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LIKELY IMPACTS OF CLIMATE CHANGE ON FOREST FIRES AND ADAPTATION STRATEGIES

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ABSTRACT

Forest fires devastate forests that provide livelihood opportunities to millions of people around the world, besides emitting green house gases responsible for global warming. They are also detrimental to wildlife habitat and adversely impact ecotourism on which local communities depend. On the other hand, forest fire as a natural process helps forests by promoting flowering, branching and seedling establishment, besides aiding natural regeneration. The heating of the forest floor also result in beneficial microbial activity, and hasten decaying processes useful for the forest vegetation. In the background of changing climate, the recent global level studies are indicating a large increase in forest fires, which are projected to be higher by 38% over the next 30 years and 62% by the end of the century. The evidences of enhanced forest fires from around the world are also supporting these projections. The major forest types vulnerable to enhanced forest fires in India are the Tropical Dry Deciduous Forests, Tropical Dry Evergreen Forests, Tropical Thorn Forests and Sub-tropical Pine Forests, besides several others. The paper discusses the likely impacts of climate change on forest fires and ensuing challenges in management of forests. The adaptation and mitigation strategies to deal with the increasing forest fires are also suggested.

Key words: Forest Fires, Wildfire, Climate Change, Adaptation, Mitigation.

Introduction

Forest cover is one of the most prominent features of the global landscapes covering more than 30 per cent of its geographical area. These forests, spread over different physiographic zones, are integral to environment, economy, culture and history of the different countries. In addition to well-known tangible benefits such as timber, fuelwood, fodder, fibre, grasses and other NTFPs, forests also provide a number of ecosystem services. The Millennium Ecosystem Assessment (MEA, 2005) classified forest ecosystem services in four broad groups, i.e., provisioning services, cultural services, regulating services and supporting services. The provisioning services include all consumptive benefits like timber, non-timber forest products and genetic resources. Even provisioning of fresh water is one of the most important services. As per World Bank, 2016 forested watersheds and wetlands supply 75% of global fresh water for domestic, agriculture and industrial needs. The cultural services are non-consumptive benefits obtained from forests like religious and aesthetic values, habitat and recreational benefits such as ecotourism. The regulating services are the functional benefits like carbon sequestration and storage, hydrological services, watershed protection, biological control, pollination and natural hazard mitigation. The supporting services are the key services like soil formation, primary production, nutrient cycling and biodiversity, on which all other ecosystem services depend.

Every year, about 350 million hectares of land are devastated by forest fires worldwide, which correspond to about the size of India (Knorr *et al.,* 2016). Forest fires could be dangerous, and require special precautions to make sure they are not carelessly ignited. Crown fires destroy forests that provide livelihood opportunities to millions of people around the world, besides emitting green house gases (GHGs) responsible for global warming. They are also detrimental to wildlife habitat and adversely impact ecotourism on which local communities depend. On the other hand, a forest fire as a natural process helps forests by promoting flowering, branching and seedling establishment. The fires that are limited to the surface are known to help in the natural regeneration of forests. The heating of the forest floor also result in helpful microbial activity, and hasten decaying processes that are useful for the vegetation. In fact limited fires in forests and grasslands are essential as they contribute to natural rejuvenation and biodiversity of the area (Knorr *et al.,* 2016). In India, forest fires are widespread and recurring phenomenon and cause extensive damage to forests (ICFRE, 2010). Most of the fires originate because of anthropogenic influence as people light fires in forests for reasons such as seed collection; induce grass growth and shifting cultivation.

Under the influence of changing climate, the forest ecosystems are under threat due to likely spurt in forest fires which requires developing strategies for planned adaptation and mitigation.

Projection for future Climate

The fifth assessment report (AR5) of Inter-governmental Panel on Climate Change (IPCC) has confirmed that warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The report also highlights that each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 and in the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years. The report further states that the global surface temperatures have risen by almost 0.89°C over the period 1901-2012 and more than half of the observed increase in temperature during 1951-2012 has been caused by human activities (IPCC, 2013). The report has also predicted that relative to the reference period of 1986-2005, the global surface temperature increase by the end of 2100 is likely to be in the range of 1.5°C to 4.5°C, which is expected to cause further warming and induce many changes in the global climate systems during this century.

A scientific study from Indian Network for Climate Change Assessment (INCCA, 2010) on prediction of future climate for India has predicted an all round warming over the Indian sub-continent associated with increasing greenhouse gases (GHGs) concentrations. The study has projected a likely rise in annual mean surface air temperature by the end of the century in the range of 3.5°C to 4.3°C. The prediction also depicts that there may not be significant decrease in the monsoon rainfall in the future except in some parts of the southern peninsula; instead of that it may rise and vary from 9% to 16% towards the end of the 21st century. The Net Primary Productivity (NPP), however is projected to increase by an average of 30.3% by 2035 and by 56.2% by 2085 due to expected increase in CO_2 fertilization.

Likely impacts of climate change on Forest fires

As per IPCC fourth assessment report (IPCC, 2007) a large increase in fires over much of the globe is expected as we move through this century. The assessment has been made by using fire models driven by output from sixteen climate models used in the fourth assessment report, which projects that 38% of the planet should see increases in fire activity over the next 30 years. This figure increases to 62% by the end of the century. However, in many regions where precipitation is expected to increase, particularly in the tropics, a decrease in fire activity is predicted. The scientists have predicted that 8% of Earth will see decreases in fire probability over the next 30 years, and 20% will see decreases by the end of the century. The four important factors which govern the fire probabilities are extent of vegetation, precipitation of driest month, mean temperature of warmest month, and the difference between summer and winter temperature. Two other minor factors were mean temperature of wettest month, and annual precipitation. The report also conveys that future fire occurrence appears to primarily be a function of available moisture in many areas, and that the expected global increase in temperature of 3.5°C used in the models will not become the single dominant control on global wildfires.

The concerns continue to grow about the effects of climate change on forest fires with more and more studies confirming the same. In a global level study by Jolly *et al*., 2015, the authors used three daily global climate data sets and three fire danger indices to develop a simple annual metric of fire weather season length, and mapped spatio-temporal trends from 1979 to 2013. The results have shown that fire seasons have lengthened across 25.3% of the Earth's vegetated surface, resulting in an 18.7% increase in global mean fire weather season length. The results also exhibited a doubling of global burnable area affected by long fire weather seasons, and an increased global frequency of long fire weather seasons across 53.4% of Earth's vegetated surface during the second half of the study period. Hence they concluded that the climate strongly influences global forest fire activity, and recent forest fire surges may signal fire weather-induced pyro-geographic shifts. According to another study by Liu *et al*., 2013, by 2050, the forest fires are expected to increase by 50 per cent across the United States under the changing climate, and by over 100 per cent in areas of the Western US. The authors further add that forest fire is a disturbance of ecosystems, besides impacting the atmosphere. They also modify terrestrial ecosystem services such as carbon sequestration, soil fertility, grazing value, biodiversity, and tourism.

As per US National Climate Assessment of 2014, sixteen per cent of the total greenhouse gas emissions from fossil fuels are in effect offset by carbon storage in forests and wood products each year. However this rate of carbon uptake by forest sector is projected to reduce in future and by 2030 or even earlier, the nation's forests could flip from being a net carbon “sink” to a “source” of emissions (Anon., 2014). In Canada, the two major forest disturbances of wildfires and outbreak of mountain pine beetle has already converted forests from being the net sink to the source of carbon between 2000 and 2005 (Kurz *et al*., 2008).

Scientists and policymakers are now seriously concerned about the atmospheric effects of forest fires

emissions on climate. These fires adversely impact atmospheric conditions through emissions of gases, particles, water, and heat. Some of the studies have focused on radiative forcing from fire emissions. As per some scientists (Gonzalez *et al.,* 2015) smoke particles from forest fires reduce overall solar radiation absorbed by the atmosphere at local and regional levels but the global scale, fire emissions of carbon dioxide contribute substantially to the global greenhouse effect. Hence, scientists now believe that as a result of changing climate, the forests across the world could start to burn more, or burn in more devastating manner resulting in substantial increase in GHGs that could be large enough to further stoke climate change. Just as growing tree sequester carbon out of the atmosphere through the process of photosynthesis, a tree burnt in the fire will do the reverse and release it back again. A study on above ground live carbon stock changes of California wildland ecosystems conducted during 2001-10 has illustrated how carbon stock losses from wildfires can potentially exceed carbon sequestration at a local scale (Gonzalez *et al*., 2015).

In a climate in which wildfires are a steady and regular occurrence but don't change much in intensity or number from year to year, they will still release carbon, but the re-growth of forests and other plant life will sequester the same again resulting in balancing the earlier release (Bowman *et al.,* 2009). But this balance is likely to be disturbed with increasing levels of emissions in a climate where there is a change of the size, number, or intensity of forest fires. In such a situation the forests would burn and release carbon considerably faster than gradual replacement by re-growth resulting in a substantial positive feedback on the climate system.

Climate Change and Forest Fires in India

There is hardly any study available in India on likely impacts of changing climate on occurrence and spread of forest fires. However, a few studies are available on likely impacts of climate change on forests of the country. The study by Ravindranath *et al.,* 2006 on analysis of the 35,190 forested grids at national level reports that more than two third forested grids are likely to undergo vegetation change by the year 2100. Almost all major forest types of India, *viz.,* Deodar, Fir-Spruce, Sal, Chir-pine, Fir, Blue pine, Mixed Conifers, Western Ghat semi-evergreen forests, Western Ghat evergreen forests, Mangroves, Khair-Sissoo forests, Scrubs, Miscellaneous forests, Up-land hardwoods, Teak, Bamboo forests, Khasi pine and Depterocarps species are likely to be impacted by the projected climate change. The study further states that these impacts are expected to have adverse socio-economic implications for the forest-dependent communities and the economy of the country. While discussing the adaptation strategies the study recommends the initiation of forest fire management in a more dedicated manner as an important adaptation measure.

Another study on the assessment of climate impacts on forests by Gopalkrishnan *et al.,* 2011 showed that at the national level, about 45% of the forested grids are projected to undergo change in vegetation. Vulnerability assessment showed that the vulnerable forested grids are spread across India. However, their concentration is higher in the upper Himalayan stretches, parts of Central India, northern Western Ghats and the Eastern Ghats. In contrast, the northeastern forests, southern Western Ghats and the forested regions of eastern India are predicted to be the least vulnerable. As per the study, a low tree density, low biodiversity status as well as higher levels of fragmentation, in addition to climate change, contribute to the vulnerability of these forests. The mountainous forests, i.e., sub-alpine and alpine forest, the Himalayan dry temperate forest and the Himalayan moist temperate forest are susceptible to the adverse effects of climate change. This is because climate change is predicted to be larger for regions that have greater elevations. This study also did not investigate the likely impacts of changing climate on forest fires but has recommended incorporating fire protection and management practices, and implementing advance fire warning systems and adopting sanitary harvest practices and thinning as adaptation measures.

India's Second National Communication to UNFCCC also highlight the vulnerability of India's forests and report that out of 1064 vegetation grids, 326 (30.6%) grids are projected experience change in vegetation by the year 2035 and the number goes to 489 (45.9%) by the year 2085. This amply demonstrates the vulnerability of India's forests to the changing climate (MoEF, 2012), which would be additional pressure on forests, besides huge anthropogenic influence that already exists.

Available literature on analyses of forest fires in India also points towards its increasing trend. The study carried out by Srivastava and Garg, 2012 on regional and temporal analysis of forest fires in India using MODIS (Moderate Resolution Imaging Spectroradiometer) data from Web Fire Mapper on active fire location for 2001-11 attempted to relate vegetation fire incidences with causal factors and vulnerability of the forest types in India. Four regional cluster variations based on forest types were obtained and authors found that Tropical Dry Deciduous

Forests contributed the highest number of fires with maximum numbers in 2004, 2009 and 2010. The main factor affecting the spread of forest fire was inflammable material, i.e. type and characteristics of vegetation. The study also analyzed the vegetation component using land use/land cover maps derived from satellite data, and anthropogenic factors such as livelihoods coupled with fire-favorable weather. Based on the findings of the study, the authors have recommended an integrated approach to forest fire management and use of remotely sensed data for prevention by setting up of early warning systems.

Another study on assessment of increasing threat of forest fires in Rajasthan has been carried out by Krishna and Reddy, 2012 during the summer months of March to May for the period of 2005-10 based on observation of multi-temporal IRS P6 AWiFS data sets. Observations during the study period showed the increasing intensity and spread of forest fires in Rajasthan with maximum burnt area in 2009, which happened to be the warmest year since 1901, indicating the role of changing climate. The study further showed that the fires have been more prevalent in dry deciduous forests which accounted for more than 90% of the burnt area. The abundance of fires in the edge forests in relation to interior forests clearly indicated the significant anthropogenic influence.

Climate Change Impacts on Forest Fires: Some Evidences

There are many evidences of enhanced forest fires from around the world besides several studies projecting higher incidences for future as well. In 2011, wildfires consumed more than 8 million acres of forest in the U.S.A. causing 15 deaths and more than $1.9 billion in damages. Warm temperatures and drought conditions during the early summer contributed to this event (USGCRP, 2014).

As per NASA Langley Research Center (NASA, 2010), thousands of wildfires, large and small are underway at any given time across the globe. Beyond the obvious immediate health effects, this "biomass" burning is part of the equation for global warming. In northern latitudes, wildfires actually are a symptom of the Earth's warming, and research suggests that a hotter Earth resulting from global warming will lead to more frequent and larger fires. Wild fires are mostly occurring in Boreal forests in Alaska, Canada, Russia, China, Scandinavia, Savannah grasslands in Africa, Tropical forests in Brazil, Indonesia, Colombia, Ivory Coast, Thailand, Laos, Nigeria, Phillipines, Burma, Peru, and Temperate forests in U.S. and Europe. The fires are more common in boreal forests of northern latitudes due to their warming, and experiencing less precipitation, making them more susceptible to fire. Coniferous trees which commonly inhabit these forests shed needles, which are stored in deep organic layers over time and provide abundant fuel for fires. These fires burn the hottest and contribute more pollutants per unit area burned.

Forest Fires in India: Recent Trends

Uncontrolled fires have been causing tremendous damage to the forest biodiversity of the country. It occurs under conditions of high temperature, extreme dryness, strong winds and low moisture in the forest floor. Since the year 2005, FSI has been monitoring forest fires across the country using inputs received from Moderate-resolution Imaging Spectroradiometer (MODIS) satellite system. While carrying out National Forest Inventory (NFI), FSI also observes the incidence of fire ocularly and classify it as 'heavy' if the area is affected by fire more than 50%, 'moderate' if the area is affected 10-50%, and 'mild' if the area is affected less than 10%. A total of 2,41,892 forest fires have been reported from 2004-2005 to 2015-2016 in the country. From this survey it is observed that the Tropical Thorn Forests, Tropical Dry Deciduous Forests and Sub Tropical Broadleaved Forests are most prone to the forest fires. The study also reveals that 1.68 m ha (2.4%) of the country's forests are reported to have heavy fire incidence, 5.26 m ha (7.5%) forests have moderate fire incidence, 38.17 m ha (54.4%) forests have mild fire incidence and 26.06 m ha (35.71%) forests recorded no fire incidence (ISFR, 2015). Though the trends of forest fire incidences have not been provided but the State wise estimate of annually burnt forest area during 2002-2008 revealed that on an average 2.13% of recorded forest area experienced moderate to heavy fires and 3.83% experienced mild to heavy forest fires (ICFRE, 2010).

An earlier study conducted by FSI in 1995 involved 26 States for forest fire mapping using IRS-1B/LISS-I satellite data for the period of April to June. The visual interpretation of data classified the whole forest area into fire affected, smoke, and fire unaffected. The study suggested that 1.45 m ha (2.31%) forest cover was affected by fire (FSI, 2004). Another study specifically carried out in 8 districts of Uttarakhand in 1999 based on WiFS data showed that 22.42% of the forests were observed to be either severely or moderately burnt. The similar study in the same year for the whole State using LISS-III data revealed that 22.64 % of forest cover was affected by fire, indicating that the State of Uttarakhand is most vulnerable to the forest fires (FSI, 2004). The vast tracts of forest lands in Uttarakhand between 1000 and 1800 m range are covered with Chir pine, which though fire hardy is vulnerable to the forest fires. The researchers from Centre for Ecology Development and Research have reported that

with the changing climate leading to lengthening of fire season, an increase in the frequency and severity of forest fires in fire prone area is expected (Thadani *et al.*, 2015). Regional and temporal analyses of forest fires for the period 2001-11 by Srivastava and Garg, 2013, also reported regular heavy incidences of fires in Chir pine forests of Uttarakhand in summer months. The State had been in news for enhanced forest fires in May, 2016 when it had to deploy National Disaster Response Force and made use of Indian Air Force Mi-17 helicopters to douse the fires.

Suggested Measures for Adaptation and Mitigation

The recorded forest area of India is 764,566 km^2, which constitutes 23.26% of its total geographical area. By legal status, Reserved Forests constitutes 12.93%, Protected Forests 6.37% and Un-classed Forests 3.96% of the geographical area (ISFR, 2015). The country is endowed with very rich flora and fauna. The forests are unique with spectacular plant groups such as Conifers, Sal, Teak, Bamboos, Casurina, Dipterocarps and many other species. The country has 103 national parks, 536 wildlife sanctuaries, 18 biosphere reserves, 26 conservation reserves and 67 community reserves (WII, 2016) where in most of the biodiversity is understood to be existing. Approximately 275 million people in India are known to live in the forest fringes and earn bulk of their livelihood from forests (World Bank, 2006). The forest ecosystems in India are under heavy socio-economic pressures like unsustainable harvests of forest products, encroachments, wide spread invasive species and various other biotic interferences leading to forest degradation. Adverse impacts of Climate Change resulting in enhanced forest fires would be an additional pressure on the already vulnerable vegetation. This can significantly affect the livelihood opportunities and availability of goods and services from forests.

The scientists and the research community believe that frequency, severity and area affected by forest fire are likely to increase in future resulting in loss of the services that the forests provide. The major forest types vulnerable to enhanced forest fires in response to changing climate are the Tropical Dry Deciduous Forests, Tropical Dry Evergreen Forests, Tropical Thorn Forests, and Sub-tropical Pine Forests, besides several other sub-types. Hence, there is a need to device adaptation strategies aimed at improving the resilience of forests to the projected devastating effects of fires. In this background, following suggestions are made:

1. Climate change guidelines for forest managers given by FAO could be usefully applied which call for integrated forest fire management as an essential part of the climate change adaptation and mitigation strategy (FAO, 2013). It encompasses fire prevention, preparedness and suppression, and forest restoration after fire. The strategy should promote fire smart landscapes that are resistant to the spread of fire and resilient to its occurrence. This could be carried out by following the standard fire prevention, management and control protocols developed over a period of time at every vulnerable location.
2. The country needs to carry out scientific study on likely impacts of climate Change on forest fires of India. One such study by Flannigan *et al*., 2000 addresses the impacts of climate change on forest fires and describe how this, in turn, will impact on the forests of the United States. The study has used two transient general circulation models (GCMs), namely the Hadley Centre and the Canadian GCMs, to estimate fire season severity in the middle of the 21st century. Ratios of $2\times CO_2$ seasonal severity rating (SSR) over present day SSR have been calculated for the means and maximums for North America. The results suggested that the SSR would increase by 10–50% over most of North America, which would translate into increased forest fire activity. The study concluded that forest fires could be viewed as an agent of change for US forests as the fire regime will respond rapidly to the warming world. It is high time that such studies are initiated in India so that likely impacts of climate change on forest fires could be predicted for building a pro-active approach to deal with the aggravated forest fires.
3. Forest fires are the secondary effect of climate change as they result from increased temperature and drought. These fires get aggravated with late or failure of pre-monsoon rainfall. In order to mitigate the impact of climate change of forest fires Thadani *et al*., 2015 have suggested management of fuel type and fuel load along with fire lines with increasing participation of local communities so that forests especially of Chir pine and Oak and other vulnerable types could be saved from bigger fire events. They have suggested simple strategies such as use of pine needles as an alternate source of energy, plantation of fodder grasses, and involving local people in management of these areas and protection and reporting duties against economic incentives. The State Forest Departments also needs to strengthen the existing fire alert, detection and management systems and work towards reducing the response time. Pursuant to the directions of Hon'ble Courts, the

State of Uttarakhand is already seized with the task of upgrading their infrastructures, technology and staff strength for prevention and control of forest fires along with involving the local communities meaningfully in this audacious task. Building capacity of front line staff will also be critical to the success of these measures.

4. It will also be appropriate to act on the recommendations of The National Forest Commission (MoEF, 2006), which call for all fires extending over 20km^2 of forest and grasslands be declared as a disaster by the concerned State Government; developing appropriate techniques supported by suitable equipment and making the staff accountable by reflecting their commitment in their annual performance reports, and to curb the underreporting of forest fires by devising a mechanism of regular cross-checking by higher authorities.
5. Climate change concerns are recognized in National Working Plan Code-2014 wherein forest fires and protection are dealt under the objectives and essentials of forest management planning. The Code has recommended carrying out fire frequency and burnt area mapping for fire vulnerability on one hand and operational fire monitoring on the other. Based on this the Code has also prescribed for an exclusive or overlapping mandatory Working Circle (WC) related to maintenance and enhancement of forest health and vitality with 'Forest Fire Management' in list of such suggested WCs. However, the SFDs need to go a step further to record more information on area affected by forest fires in Part-I on summary of facts. This part of the chapter should be more elaborate and specifically record incidences of fire and co-relate them to its chronology with the temperature during the occurrence. The data thus obtained needs to be analyzed to foresee the future occurrences so that decision on including the area in 'Forest Fire Management' WC could be taken. The States need to issue more objective guidelines in this regard.
6. The serious issue of likely surge in forest fires in wake of changing climate also warrants a strong mention in the new Forest Policy pending with MoEF&CC for review and consultation. It is essential that serious problem of climate change induced forest fires find an explicit mention in the new Forest Policy supported by a clearly spelled out strategy on their adaptation and mitigation.
7. Recognizing the large dimension of the problem, the success in prevention and control of forests fires can only be achieved by active involvement of the local community groups by making them as partners in integrated forest fire management. Creating mass awareness on this burning issue of aggravated forest fires could also be critical in motivating the people's involvement. The country may learn from the experience of U.S., where way back in 1944, the US Forest Service and the Advertising Council created a Muscat named 'Smokey Beer' and made it a symbol for their joint effort to promote the prevention of forest fires. The poster of Smokey Beer depicted the slogan *'Care will prevent 9 out of 10 forest fires'*, which later changed to *'Only you can prevent forest fires'*. This campaign had been a great success over the last 72 years. The importance assigned to the Muscat could be gauged by the fact that the name and image of Smokey Beer is protected by the U.S. federal law, *the Smokey Beer Act of 1952*. Scores of books, animations, posters, stamps, videos and celebrations have been dedicated to the Smokey Beer, who attained an iconic status over the years.

Conclusion

IPCC fourth assessment report predicts a large increase in forest fires over much of the globe as we move through this century. The assessment has been made by using fire models driven by output from sixteen climate models, which projects that 38% of the planet could see increase in fire activity over the next 30 years. This projection is supported by whole body of evidences of enhanced forest fires from around the world besides several studies projecting higher incidences for future as well. Uncontrolled fires have been causing tremendous damage to the forests and biodiversity of our country. As per FSI, presently two third of the country's forests are reported to suffer from mild to heavy fire incidences. The scientists and the research community believe that frequency, severity and area affected by forest fires are likely to increase in future resulting in large scale devastation besides substantial emissions of GHGs. This alarming situation demands to device adaptation strategies aimed at improving the resilience of forests to the projected higher incidences of forest fires. The measures such as fire prevention, preparedness and suppression, and restoration of fire affected areas could be essential components of adaptation and mitigation strategies.

वनाग्नि एवं अनुकूलन रणनीतियों पर जलवायु परिवर्तन का संभावित प्रभाव

मोहित गेरा

सारांश

वन अग्नियाँ वनों का भारी विध्वंश करती हैं, जो ग्लोबल वार्मिंग तापन के लिए उत्तरदायी ग्रीन हाउस गैसों का उत्सर्जन करने के अलावा विश्व भर में करोड़ों लोगों के लिए आजीविका के सुअवसर उपलब्ध कराते हैं। ये वन्यजीव आवासों के लिए भी हानिकर हैं और ये पारिपर्यटन पर भी प्रतिकूल प्रभाव डालती हैं जिन पर स्थानीय समुदाय निर्भर रहते है। दूसरी ओर एक प्राकृतिक प्रक्रिया के रूप में वनाग्नि प्राकृतिक पुनर्जनन में सहायता देने के अलावा पुष्पण, शाखन एवं पौध स्थापना को प्रोत्साहित करके वनों की सहायता करती है। वन फर्श के तापन के फलस्वरूप लाभकारी जीवाण्विक कार्यकलाप भी होते हैं और यह क्षय प्रक्रियाओं को तेज करती है, जो वन वनस्पति के लिए उपयोगी है। परिवर्तनशील जलवायु की पृष्ठभूमि में हाल ही के विश्व स्तरीय अध्ययन वनाग्नियों में व्यापक वृद्धि को दर्शाते हैं, जो अगले 30 वर्षों में 38 प्रतिशत तक और शताब्दी के अन्त तक 62 प्रतिशत तक उच्च होना प्रक्षिप्त किया गया है। विश्वभर से वर्धित वनाग्नियों के प्रमाण भी इन अनुमानों का अनुमोदन करते हैं। भारत में वर्धित वनाग्नियों के प्रति संवेदनशील प्रमुख वन किस्में कई अन्य के अलावा उष्णकटिबंधीय शुष्क पर्णपाती वन, उष्णकटिबंधीय शुष्क सदाहरित वन, उष्णकटिबंधीय कंटीले वन और उप-उष्णकटिबंधीय चीड़ वन हैं। इस शोधपत्र में वनाग्नियों और वनों के प्रबंधन में अनुवर्ती चुनौतियों पर जलवायु परिवर्तन के संभावित प्रभावों पर विचार किया गया है। वर्धमान वन अग्नियों का सामना करने के लिए अनुकूलन एवं न्यूनीकरण रणनीतियों का भी सुझाव दिया गया है।

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