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Forest Fire: Impacts and Control Measures

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Frequent forest fires have emerged as one of the most devastating threats to Himalayan biodiversity, adversely affecting the natural regeneration and productive capacity of forests. Forest fire adversely affects soil quality, wildlife population & habitat, and forest produce, resulting in the negative effect on the rural economy and ecosystem services (Kimothi M.M and Jadav N. R., 1998). Forest fire is defined as "any uncontrolled fire in combustible vegetation that occurs in the countryside or in a wilderness area". It has been classified as wild fire, brush fire, bushfire, grass fire, hill fire, squirrel fire, etc. depending upon its severity and the resultant damage (Cambridge Advanced Learner's Dictionary, 2008).

Woodland fire has been viewed as one of the major reasons responsible for altercation of biodiversity and change in climatic conditions. The earth's temperature is rising at a faster rate, causing increase in the fire intensity and expansion of fire prone area, especially during winter and summer months, which is known as the 'forest fire season'. Moreover, climate change and scanty precipitation in the Himalaya also assumes important role in occurrence and spread of forest fire (Lal et al., 2021). Forest fire results in a partial or complete degradation of vegetation which consequently results in the modification of radiation balance by increasing surface albedo and the production of greater surface runoff and soil erosion (Darmawan M. *et al*., 2001).

Most of the forest fire occurs in the Chir Pine forests, which later on extends to the associated species such as Banj Oak, etc. According to IIT Khadagpur, the habitat range of trees like Rhododendron will shift to north or north east due to the availability of higher soil moisture. The species such as *Pennisetum* which was widely used as a fodder by locals is being replaced by *Bidens pilosa* (thorns), *lantana camara* and *Erigeron annuus*. The forest fire results in the incomplete combustion of wood biomass which releases black the carbon. It also produces Ozone when poisonous gases like carbon monoxide reacts with sunlight.

The estimated average tangible annual loss due to forest fires in country is Rs.440 crore (US$ 100 million approximately). During *2021, the Forest Survey of India sent 3, 86,031 forest fire alerts which is more than double from the 2020's figure of 154,032. Overall* a total of 345,989 forest fires were recorded across the country. Due to lockdown, very less human movement and field activity was recorded during the forest fire seasons unlike previous years when inflammable leaves and woods were collected from the nearby forest area by the local habitat. The dry leaves shed from trees in spring and remained on the ground that increase the fuel load on the ground floor. The other states of country, such as, Madhya Pradesh, Chhattisgarh, Maharashtra, Jharkhand, Uttarakhand, Andhra Pradesh, Telangana, Mizoram, Assam and Manipur are also vulnerable to occurrence of forest fires. At least 700 species of bird and animals are at the high risk because of the forest fire.

Effects of forest fires on plant diversity

Severe fires have had a significant negative impact on the plant diversity. In areas, where human activities are in excess, the devastating fires sometimes lead to complete burning of the forest

leaving the soil completely bare. Those forests which are not adapted to fire can kill virtually all seedlings sprouts and young trees, because they are not protected by thick bark. Damage to seed bank, seedlings and saplings, are the major hinders to the regeneration of existing species (Woods P., 1989). *Terminalia* Species, such as, *T. chebula, T. Bellirica and T. tomentosa* are having good commercial and medicinal value, are facing severe problem due to forest fire. Species like *Lantana camara, Lagerstroemia indica, Eupatorium glandulosum, Parthenium hysterophorus, Cassia tora, Cassia occidentalis,* etc. have invaded the several sites. Many believe that fires have negative effects, but controlled fire is actually necessary to increase the biological diversity (Douglas *et al*., 1971; Kovacic & David A., 1998). The composition of forest species change post fire, which may be either good or bad depending on the utility of the stands that preceded and succeeded the fires (Lutz H. J., 1956).

Forest fire strongly promotes fire tolerant species like *Pinus roxburghii, Shorea robusta, Tectona grandis, Ziziphus* species, *Lyonia ovalifolia, Myrica esculenta, Pyrus pashia, Rhus parviflora* (shrub), *Chrysopogon aciculatus, Heteropogon contortus* (grass), *Crotolaria pallida , Desmodium microphyllum* (legume), *Ajuga parviflora* and *Micromeria biflora* (non-legume). After a forest fire some species which usually regenerates like *Lyonia ovalifolia, Lantana camara, Lagerstroemia indica, Eupatorium glandulosum, Parthenium hysterophorus, Cassia tora, Celtis occidentalis, Sarcococca* species and *Prinsepia* species.

Controlled fire can maintain forest health, recycle nutrients, promote tree species recovery, and eliminate intrusive weed & microorganisms. The increased population has created more pressure on the forest resources which is equally increasing the incidence of forest fire. Some plant species, such as, Pine require fire for breaking the seed dormancy which hasten the seed germination. The wild lupine (*Lupinus perennis*) plant is the sole food source of endangered Karner Blue butterfly (*Lycaeides melissa samuelis*). Wild lupine requires certain ecosystem balance and fire can alter that ecosystem. Despite the positive effect of controlled fire, most of the wildfires are destructive in nature that can lead to the extinction of species. Less than 5% of forest fires are caused by the natural factors, while majority of fire are caused either by the unknown things or by human interference.

Forest fire control measures

Forest fire incidence can be prevented by educating the people about the consequence of fire and increasing the participation of people in joint forest fire management. Early detection and warning system through a well co-ordinated system of observation points, efficient ground patrolling and communication network can effectively control forest fire. The increased emphasis on training, research and education on forest fire can contribute in preventing forest fire incidence. Another way to control forest fire is the development of waterholes across the mountains to recharge groundwater and to maintain the soil moisture (Dobhal S. *et al*., 2020).

(i) Forest fire control activities by forest department

Maintenance of an elaborate network of existing fire line, early clearing & burning of excess fuel, control burning in fire prone areas, training of staff & local residents relating to fire fighting methods and handling of fire can effectively control forest fire related hazards. The UKFD- ITGC fighting tools, use of remote sensing for forest fire monitoring by UKD-IT and GIS throughout the year, creating a quick response team by forest division and assigning them roles & responsibilities, clearing of dry forest matter along with roads & railway lines, sending daily reports by the division related to forest fire incidence and its current status are the major activity practices by forest department to control forest fire.

(ii) IT and Geo-informatics plays very crucial role in mitigating fire by sending alerts. The UK-FD provide training and support in IT & GIS applications across the department, it also maintains preparatory planning's in the pre-fire season by real time active fire detection for

monitoring & mitigation in the fire season and damage assessment & investigation in the post fire season. The fire detection is done using RS and GIS, while IT delivers the fire related information to the ground level staff in time. Some of the forest fire management strategy or the SOP used by IT-GIS is mapping of fire sensitive areas for planning purpose and identification of fire prone areas by using the previous 10 years forest fire locations data from all over the state. Locations classified as, sensitive, moderately sensitive & most sensitive and then a composite map of the identified forest areas sensitive to forest fire was prepared & released to the respective divisions for the planning purposes.

(iii) Bhuvan Portal

Bhuvan is a Geo-portal of ISRO show casing Indian imaging capabilities in multi sensor, multi-platform and multi- temporal domain. The Portal gives a gateway to explore and discover virtual earth in 3D space with specific emphasis on Indian region. Bhuvan provides timely disaster support services and free satellite data with products download facility and rich thematic datasets to enrich its maps and collect point of interest data. So, it plays an important role during the process of forest fire mitigation. The Bhuvan portal gives exact location of fire.

(iv) Post Fire Alerts

Dissemination of active/post fire alerts by Information Technology and Geo-informatics Centre (ITGC) is also getting daily post fire alerts directly from National Aeronautics Space Administration- Fire Information for Resource Management System (NASA-FIRMS), through email that includes near real time active fire data.

Conclusion

Imparting environmental education, training and awareness for controlling forest fire can reduce the fire hazards as well as the fuel load in the forests. Regular controlled burning can mitigate the intensity and severity of forest fire. Encouraging the use of flammable biomass available around human settlements for other purposes, such as, organic manuring and making fuel bricks from pine needles, etc. can reduce the fuel load in forest. Increasing the height of rills created for resin tapping on the tree bole could minimize forest fire injuries to the individual trees. Plantation of multipurpose and locally valued tree species for fodder, fuel wood and minor timber (e.g., *Bauhinia* spp., *Celtis australis*, *Dalbergia sissoo*, *Ficus roxburghii*, *Grewia optiva*, *Quercus* spp., etc.) should be given priority over pine which apart from fulfilling the local needs also reduce the flammability in forests.

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