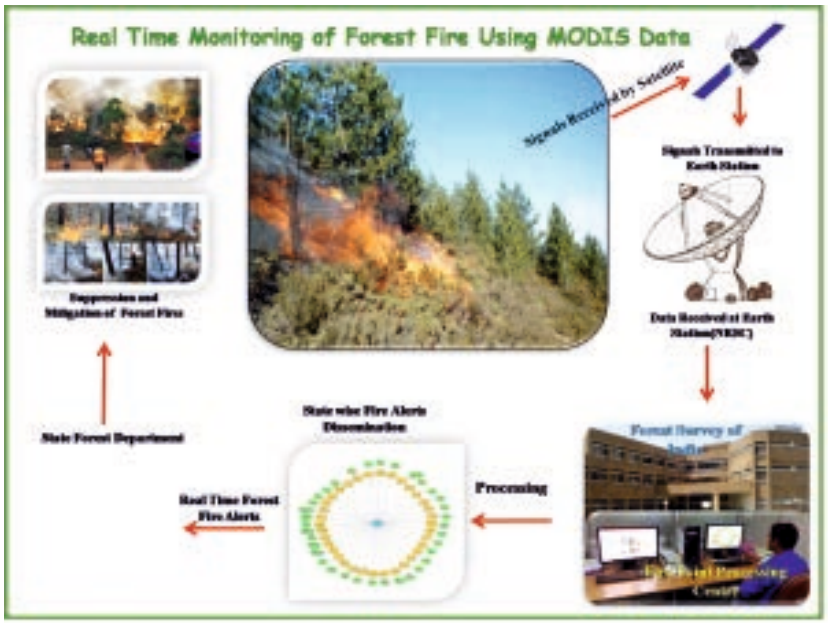
The respective SFD is able to precisely locate the position of hotspot (active forest fire location) at compartment level with the Google-Earth picture at the backend. The information generated in the form of Table and Maps are also uploaded on the official website of FSI daily 3-4 times a day. In addition, the same information is also disseminated through SMS to the State Forest Department's registered users to the website (www.fsi.nic.in) for confirmation as well as quick remedial measures.

FSI is using an advance system for processing and dissemination of fire signals using this kind of monitoring. Online feedback forms are also made available to the state forest departments where the nodal officer nominated for forest fire monitoring from the respective states can login and fill the feedback forms for the validated forest fire points by SFDs on ground during their ground checking work.

Major Highlights

- Round the clock forest fire monitoring and dissemination to the SFD's.
- Dissemination of fire points as KML that can be visualized on Google Earth.
- Attachment of Toposheet No., Lat/Long, State, District name with each fire points.
- Signal dissemination as SMS alerts to register user across the country.
- Uploading the processed information as Map and Excel file on FSI website on daily basis.





7.2.3

National Disaster Response Force (NDRF)

- The National Disaster Response Force (NDRF) is a specialized force constituted "for the purpose of specialist response to a threatening disaster situation or disaster" under the Disaster Management Act, 2005.
- National Disaster Response Force (NDRF) is a force of 12 battalions, organised on para-military lines, and manned by persons on deputation from the para-military forces of India and the total strength of each battalion is approximately 1,149.

7.3

Preventive measures of forest fire

- Measures, which prevent the occurrence
- or minimize the chances of occurrence of fire.

7.3.1

Indirect preventive measures

Restriction of entry into the forest

- Entry of common public in the forest restricted during fire season.
- Strict vigil on poachers and suspicious looking people in the forests.

Public awareness/public opinion

- While the goodwill of the local people will prevent deliberate fires, it cannot put to an end to accidental fire.
- Creating public awareness through press, radio, television, posters and films shows about the causes of fire and their effect will go a long way in preventing the fire.

Forbidding collection of certain items of forest produce during summer

- Collection of honey, seeds etc. should be restricted during the summer to reduce the chances of accidental fire.

Denial of benefits, which accrue from forest fire

- Denial of benefits of grazing in fire burnt areas by invoking section 26(3) and 33(2) of the Indian Forest Act 1972 for people, who set fire to burn the dry grass to get an early new flush of green grass.

Putting up notices prohibiting kindling and carrying of fire

- Before the fire season begins, poster about fire hazards, prohibition of kindling and carrying of fire through the forest can be put up in prominent places to remind people about fire risk and preventing chances of fire.

7.3.2

Direct preventive measures

Clearing camping sites and areas along paths and roads

- A large number of accidental fires start from camping sites where people stay for short periods of time. Inflammable material around such sites should be cleared before the onset of dry season.
- Fires starting from Bidi or Cigarette slumps thrown carelessly by the roadside can be prevented by controlled burning all grass and leaves.

Early burning

- Early burning is done to burn down all inflammable material such as grass, fallen leaves and broken branches before the commencement of hot weather to prevent the occurrence of fire and even when it does occur it can be easily controlled.
- When early burning is done carefully, forest floor is carpeted with new green grass.
- Fires are harmful to the forests and early burning is no exception, but extreme care should be taken during the process.
- Various factors should be taken into consideration, such as, uncertainly of weather, unsuitability of certain forests to burning, slash disposal and controlled burning in resin taping areas and clearance of fire lines.

7.3.3

Prevention of Man Caused Fires

Two basic steps to prevent fire:

i) Reduce risk through awareness

- Signs, posters, advertisement, exhibits etc.
- Radio, still pictures, motion pictures and television etc.
- Personal contacts with individuals and groups.
- Law enforcement.
- Prevention through education to children.



ii) Hazard reduction

- Stop or help stop a fire from reaching a particular area or property.
- Prevent a fire from a spreading to a known or suspected ignition source.
- Breakup forest area into units to help in general strategy of fire control.
- Reduce fuel hazard in an area like slash disposal.
- 2 Fire Breaks - Impose some obstacle to the spread of fires.
- Act as a barrier to prevent the spread of fire to a particular area.
- Prevent the spread of fire from a fire source to other areas.
- Break up large fuel areas into smaller ones.

7.4

Major Issues and Gaps in Forest Fire Management in India

- Lack of appropriate policy and planning to tackle forest fire.
- Lack of proper institutional mechanism.
- Lack of scientific approach to collect fire data and document it for forest fire management.
- Lack of information related to area burnt, damage to forest crop, environment and wildlife along with indirect loss to soil and water resources. This information is possible only through research and investigation.
- Lack of fire vulnerability map based on forest vegetation and past history.
- Lack of funding and mismatch between the time of budget allocation and budget required.
- Not many initiatives has been done to involve local community except few states.
- Poor early warning system.
- Lack of preventive and preparedness measures to ensure better response: like clearing fire lines, removing the fuel, recruiting forest fire watchers, making the equipment ready to use, rehearsal and drill practices, reuniting fire protection committees etc.
- Lack of coordination.



MEXICAN EXPERIENCE ON FOREST FIRE PREVENTION & MANAGEMENT

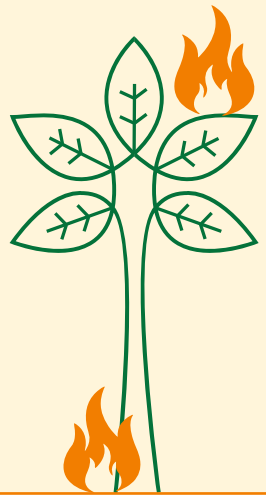
Mexico has recently re-assessed its national policy on forest fires, from a policy of total suppression to a more integrated policy of fire management. This transition took place with a growing recognition that some fires are beneficial–ecologically, socially, and economically.

Until 2012, Mexico's national forest fire program focused on the complete suppression of fires by contracting helicopters to douse flames. In addition, state forest fire programs were weak and there was little institutional coordination. In 2013, it was recognized that the total suppression of fires was not enough, so the country set out to revamp its national forest fire program with the context of a changing climate. An institutional consensus emerged around the need to develop a public policy that recognized the ecological and social role of forest fires, acknowledging that some fires can also be beneficial. For instance, some ecosystems, such as pine forests, are adapted to fire, as fire releases seeds from cones and promote regeneration. Some of the other benefits of forest fires that have been recognized relate to the control of pathogens, invasive species, maintenance of natural pastures, and improvements in habitat for wildlife.



Achieving this shift in Mexico's approach to FFPM took time and strong institutional, technical, scientific, and social leadership. The transition provided a unique opportunity to reform forestry policy while at the same time making improvements in operations under existing laws. Mexico has been able to improve its approach to FFPM without increasing the budget. Instead, the focus in Mexico has been on allocating resources more effectively and efficiently to strengthen the two fundamental pillars of fire management: better coordination between three levels of government, as well as greater participation by society.

Some of the measures that have been implemented since 2013 include increasing community-based fire management and training for rural crews; establishing agreements between CONAFOR (the National Forestry Commission in Mexico) and federal, state and local agencies; constructing national, regional and state centers for forest fire control; increasing the number of forest firefighters from 5,000 to 22,000; upgrading personal protection equipment; acquiring tools, vehicles and tanker trucks; improving the management of fuels; building the capacity of forest firefighters and technical staff; strengthening basic research (including on fire danger rating and fuel models); promoting public engagement; and bolstering international cooperation with the United States, Canada, the Dominican Republic, Colombia, and other Central and South American countries.



8

FIRE FIGHTING TOOLS AND EQUIPMENTS

Considering the disastrous impacts and difficulty in controlling the forest fires, the Forest Research Institute, Dehradun has developed an in-house forest fire extinguishing kit which has been given to forest department personnel's for controlling forest fire in difficult terrains. This kit can be purchased from Atul Trading Corporation, 47, Dispensary Road, Dehradun (Phone No. 0135 2657573).

8

Traditional Tools and Equipments

The following tools are useful in controlling forest fires.

This tool is designed for raking and cutting of small bushes for construction and maintenance of forest fire lines.

There are three kinds of fire rakes exhibited below as photographs:-

a. **Arrow Type Rake**
It is used to remove twigs and small branches

b. **Nail Type Fire Rake**
It is used for raking light litter.

c. **Peg Tooth Type**
It is used for raking thick litter.

The rakes are made of stainless steel plate with following specifications:

- **Gauge:** 3 mm,
- **Weight:** 800 gm,
- **Peg tooth angle:** 32-35 degree.



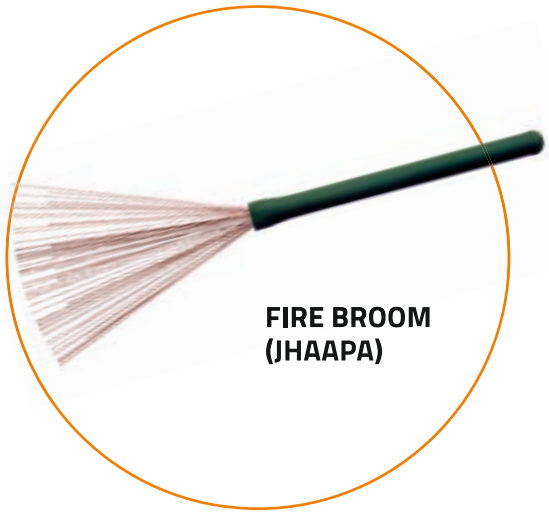
8.1

FIRE RAKES (KANGHI)

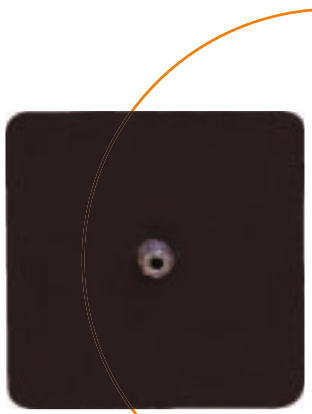
It is specially designed to beat the fire and control the ground fire. It is an innovative tool to combat surface fire. After numerous trials, the fire broom has been developed. The handiest tool to beat the fire is made from spring steel wire reinforced with steel cup connection to club with adjustable rod. The purpose of developing this tool is to avoid loss of biodiversity and not using green branches (jhaapa) by the fire fighters. The specifications are as below:

- Steel wire: 2 mm diameter
- Weight: 800 gm
- Length of broom: 45-50 cm

8.2



FIRE BROOM (JHAAPA)



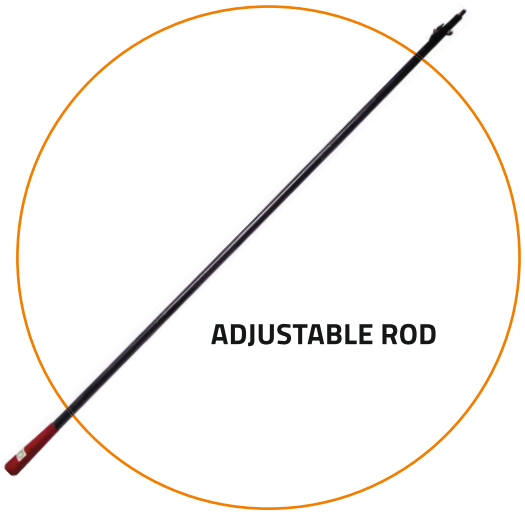
FIRE BEATER (FIRE PRESSED)

8.3

It is a new kind of tool developed to put off fire hidden under lumps. It will be of much use in post fire operation. It is effective and widely used in beating the fire in grass and hard Inflammable material. It is made from steel or iron with dimensions of length and breadth is 24x24 cm.

It is of multiple uses and can be fitted with all types of developed tools. Weight of the rod is light. It is adjustable to various lengths. It is made up of high glass conduit pipe with wooden or plastic grip. Adjustable length is of about 5-9 feet.

8.4



ADJUSTABLE ROD





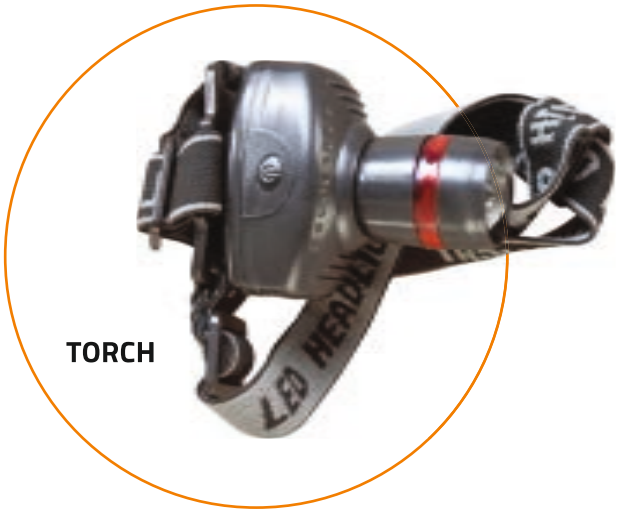
PATHAL (MODIFIED SICKLE)

8.5

It is designed to cut the small branches and twigs for clearing way for crew members.

It is a kind of portable torch which can be tied on the head of crew member during forest fire operations. It can also be mounted on the wrist of crew member during night time. It has two small rechargeable batteries with LED lamp.

8.6



TORCH



WATER BOTTLE

8.7

A light weight plastic bottle which can carry about 2 litre of water is very useful for crew member during fire operation.

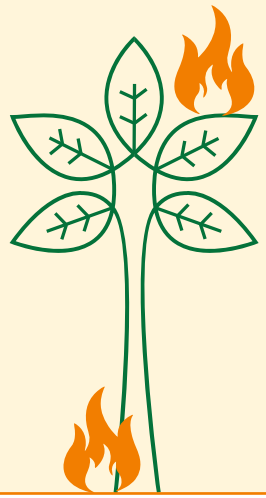
This special kind of bag is designed to keep various tools in such a way that the carrier does not feel weight as well as un-comfort. Inside the bags various adjustments are made to keep the tools without touching each other.

8.8



FOREST FIRE TOOL KIT





9

MODERN TOOLS AND EQUIPMENTS

Extinguishing Agent

As all the water reservoirs either originates or present in the forest areas, hence, the use of chemical extinguishing agents should be prohibited during forest fire extinguishing process. The only recommended extinguishing agent is water.

DUAL BAG FIRE PUMP

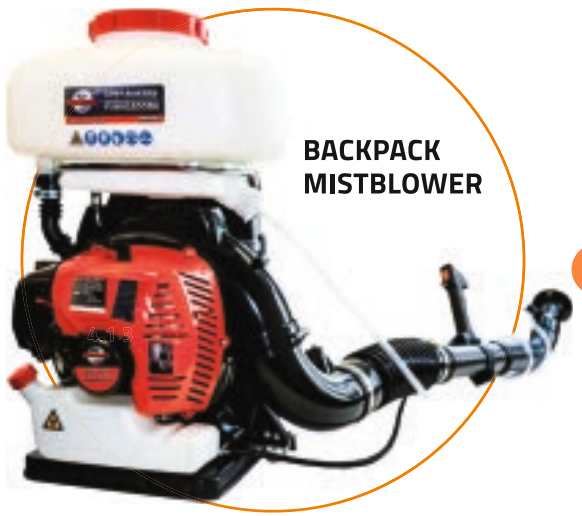
Used for fire suppression. The water storage capacity is 18.92 litres inner bag liner with protective nylon fabric outer bag. Rugged outer bag offers more protection from punctures. Harness straps with chest cinch strap help balance the load and prevent straps from pulling outward. Two liners come with fire pump- extra liner is stored in the outer pouch of the nylon bag.

9.1



BACKPACK MISTBLOWER

9.2



Powerful 2-in-1 backpack mistblower for spraying large areas of liquid and dusting and spraying granules. With a spraying distance of up to 14 meters and easy to use functions, this model allows you to work efficiently and in comfort. The 2 in 1 conversion mechanism allows you to switch from spraying liquid to dusting granules in no time. The water storage capacity is 14 liters. Maximum air throughput 1.3 m^3/h4. The weight of this machine is 12.8 kg.

The pump can be carried on the back of a crew member. It has a Capacity of 20 litres. The weight is 2.54 kg, Size is 62 x 48 x 5 cm, Backpack weight is 1.48 Kg, Lance weight is 1.06 Kg, Hose length is 1 meter.

9.3



BACK PACK WATER PUMP



DRIP TORCH

9.4

A drip torch is a tool used in wildfire suppression, controlled burning, and other forestry applications to intentionally ignite fires. The intentional ignition of fires is a common firefighting tactic. A burnout (also called a firing operation, counter fire or firing out) is a smaller fire ignited along a control line ahead of the main fire. The intent is to consume fuel ahead of the main fire, strengthening the control line. A backfire is a more aggressive type of burning done to influence the behavior of the main fire. The height is 14 inch when closed and 25.5 inch when assembled. The Diameter is 6 inch. The empty weight is 2.08 kg and full weight is 7.26 kg. The capacity is 4.73 liters.

It provides comprehensive environmental data on nine different measurements. Simply turn it on and scroll left and right to see exactly what the environment is doing. It measures Barometric pressure, Pressure trend, Altitude, Relative humidity, Heat stress index, Dew point, Wet bulb temperature, Wind Chill, Air, water and snow temperature, Current wind speed, Average wind speed and Maximum wind gust. The features are Real-time clock, Waterproof and floats, Large easy-to-read display with backlight, Data hold function, High precision pressure sensor, Quick response, external thermistor, Forecast weather with pressure trend indicator, Humidity sensor can be recalibrated in the filed with the Relative Humidity Calibration Kit, Innovative, thermally adjusted humidity sensor designed for stability and accuracy in abrupt condition changes, Patented user-replaceable impeller, Reliable, portable and easy to use, Protective cover with sure-grip over molding.

9.5



WIND METER

These portable tanks are used to store water near to fire incidence areas with the help of fire hose. It has a fully removable top for easy access. Fire Protection Water Storage Tanks provide fire fighters, redients and businesses with water in locations where the demand for water can exceed the available municipal water supply. This is especially true for suburban or rural areas served by wells, with limited delivery, or locations prone to wild fires.

9.6



POLYPROPYLENE TANKS





FIRE HOSE

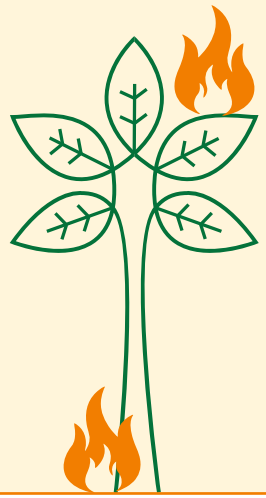
9.7

A fire hose (or firehose) is a high-pressure hose that carries water or other fire retardant (such as foam) to a fire to extinguish it. Outdoors, it attaches either to a fire engine or a fire hydrant. Indoors, it can permanently attach to a building's standpipe or plumbing system.

It is constructed with an all-synthetic jacket from virgin spun polyester for extra abrasion and snag resistance. It gives maximum flow with minimum friction loss.

10

FIRE SAFETY EQUIPMENTS



Fire Jump Suit is a suit designed to protect a firefighter from high temperature during firefighting. Pockets include a radio pocket on left breast, spade pocket on right, two rear spade pockets and an extra large slash pocket with pass through feature. Hook and loop closures on wrists and ankles, a self locking brass zipper front closure with two security snaps, and 2" elastic back band with 4" side take-ups for a perfect fit. All stress points are bartacked with NOMEX thread.



FIRE RESCUE COAT

10.2

Fire Rescue Coat is made from Fire Resistant, synthetic fabric which retains its structural strength after fire exposure and resists cuts and tears. It offers an unprecedented list of standard features. Full cut, generous designs offer freedom of movement and cool comfort in the most demanding conditions. Caped shoulder design with built in ease for full freedom of arm movement, Gusset cuff with hook and loop closure, Alpine style collar, Radio pocket with mic tab, Unidirectional front cargo pockets with concealed hand warmers, Large interior storage pocket and glove hanger tab.







FACE PROTECTOR/ PARTICLE MASK

10.3

It is the world's first dual function, multi-layered, high heat resistant facial and respiratory protection garment. The Hot Shield is the only brush fire face mask that protects major portions of the face and neck from burning sparks, embers and even the flames of a 1000° blow torch. It also protects the respiratory tract by using a combination of physical barriers including a disposable particle mask.

This Hood provides superior protection and allows heat to escape without the risk of steam burn.

10.4



FIRE HOOD



NECK PROTECTOR

10.5

Initial Attack Full Tecasafe Plus, ear, neck and face protector.

Protect face with Tecasafe Plus. Crew Boss Face Protectors are compatible with both Morning Pride and Bullard style helmets and install with ease. Pressure-sensitive hook and loop tabs allow easy installation in any wildland helmet. Nomex thread used throughout.

Bullard Wildfire helmets are specifically engineered to meet the special needs of wildland/forestry firefighters. Manufactured from heat-resistant thermoplastic for superior impact and penetration protection. These helmets also exceed all major state fire codes for wildland firefighting. Easy to adjust Flex-Gear ratchet, sizing suspension, Thermoplastic shell, Available in cap style or full brim hat style, Reflective lime-yellow stripes, Three goggle clips, Adjustable chinstrap, Comfortable 6-point suspension, Leather ratchet cover (on ratchet models), Absorbent cotton brow pad, Velcro attachments inside shell (3)

10.6





10.7

It is constructed of Carbon X materials, the only inherently non-flammable and most thermally resistant fabric in the world today. Half Face Respirator has been designed for any and all workers who desire heat & flame protection for their face & neck yet must wear a fit test capable silicone half face respirator. Outside of a positive pressure breathing apparatus, this is a very comfortable and highly protective alternative.

ESS FIREFIGHTER RUBBER GOGGLES SMOKELESS

Firefighter Rubber Safety Goggles. It is a smokeless goggle with sealed vents and soft cell face foam.

10.8



PIGSKIN FIRE GLOVES



10.9

Hand protection during fire fighting is of paramount importance. Gloves are an essential part of the overall protective ensemble and must work with the selected coat to provide a good interface for overall firefighter thermal and liquid protection. It is Fire Retardant, Heat Resistant, Abrasion Resistant.

It is made of Fire retardant leather for substantial durability and underfoot stability. It consist of Reinforced fire resistant Vibram rubber toe and heel for increased durability and protection, two layers of material across toe box for additional protection

10.10



FIRE WORK BOOTS



L RADIO CHEST HARNESS

10.11

Radio chest harness for carrying dual radios.

2 adjustable radio pockets fit a wide range of models from larger legacy radios to smaller, modern handsets Cell phone pocket developed to fit large phones and their cases, Multiple storage throughout for batteries, maps, notebooks and pens, Slots for holding two pens Low profile back harness constructed from lightweight yet durable Hypalon, Can mount directly to your line pack shoulder harness with Integration Straps Zippered front pocket for Kestrel or GPS. The weight is 0.36 kg.

This type of bag could be used for extinguishing fire on hazardous terrain as well as jumping into a harrowing fire. There is 1,500 cubic inches of space optimized for efficient compartmentalization of gear. The bag also provides sufficient internal and external zipped pockets for easy access of different accessories. Ballistic nylon on the bottom of the pockets and superior nylon drawstrings provide the ultimate durability, strength, and increased abrasion resistance.

10.12

GEAR BAG





FIRE SHELTER

10.13

New-generation fire shelter provides increased protection from radiant and convective heat in wildland firefighter entrapment situations. In an emergency situation, the fire shelter could save a life. Each shelter set includes fire shelter, nylon duck carrying case and carrying case plastic liner. Deployed Size 96"L x 19.5"H x 33"W, Packed Size 9"H x 5.5"L x 4"W, Weight 2.36 kg.

AERIAL FIRE FIGHTING

Drones are used in Forest Fire Surveillance system by many countries to detect forest fire location in very less time and mitigation of fire within time.

1



DRONES



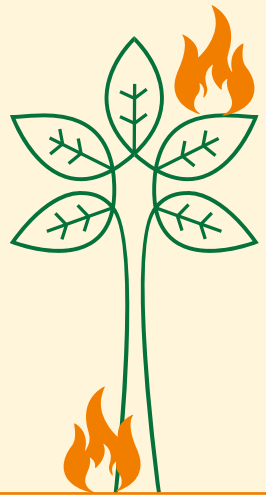
FIRE FIGHTING HELICOPTERS

2

These are used by many countries to suppress crown fire.

11

LEGAL PROVISIONS OF FOREST FIRE



Indian Forest Act 1927

Section 26 - Acts prohibited in Reserve Forests.

(1) Any person who-

a. Sets fire to a RF, or in contravention, of any rules made by the State Govt. in this behalf, kindles any fire, or leave any fire burning, in such manner as to endanger such a forest: or who, in a RF

b. Kindles, keeps or carries any fire except at such seasons as the Forest Officer may notify in this behalf

c. Fells, girdles, lops or burns any tree or strips off the bark or leave from, or otherwise damages, the same

d. Shall be punishable with imprisonment for a term, which may extend to 6 months, or with fine, which may extend to Rs. 500 or with both, in addition to such compensation for damage done to het forest as the convicting Court may direct to be paid

(2) Nothing in this section shall be deemed to prohibit -

a. Any act done by permission in writing of the Forest-officer, or under any rule made by the State Govt; or

b. The exercise of any right continued under clause (c) of sub-section (2) of Section 15, or created by grant or contract in writing made by or on behalf of the Govt., and

(3) Whenever fire is caused willfully or by gross negligence in RF, the State Govt. may (notwithstanding that any penalty has been inflicted under this section) direct that in such forest or any portion thereof the exercise of all rights of pasture or to forest-produce shall be suspended for such period as it thinks fit.

Section 33 - Penalties for acts in contravention of notification u/s 30 or of rules u/s 32

(1) Any person who commits any of the following offences, namely

a. Fells, girdles, lops, taps or burns any tree u/s 30, or strips off the bark or leaves from or otherwise damages, any such tree;
b. Sets fire to such forest, or kindles a fire without taking all reasonable precautions to prevent its spreading to any tree reserved u/s 30, whether standing, fallen or foiled, or to say closed portion of such forest;
c. Leaves burning any fire kindled by him in the vicinity of any such tree or closed portion;
d. Shall be punishable with imprisonment for a term, which may extend to 6 months, or with fine, which may extend to Rs. 500, or with both.

(2) Whenever fire is caused willfully or by grass negligence in a PF, the State Govt. may, notwithstanding that any penalty has been inflicted under this section, direct that in such forest or any portion thereof the exercise of any right of pasture or to forest-produce shall be suspended for such period as it think fit.

Section 34 - Nothing in this Chapter shall be deemed to prohibit any act done with the permission in writing of the Forest-Officer, or in accordance with rules made u/s 32, or, except as regards any portion of a forest closed u/s 33, in the exercise of any right recorded u/s 29.

Wildlife Protection Act, 1972

Section 30 - Causing fire prohibited - No

person shall set fire to a sanctuary, or kindle any fire, or leave any fire burning, in a sanctuary, in such, manner as to endanger such sanctuary.

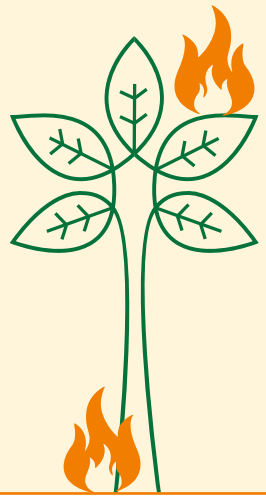
Section 35 (8) - The provisions of section 30 shall, as far as may be, apply in relation to a NP as they apply in relation to a sanctuary.

Section 51 (Before 2002 Amendment) -

Any person who contravenes any provisions of this Act or any rule or order made thereunder, shall be guilty of an offence against this Act, on conviction, be punishable with imprisonment for max of 3 years and/or maximum fine of Rs. 25,000.



GLOSSARY OF COMMON TERMS



Anchor point	Refers to an advantageous location, generally a fire barrier, from which to start constructing a fire line.
Attack a fire	A process, which limits the spread of fire by cooling or smothering it, or by removing or otherwise treating the fuel around its perimeter
Back fire	Signifies the fire intentionally set along the inner edge of a control line to consume the fuel in the path of a forest fire. Further, it can change the direction of the force of the fire's convection column. Also, a prescribed burning against the prevailing wind in the area. The backfire is generally set against the fire to be fought to exhaust the fuel, so that when the two fire meet, both go out.
Bush fire	This fire refers to the wind fire and forest fire also. Generally this type of fire burns more quickly than woods.
Clean burn	Any type of fire, whether deliberately set or accidental, that destroys all above-ground vegetation and litter, along with the lighter slash, so exposing the mineral soil.
Crown fire	A fire that runs through the tops of trees, scrub, or brush wood. However, such fire may be classed as either running or independent accordingly as they accompany, or are separate from, surface fires.
Discovery time	It is the elapse time from the starting point of the fire, either known or estimated, until the time of the first discovery. Also, more specifically the discovery that results directly in the fire suppression action.

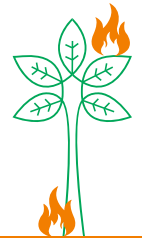
Control burning	Control burning is the burning of the leaves and undergrowth before they completely dry, preferably early in the dry session so to act as insurance against the severe fire damage.
Fire atlas	Refers to an ordered collection of fire maps, charts and statistics, used as a basis for the fire control plan.
Fire break	An existing barrier, or one constructed before a fire occurs, from which all or most of the inflammable materials have been removed. It is designed to stop or check creeping or running but not spotting fires, or to serve as a line from which to work and facilitate the movement of fire fighters and equipment in fire suppression.
Fire beater	A fire suppression tool, sometimes improvised, used in direct attack for beating out flames along a fire edge or from a light fire. However, it may consist merely of a bunch of twigs or wet sacking, or be manufactured tool e.g. a flap of belting fabric fastened to a long handle.
Fire line	Has different meaning at different places. (i) A loose term for a any cleared strip used in fire control. (ii) A considerable width. However, at some places e.g. southern Africa, such a line left between plantations is termed as cut-off. (iii) In USA used as fire trench. That portion of the controlled line from which termed flammable materials have been removed by scrapping or digging down to the mineral soil. (iv) A line cleared round an actionable fire, generally following its edge, for preventing further spread of the fire and effectively control it.
Ground fire	It represents the fire that burns the organic material in the soil layer, for example, a peat fire and often also the surface litter and small vegetation.
Patch burning	Describes the burning of felling debris, grass, etc. In patches for the purpose of preparing the sites for group planting or sowing.
Wildfire	It is equated with free-burning fire, bush fire; any fire other than a controlled or prescribed burn, or occurring on wildland.



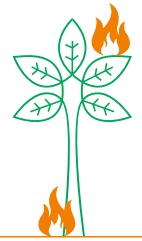



FOREST FIRE
IS A BATTLE
UNFINISHED

NOTES



NOTES



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