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Forest fire as an evil or necessity

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Abstract
The word "fire" evolved from the Greek word "pyra" meaning growing embers. Forest fire may be defined as an unclosed and freely spreading combustion that consumes the natural fuels. It has profound impacts on atmospheric chemistry, biogeochemical cycling and ecosystem structure. It has become intense and more frequent in the last few decades all over the world and is a critical issue in the biosphere–atmosphere interface. It has both the positive and negative impacts on the environment. In India the natural fires are only 5% and rest 95% is caused by human interference. Beneficial impacts; reduce the buildup of fuel, recycle nutrients, reduce competition, allowing existing trees to grow large and remove unpalatable growth remaining from previous seasons when there is limited fires. But when it exceeds its limits it come under the category of forest fire, and may engulf and destroy healthy thick forest cover within no time.

Keywords: Forest, forest fire, impact, components, management tool

1. Introduction
Since time immemorial, forests have been an integral part of human ecosystem. They are nature's greatest bounty to mankind and play a very significant role in its life. Besides providing shelter and protection to a large number of living beings, including pre-historic man, they have been a major source of food, wood and a great variety of other products. The word "fire" evolved from the Greek word "pyra" meaning growing embers. Fire is actually the heat and the light that results when three elements i.e. fuel, oxygen and the temperature are combined. From the time our planet came into existence, lightening has sparked landscape. Artificial or the human induced fire began when the earlier human being first rubbed two stones. It is interesting to know that the first experience of fire, which ancient human being felt was of forest fire. Thus forest fire has been an integral part of human civilization. It had so much significance in the earlier history of mankind that they started worshipping it as God. Forest fire has become intense and more frequent in the last few decades all over the world, and is a critical issue in the biosphere–atmosphere interface (Crutzen and Andreae 1990; Penner *et al*. 1992) [4, 12]. It has a profound effect on atmospheric chemistry (Randerson *et al*. 2006), biogeochemical cycling, (Schimel and Baker 2002) [16] and ecosystem structure (Cochrane 2003) [3]. In a countrywide study in 1995, the Forest Survey of India estimated that about 1.45 Mha of forest are affected by fire annually. According to the Ministry of Environment and Forests, Government of India, 3.73 Mha of forests are affected by fires annually in India (Bahuguna and Singh 2002) [1].

2. Components and Process of forest fire
Fire is the naturally occurring companion of energy released in the form of heat and light, when oxygen combines with a combustible or burnable material at a suitable high temperature (about 325 °C for wood to burn). There are basically three components i.e. fuel, heat and oxygen that are needed in right combination to produce fire. Combination of these components produces the "fire triangle". By nature, triangle needs three sides, missing of any of the one side will collapse the triangle. The same is true for fire. Take away any of the three components of fire - fuel, heat or oxygen, the fire collapses. Firefighters to suppress the fire, try to do just that and remove one of the three essential components of fire. Fire process starts with a steady supply of oxygen (a fire needs air that contains at least 16 percent oxygen; the earth's atmosphere contains 21 percent oxygen), fuel and temperature become critical for sustaining a fire once it is ignited. The general relationship between fuel and temperature is simple: the more fuel, higher the heat; the more heat, the faster the fire spreads. When there is plenty of heat and fuel, fires start at its own. In the words of one fire behavior expert, "Large fires live to feed themselves." Large fires can create their own winds and weather, increasing flow of oxygen. A large fire can generate hurricane – force winds with a speed of up to 120 miles an hour.

3. Fire characteristics and Behaviour

Burning is the oxidation reaction that requires the proper combination of heat, oxygen and fuel. Ignition will not occur until all three factors permit combustion. Intensity of fire is expressed as British Thermal Units (1 BTU = 252 cal.) per second per meter of fire front. The intensity is generally 1.5-9000 BTU/sec/m in forest and 1.5- 2000 BTU/sec/m in grasslands as estimated by MC Arthor, 1966 [10] in Australia. The no. of BTU per kg of fuel is relative constant (1,87,000). Knowledge of fire behavior is necessary for successful of fire in forest management activities. Fire behavior changes with weather, topography and fuel. Forest fire has profound impacts on atmospheric chemistry, biogeochemical cycling and ecosystem structure (Jaiswal *et al*., 2002) [7]. Fire control requires the unplanned increases in fire intensity and rate of spread is kept minimum. Fire movement is controlled by three factors conduction, convention and radiation. Higher is the temperature, lesser the energy required to raise fuel temperature, leads to increase the fire intensity. Higher humidity lowers down the chances of forest fires. Steepness of the slope increases the fire spread. Wind has also direct relationship with fire spread.

4. Types of forest fire

Forest fires are not always same, they may differ, depending upon its nature, size, spreading speed, behavior etc. Basically forest fires can be sub grouped into four types depending upon their nature and size:

4.1 Surface fires

It is the type of fire that burns surface litter, other loose debris of the forest floor and small vegetation. In general, it is very useful for the forest growth and regeneration. But if grown in size, this fire not only burns ground flora but also results to engulf the undergrowth and the middle storey of the forest. Surface fires spread by flaming combustion through fuels at or near the surface- grass, dead and down limbs, forest needle and leaf litter, or debris from harvesting or land clearing.

4.2 Underground fires

The fires of low intensity, consuming the organic matter beneath and the surface litter of forest floor are sub-grouped as underground fire. In most of the dense forests a thick mantle of organic matter is found on top of the mineral soil. These fires usually spread entirely underground and burn for some meters below the surface. This fire spreads very slowly and in most of the cases it becomes very hard to detect and control such type of fires. The other terminology for this type of fire is Muck fires. There should be proper policy and practices to control these types of Fires (Saigal 1989) [13].

4.3 Ground fires

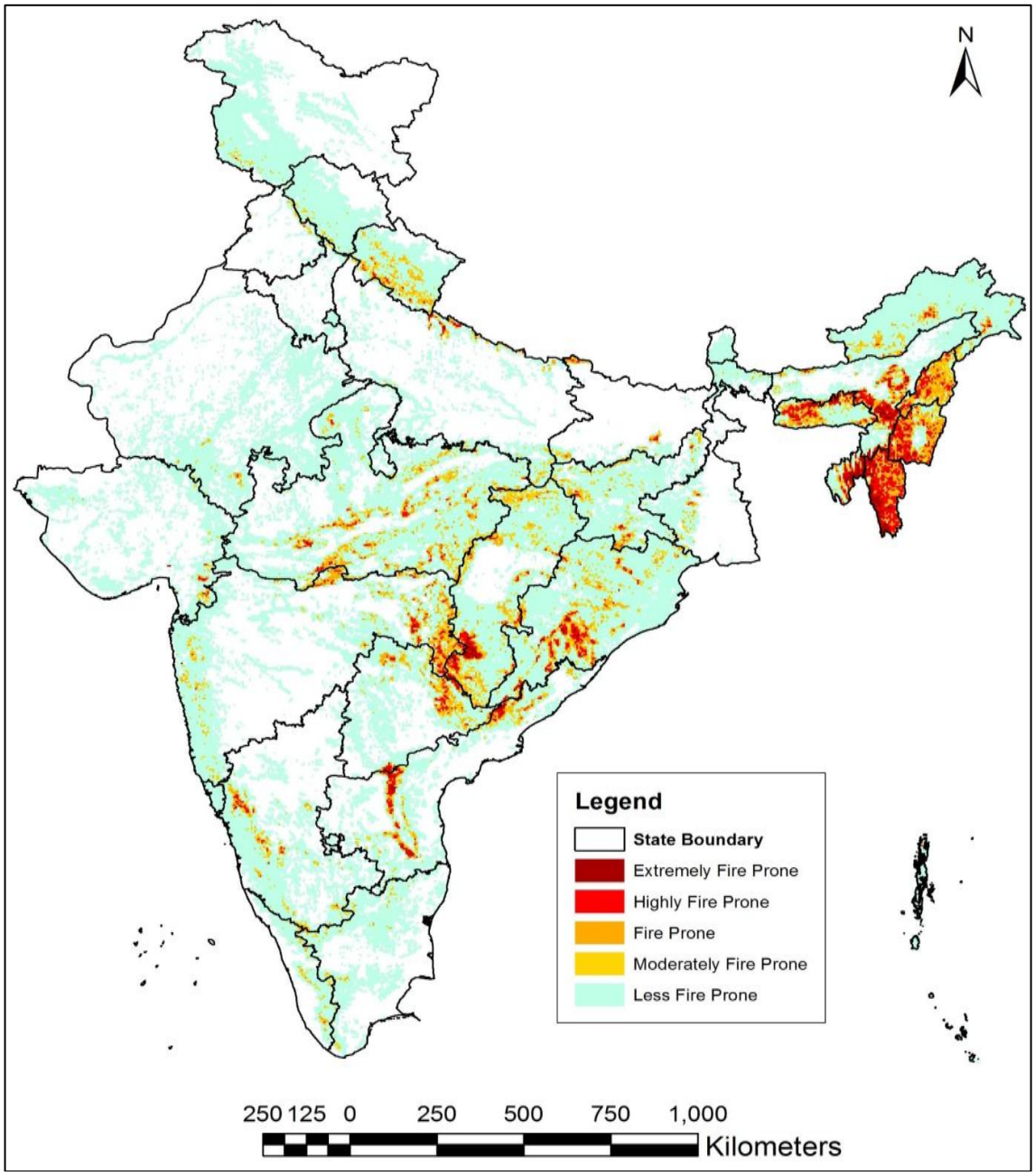
These fires are fires in the sub surface organic fuels, such as duff layers under forest stands, Arctic tundra or taiga, and organic soils of swamps or bogs. The smoldering underground fire sometime changes into ground fire. This fire burns root and other material on or beneath the surface i.e. burns the herbaceous growth on forest floor together with the layer of organic matter in various stages of decay. They are more damaging than surface fires, as they can destroy vegetation completely. A true ground fire spreads by a slowly smoldering edge with no flame and little smoke.

4.4 Crown fires

Crown fire is the most unpredictable fires that burn the top of trees and spread rapidly by wind. In most of the cases these fires are invariably ignited by surface fires. In dense conifer stands with a brisk wind, the crown fire may race ahead of the supporting. Since it is over the heads of ground force it is uncontrollable until it again drops to the ground, and since it is usually fast moving, it poses grave danger to the fire fighters becoming trapped and burned.

Table 1: Forest fire season in India (Annual) (** Peak fires, * Additional months of fire, X No fire)

State and UTs	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Assam	*	**	**	*	*	X	X	X	X	X	X	*
Andaman & Nicobar Islands	**	**	**	*	*	X	X	X	X	X	X	*
Andhra Pradesh	X	*	**	**	**	*	X	X	X	X	X	X
Bihar	X	*	**	**	**	X	X	X	X	X	X	X
Dadr & Nagar Haveli	*	*	**	**	**	*	X	X	X	X	X	X
Gujarat	*	*	**	**	**	*	X	X	X	X	X	X
Goa, Daman and Diu	X	*	**	**	**	X	X	X	X	X	X	X
Haryana	*	*	*	**	**	**	X	X	X	*	*	*
Himachal Pradesh	*	*	*	**	**	**	X	X	X	*	*	*
Karnataka	*	**	**	**	*	*	X	X	X	X	*	*
Kerala	*	*	**	**	**	*	X	X	X	X	X	*
Maharasthra	X	*	**	**	**	*	X	X	X	*	*	X
Madhya Pradesh	*	*	**	**	**	X	X	X	X	*	*	*
Nagaland	X	*	**	*	X	X	X	X	X	X	X	X
Punjab	X	*	*	**	**	**	X	X	X	X	X	X
Rajasthan	*	*	**	**	**	*	X	X	X	X	X	X
Sikkim	*	*	**	**	*	X	X	X	X	X	X	X
Tamil Nadu	*	**	**	**	**	X	X	X	X	X	*	*
Uttar Pradesh	*	*	**	**	**	X	X	X	X	X	X	*



***Source*:** State of Forest Report of 2019 (FSI)

Fig 1: Map showing fire prone forest areas under different fire prone classes

5. Forest fire: as a management tool

Although fire has been the primary agent of deforestation, yet as a natural process it serves an important function in maintaining the health of certain ecosystems. Depending upon the nature of the ecosystem, the weather, and the amount of fuel available fire reduce the buildup of fuel, and thus intensity of future burns; recycle nutrients bound up in litter; reduce competition, allowing existing trees to grow larger; to remove unpalatable growth remaining from previous seasons; to stimulate growth during seasons when there is little green grazing and ro control or destroy insect and disease. For decades, controlled burning has been used as a genuine forest management measure in the developed countries. In western countries, especially Britain, U.S.A., Canada etc. controlled fires are burnt at intervals of 10-12 years to maintain uniform growth. The understorey vegetation coverage of forest is high where there is no history of forest fire for more than 20 years followed by areas moderately affected by fires and highly affected areas. In such types of forest, there will be more competition for space, soil nutrients, water and sunlight. In comparison, the density of *Pinus roxburghii* seedling was low under the moderately disturbed areas by fire (Mani, S. 2005) [9]. A light fire did not cause any significant damage to the mature Aleppo and Brutia pine plantation (Kutiel and Inbar, 1993) [8]. Beside damage, light forest fire enhances soil nutrients resulting in good natural regeneration of understorey. The cautious and controlled use of fire respecting the vegetation stage and the management objectives could be an appropriate management tool (Bloesch, U. 1999) [2]. The impact of fire on different vegetation stages has different response. Besides the management procedures and objectives, the understorey vegetation which is considered unwanted can be burned to increase forage for cattles, space for other useful species to grow, reduce hazardous fuels preventing wildfires and reducing competition in terms of sunlight, nutrients availability and space. In an Ashe juniper community, a minimum of 1000 kg/ha of fine fuel was needed to carry a fire to kill juniper seedlings and burn piles of dozed juniper. Grasses recovered quickly and soil erosion was minimal when burned during a

wet winter and spring. During a dry winter and spring, however, burning increased drought stress on plants, reduced herbaceous yields, and exposed soil to wind and water erosion for a long period of time when soil moisture was low (Wink *et al*,, 1973) [18].

6. Forest fire- a bad master

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. Fire always causes many direct or indirect effects on the forest ecosystem. They may merely be beneficial but at most of the times these effects are deteriorating. The damage to a forest by fire depends mainly on size of the fire. The recent examples of human life loss due to fire are, 73 fatalities in Victoria (australia) in 2003 and 70 deaths in Greece fires (Global Forest Resource Assessment (GFRA), 2010) [6]. The loss to timber, loss of soil fertility, soil erosion, drying up of water sources and loss to biodiversity are immeasurable losses by forest fire. Adverse impacts of forest fires are loss of valuable timber resources, degradation of water catchments areas resulting into loss of water, loss of wildlife habitat and depletion of wildlife, loss of natural vegetation and reduction of forest cover, deteriorating biological environment, adverse impact on health system and reducing tourism values. Besides the influential effect on water moisture content and vegetation composition, fire also increases the frequency of sheet flow and rill formation (Naveh, 1984) [11]. Fire cause disturbances which is inherent, unavoidable and affects in all levels of an ecosystem (White and Jentsch, 2001) [17].

7. Conclusion

Forests can no longer be used in the same way as they have been in the past. Forest products and services must be assured through new political choices and policy decisions that ensure the survival of forests. It becomes very important to have effective forest management plans with people participation. Prevention is better than cure i.e. by clearing the forest floor before the peak season of fire. There is a need of effective forest fire management policy. Hence we can say that limits of fire is good but exceeds are very harmful. The natural forest fire occurs unexpectedly but we can prevent wildfires from its occurrence by implementing the practice of prescribed burning thereby reducing the hazardous fuels.

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