

Pyro Geography and Indian Quest during Anthropocene to COVID-19

Siba Prasad Mishra^{1*}

¹*Civil Engineering Department, Centurion University of Engineering and Technology, Bhubaneswar, India.*

Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/IJECC/2021/v11i730449

Editor(s):

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Complete Peer review History: <https://www.sdiarticle4.com/review-history/72931>

Original Research Article

Received 05 August 2021

Accepted 07 September 2021

Published 15 September 2021

ABSTRACT

Taming fire by homosapiens was one of the foremost technological advancement in the history of evolution. The homosapiens tried to tame the wild fire by locating, preserving, using as tools for hunt game, food preparation, rituals and religion, and protecting them from predators. The modern men in Anthropocene in Pyroxene period, the fire have been used for domestic, industrial, and pioneering researches to concur the earth. The type of ignition to our vast deciduous forests can be natural, accidental, out of negligence, deliberate, incendiary, agriculture purposes, resource collection, and at times cultural. Present assessment embraces the changes that occurred in the wildfire due to weather-related and anthropogenic ignited. The wild fire deaths in towns, factories and mines have been reduced for the last six years. But during the pandemic COVID-19 under the locks, shutdowns and curfews, the numbers of crowdie and industrial fires in India has abridged, but dependence on forest products for livelihood by the aboriginal people and global warming had increased numbers of forest fire in India. There are also increased electrocution fatalities in different hospitals in India due to oxygen enriched surroundings during the present Pandemic.

Keywords: *Anthropocene; electrical fire hazard; GIS; pyrocene; similipal forest; wildfires.*

ABBREVIATIONS

| | |
|---------|--|
| MYBP | : Million years before present |
| NER | : North Eastern Region |
| MOEF&CC | : Ministry of Environment, forests and Climate Change |
| MODIS | : Moderate Resolution Imaging Spectro-radiometer sensor |
| AVHRR | : Advanced Very High Resolution Radiometer; |
| FSI | : Forest Survey of India |
| AHP | : Analytical Hierarchy Process |
| PVTG | : Part to the vulnerable tribal group |
| NASA | : National Aeronautics and Space Administration |
| GIS | : Geographic information system; RS: Remote sensing; FSI: Forest survey of India |
| GFW | : Global foundation watch |
| MODIS | : Moderate Resolution Imaging Spectro-radiometer sensor |
| FP's | : Fire points |
| MYBP | : Million years before present |
| TYBP | : Thousand years before present |
| M.P. | : Madhya Pradesh |
| HP | : Himachal Pradesh |
| VIIRS | : Visible Infrared Imaging Radiometer Suite |
| NER | : North eastern region |
| IMD | : India Meteorological department |
| NFPA | : National fire protection association |
| NCRB | : National Crime Records Bureau |
| NFPA | : National fire protection association |
| SDG | : Sustainable development goals |
| ICU's | : Intensive care units |
| FAST | : Forest Fire Alert System |
| SWIR | : Short Wave Infrared |

1. INTRODUCTION

Pyrocene is considered the geospatial period, when man started using fire and the impact of fossil fuel influenced as the ecological signatures of the Homosapiens, till to the present Anthropocene epoch [1,2]. Anthropocene is considered as the recent epoch (yet to be officially stamped), succeeding Holocene geological time scale where human activities have significantly changed some processes of the hydro-geo-biosphere of the earth [3,4,5]. Among all the players of mass extinction, the global warming and the associated fire blazes can cognitively challenge climatological performances linked with accessing, booming, retaining and finally utilizing fire [6,7].

Hinduism claims all matters in the universe are composed of Panchavutas (five basic elements)

i.e. Prithivi, (earth), Jala (water), Tejas (fire), Vayu (air) and Akasha (space). Agni is the fire-god next to lord Indra (the god of rain). Vedic's realm claims, Agni is the lord of pathway and the courier between the almighties that handover the oblation the offerings, link^[1]. The fire, physical form of light and heat instigates the artifacts till human civilization where the source is the sun. Among all, the Homosapiens could be able to tame the fire and is in the advancement processes that provided them the warmth and the light which kept predators away. Hominids were used to preserve natural fire that had occurred from lightening, forest fires etc. [8,9]. Proxies of fire ashes with scorching evidences were found from archaeological exhibits of hearths, dating from ≈ 1.5 MYBP but more prominent from about 0.7 to 0.4 MYBP, [10,11,12]. The homage to Agni through the fire ceremony (Yagnya or Homa) is considered in Hinduism as gadget that couples the sattvic excellence of the Aryan fire that shaped the Indian environs [13]. The taming and effective use of fire is shown in the fire tree (Fig. 1).

A wildfire is an accidental fire, which has burned in an area expected, such as a forest, meadow, corral, or steppe since ancient times, including recent crowd fire and electrocution disasters. In the tropical climate like India it is contributed by rise in temperature and excessive land use, Link [2]. These fires can also be anthropogenic or natural. They can happen at any time or anywhere throughout the globe. About 50% of wildfires recorded, it is not known how they started, [14]. The threat of wildfires is up surging during Anthropocene epoch exceptionally in dry settings, like drought, dry summer, high temperatures and high winds. Wildfires can attack the natural bio-geo environment which can disrupt conveyance, public services, power and emergent services, and water supply that exuberates the decline of the air quality, and damage of properties, crops, resources, animals and people. As per International Disaster Database (EM-DAT), the major incidence of wildfire, from 1901 to 2014 were 387 events, killed 3753 people, injured 6812 people and affecting 6 million people [15,16]. The number of fire human deaths as per center for fire statistics in the years 2015 to 2019 were 17700, 16896, 13159, 12747, and 10915 are for respective years [17].

Present study is to probe natural wild and monstrous fire episodes of Pleistocene epoch, which was domesticated and became a part of

the present social culture with a blend of catastrophes. The past naturally occurring wild fire has been tamed to be utilized at every step of modernization and scientific advancement but at times turn wild to become apocalyptic to the people, climate, and biodiversity.

2. REVIEW OF LITERATURE

The application and taming of fire was an innovative technological repertoire search of the Hominins. They had controlled and made intelligent use of the wild glow that began in the Pleistocene epoch 1.5 to 2.5 MYBP and indicate that the use of fire was the exclusive property of humans and not of any other mammal on earth, [18,12,2,19,20]. Demark of the high risk zone mapping of various forests against fire have been done by various authors and considered the factors like land cover types, aspect, slope angle, landscape wetness index, and distance from road, settlement, tourism hubs, anti-poaching camp sheds *etc.* using soft-wares like Arc GIS, Q-GIS, ERADAS and many software, [21,22,23,24,25]. The global fire counts had surged by 13% between 2019 and 2020. About 75% of wild fires are caused by anthropogenic activities, and 65% of tropical forests burn annually. The carbon quantity in average has been sequestered by the present biome calculated (t CO₂ per ha) from tropical and Savanna forests 23 % and 18 % respectively with increase in extent of fire season annually on average by 19 %in the globe. Link ^[3].Average fatalities due to forest fire were 71people/year but since 2015 it has been increased to 122 people/year, Link⁴.

FSI surveyed incremental surge in forest fires during 21st century as there were 8654 forest points (FP's), 30892 FP's, 35888FP's, in the years 2004-05, 2009-10 and 2017 respectively, Link⁵. The present interaction between wildfire, the eco-sphere and the biome have drawn the attention of the fire managers and the environment thinkers. The reporting of global fire emission data base (GFEDB) was recorded from 1982 to 2017. Later the help of MODIS (AVHRR) Change Detection and Classification (CCDC) is made by time-series model, which gave Landsat data monitoring land cover change along with the fire severity [26,27,28].

3. METHODS AND METHODOLOGY

Fire is a long and complicated process in forests, that are good servants but often bad masters if

they are wild and not properly tamed. The fire can be superficial, underground or in the crown. The domestication of fire in the Indian subcontinent dates back to 30 KYBP from charcoal finds (hearths) from the archaeological sites of Deoghat, Koldihwa, Mahagara, Chillahia, Chopani-Mando and the Belan River Valley, [29]. The MODIS data (Moderate Resolution Imaging Spectro-radiometer sensor) has reported there were 29547 fires were reported in the year 2019. About 35MH of area are under wildfire annually [30,31]. But present days we can use various innovative technologies to know about the forest fire sites through GIS. The Advanced Very High Resolution Radiometer (AVHRR) sensor series are widely used to develop pre-MODIS daily historical records. However, compared to MODIS, the AVHRR sensor has a lower geometric and radiometric quality and lacks the short-wave infrared (SWIR) band.

The forest fire data has been gathered from various sources, forest survey of India through various articles, up-to-date fire analysis reports given in internet sources. Since the fire deaths in hospitals have increased due to electrocution during last 5 years and particularly during COVID-19 (ICUs and COVID Hospitals) an attempt has been made together the hospital fire deaths along with forest fire and urban fires to prove the fire disaster is a curse in disguise due to change in global warming and climate change.

3.1 Fire in Geological Time Scale

Geographically the period belongs to Cenozoic era, Quaternary period and the anthropogenic Epoch which is accepted but yet to be declared from the atomic explosions started from 1950. The present Anthropocene epoch superseding the transient 11800years old Holocene epoch which is characterized by waning of arboreal plants, and rise of herbaceous vegetation. The naturally boosted fire during early pyroxene period, has changed the sources of ignition to natural, accidental, out of laxity, deliberate, incendiary, agriculture purposes, resource collection, and at times cultural during the Anthropocene epoch.

3.2 Fire in Past

The troglodytes of South Africa (1.5MYBP) used to tame fire from its ferocity as they started cooking food in hearths. The presently extinct hominin relatives, including Neanderthals, and Denisovans, in Paleolithic (30TYBP to 10TYBP), Mesolithic (10TYBP to 08TYBP), and Neolithic

(8.0TYBP to 3.0TYBP) periods, the hunt gatherers, apart from cooking and lighting started using fire for fishing, hunting, driving the predators, saving fresh plantations, keeping landscape clean for safety from wild animals, in wars, and later for slash-and-burn farming for better agriculture practices. In post Anthropocene epoch there were reports of fire in Constantinople (Istanbul), The Great Rome (64 AD), Amsterdam (1421 & 1452), Copenhagen (1728 & 1795), Moscow (4 times from 1547-1812), New York City (1776 & 1835), New Orleans (1788 & 1794), six times in London city from 1130 to 1666, 1794 & 1861. The major fires in 18th century were at places Peshtigo (1871), Chicago (1871), Boston (1872), San Francisco (1906), Halifax (1917), Tokyo (1923) and Texas City (1947), Link⁶.

3.3 Major fires in Anthropocene Epoch

Present upsurge in the fire regimes are proved to be mostly anthropogenic, and altered climate induced. The prehistoric interactions between the man and the fire has become complex to aware, detect, keep proper watch and ward under the present settings [19]. The scientists claim the rise in atmospheric greenhouse gasses (GHG), rise in CO₂ due to increased 6KYBP old Neolithic agriculture, urbanization and industrialization and wildfires in world history, [32,33].

Forest fires in Sakhalin, Khabarovsk, and Primorskii in eastern Siberia are spreading rapidly in the month of July-2021. Wildfire in the globe has become more anthropogenic than

natural, which has been worsening worldwide in recent decades. Bushfires in Australia have burnt ≈11MH sporadic bush land, killed 33 people, burnt about 2000 settlements, and expatriated thousands of people since Sept. 2019. About 1.5 numbers of deaths/100 Thousand persons and incidents as 3.1millions stated due to fire incidents globally in 2017 as per Centre of Fire Statistics, 2019, [34]. Wildfires have been significant courses that have affected the Earth's terrestrial and atmospheric environment for last 350 MYBP. The hominids and homosapiens were living with fire since their emergence for about 30 to 40KYBP [16]. The countries, Canada and Sweden had massive fires in 2018. The summer 2019, the Arctic region had faced record wildfires, in June alone. There was emission of 50 megatons (Mt) of CO₂ in June-2019 more than the Arctic fires from the years 2010 to 2018. There was pervasive wildfires up-surfing wild fire in tropical rain forests in SE Asia and Amazon of South Africa (WMO), Link⁷.

Global warming, climate change and wildfires reinforce conjointly in the present Anthropocene Epoch with larger blazes throughout the globe. The frequencies of the forest fire have become more wild, alarming, and apocalyptic in the twenty first century with more numbers of intense fire incidences than the 20th century, (Fig. 2) [35,36] Link [8]. The 21st century major wild forest fires that damaged various forests of the world are given in Table 1 and it shows that the frequencies of major wild fires in the world are increasing during last 4-5years.

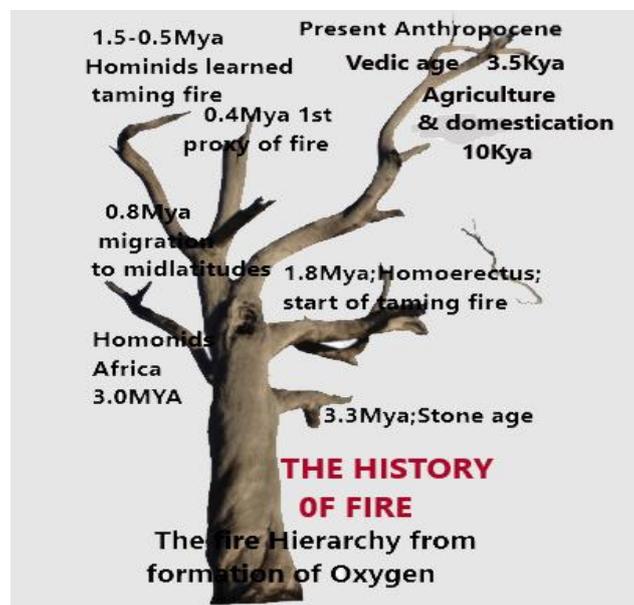


Fig. 1. The fire hierarchy from the Hominids evolved on earth

Table 1. The 21st century major wild forest fires that damaged various forests of the world

| Place of fire | Year | Impact | Type | Main Place | Source |
|-----------------------------|--|--|-------------------------------|--|---|
| South Russia (Siberia) | 14 th Mar to 8 th Aug 2003 | 200000Km ² burned; CO ₂ 400640 Tg | Russian Bo real forest | Sakhelina & series of fires | Forest Fires in Eastern Siberia 2003 – JAXA /EORC |
| Australian Bush fire | 2006-2007/ Lightning | 13,000Km ² burnt & 5 Killed. | bushfire | Great divide complex | Victoria 2006; Bushfire - Great Divide Complex |
| Black Saturday (46 °C) | Stated 7 th Feb 2009 | groups. Died 173 people; 400,000 Ha burnt | Bush fire | Marysville, Australia. Melbourne | 7th February 2009, Black Saturday; S1596-Linda_Becker_Redacted |
| Bolivia forest fires | 18 th Aug to 27 th Sept 2010 | burning of 4 million ha burnt (State emergency called) | Forest fire | Drought; huge smoke & health problem | Bolivia: Wild Fires - Aug 2010 https://reliefweb.int/disaster/wf-2010-000163-bol |
| Australian bushfire season | Aug 2012 to May 2013 | Burnt >914,760 ha | Bush fire | 640 houses burnt four Deaths | wikipedia.org/wiki/2012_Australian_bushfire_season |
| Northwest Territories fires | from 3 rd July-2014 | Burnt ≈ 34000 Ha | All type forests | S spread 5000Km ² , health issues | https://en.wikipedia.org/wiki/2014_Northwest_Territories_fires |
| British Columbia wildfires | 6 th July 2017 | Burnt ≈ 1.2million Ha | Boreal pine forest | Longest emergency for 10weeks | Wiki; 2017_ British_ Columbia_wildfires |
| Siberia wildfires | July 2019 Cause wind and heat; | 20.9 million ha land, &10.9 million ha of forest in Russia; | ever-green coniferous forests | Lungs disease in COVID-19; Krasnoyarsk ; Siberia | https://news.mongabay.com/2020/07/photos-show-scale-of-massive-fires-tearing-through-siberian-forests/ |
| Amazon rainforest wildfires | 29th, Aug. 2019 | Burnt 9060Km ² hectares affected 43000Km ² | Evergreen rain forest | Pantanal area | https://theconversation.com/historic-amazon-rainforest-fires- |
| Australian Bush fire | 2019 | Burnt 18000Km ² of land | Bush fire | Killed 33, burn 2000 homes | 2019-2020 Australian Bushfires - Center for Disaster; September 9, 2019 |
| California wildfires | Aug-2020 | 18000Km ² , burnt | mixed ever green forests | Killed 31 & burn >1000 homes | https://www.theguardian.com/us-news/2020/dec/30/california-wildfires |
| California's wildfire | July 2021 | 16255Km ² | mixed ever green forests | burned 323 houses | wiki/2021_California_wildfires |

4. GLOBAL FOREST GOALS 2021

The global forest goals, Report 2021 reported that 75% of emerging zoonotic crops in when forests are bald, 25% of medicinal drugs produced from Jungle products in developed, and 85% in developing countries Link¹⁰. Present pandemic strategies invite all forest products

from food, medicine to health care purposes. Forest can be classified as fire dependent, and fire sensitive ecosystem. The forest dependent ecosystem is 46%, that develop with fire include forests of the African savannahs, all pine forests of taiga, south Asian countries including India, the eucalyptus forests of Australia, the California coniferous forests, the forests of Mediterranean

region. Globally the fire-sensitive large ecosystems (about 36%) have negative impacts. The anthropogenic fire-sensitive biotas are the tropical rainforests of African Amazon and Congo, and some in SE Asia. In these ecosystems, are drastically vulnerable by wild fires that impacts on vegetation of grass lands. But in the last decade there is identification of shift in the fire regime in global forests and biodiversity regime. Release of vast quantities of carbon stored in tree species and soils is in the continuous process Fig. 3, [37].

4.1 Wildfire Activities in India

The vegetation cover has developed progressively, and stands presently at 24.39% of India's geographical expanse according to the 2017 assessment by FSI. Presently with growth of demography, forest fires have posed challenges to protect India's forests. Taming wild forest fire in India is of concern as in average 30000 forest fires, 95% of which is anthropogenic, [38] were reported in 2019. The Moderate Resolution Imaging Spectroradiometer (MODIS) sensor data of year 2018 reveals that there were 37059 fires were sensed Link¹¹. About 36% of forest cover (657TKm²) in India is susceptible to regular fires and out of them, 10% are extremely prone, and ≈21% high to extreme are fire prone forest areas. They are Vindhya, Bundelkhand, and Terai, subtropical forests. (Forest Survey of India (FSI) report 2019).

A wildfire blazed in Bandipur Tiger Reserve, Karnataka, on 21st Feb, 2019, due to abrupt climatic change and fast growth of dry grass along with Lantana had destroyed 10000 acres of forest land but caused no casualties to the people and animals of the area. About 6424 fire spots were identified in Telangana (from 22nd Mar. to 11th April in 2020) whereas numbers have increased 2.5 times in 2021 to 15920 forest fires in 2021. Fire survey of India (FSI) has spotted 277758 wildfire points between the years 2004-05 to 2016-17. Mizoram state in NE ranks the first with 32600 fire points. The states, Nagaland, Manipur, Odisha, Himachal Pradesh (HP), Madhya Pradesh (MP), and Gujarat, have experienced wild forest fires June 2021. They are normally initiated in the premises of the reserve forests, biosphere reserves, Zoos, Gardens or wildlife sanctuaries. Wild fire in Uttarakhand, Himachal Pradesh, Tamil Nadu (Kurangani fire) in 2016, Mt. Abu and Vaishnodevi fires of 2018

and forest fires in Uttarakhand, Manipur and Odisha (Similipal) are some recent examples (Fig. 4).

India can be characterized as fire sensitive (not specifically adaptable to forest fire though develops habitats and niches), fire dependent (humid to moist tropical forests, where forests maintain biodiversity) and fire independent ecosystems (tropical rain forests), [39]. Some of the fire resistant ecosystems found in India are Kendu Leaves forests in Odisha, tall-grasses (*C. flexuosus* savannas) in KMTR (The Kalakad-Mundanthurai Tiger Reserve) in Western Ghats and some deciduous forests in central India.

4.2 Forest Fire Alerts in India

Forest Survey of India (FSI), alerts forest departments (FD'S) of various states about wild forest fire points identified by the MODIS sensor data of National Aeronautics & Space Administration (NASA) from (Aqua and Terra Satellites) from 2004. India has recorded 82170 forest fire alerts from April 1-14, 2021 which concerns the forest managers as it was about to double in number of 2020 as per Global Forest Watch (GFW), Link¹²

FSI has reported that there is still 35.71% of forests are yet to be exposed to wild fires in India. The forests in NE and the Deccan plateau areas in India are the worst affected from fire [40]. Out of about 712249 km² of forest shield, about 152421km (21.4%) is exceedingly prone to fire covering forests of NE states, Chhattisgarh, Odisha, Uttarakhand, and Madhya Pradesh. So the Forest Fire Alert System FAST 1.0, 2.0 and 3.0 from the MODIS are used. The Forest Fire Danger Rating, from 24th June, 2021 to 30th June, 2021, based on forest warning points FWI of FSI map is in Fig. 5. (FSI VAN AGNI:1.0; from Van Agni Geoportal)

The state MP covers 77000km² the lion share of forests to the geographical areas of India. Using Visible Infrared Imaging Radiometer Suite (VIIRS), the Global forest watch (GFW) has alerted. MP had the highest number (22797) of VIIRS alerts during, April 1-14, 2021 which is double the previous year's numbers of alerts (Fig. 5).

The India has total number of alerts during that period was with 43031 alerts in 2020. But in 2021 it was approximately doubled to 82170 alerts, the highest in last five years, Link¹⁴ (Fig. 5).

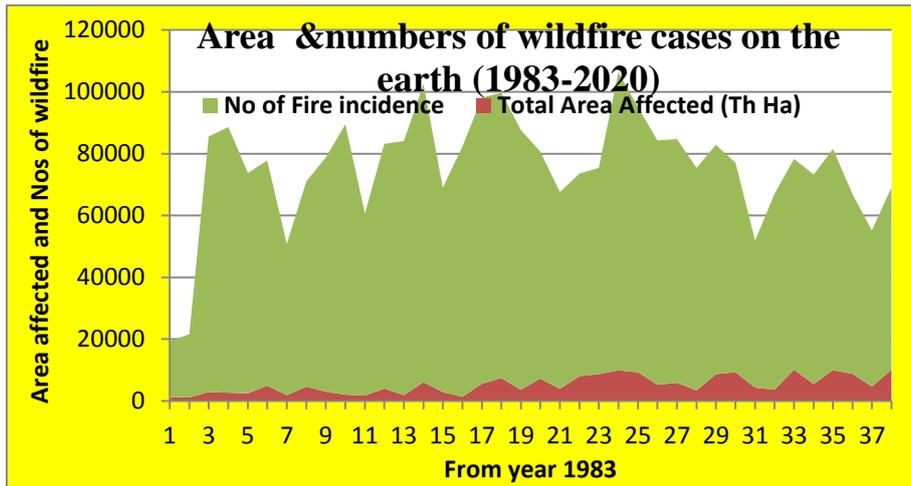


Fig. 2. Annual frequencies of Global wildfire cases
 (source: <https://www.nifc.gov/fire-information/statistics>)

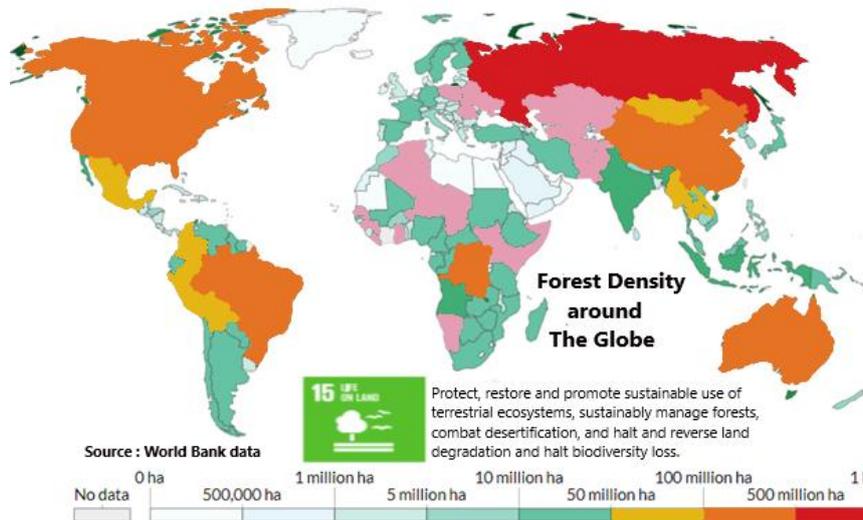


Fig. 3. The Classification of fire around the world Source: World Bank

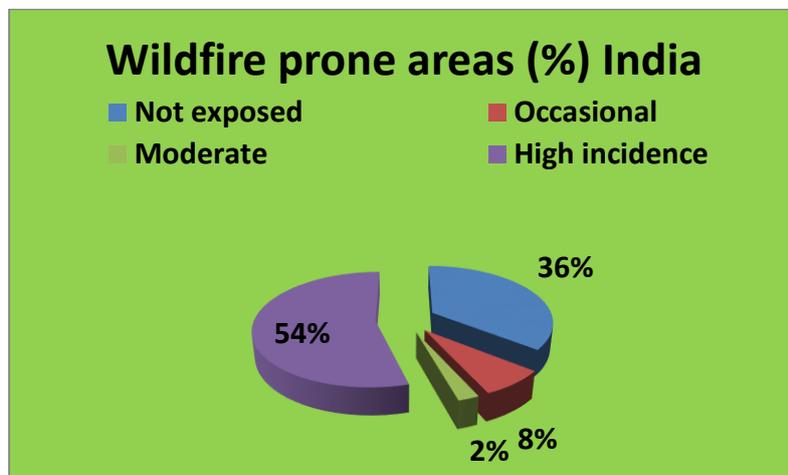


Fig. 4. Fire type & % prone forest areas, India
 (Source: <https://fsi.nic.in/forest-fire-activities?>)

Table 2. The statistics of wild fire in Indian forests in last three years

| # | Name | Date | Location | Deaths | Source |
|-----|---------------------------------------|--------------------------------------|---|--------|---|
| 1 | Kurangani Hills Forest Fire | 11 th Mar 2018 | Theni district, Tamil Nadu | 16 | Theni forest fire: a trek that ended in tragedy - The Hindu |
| 2 | Bandipur Forest fires | 21- 25 Feb-2019 | Chamarajanagar district, Karnataka | 0 | 2019 Bandipur forest fires - Wikipedia |
| 3 | Uttarakhand Forest Fire | 2016 | Almora district | 09 | 2019 Bandipur forest fires - Wikipedia |
| 4 | 2020 Uttarakhand Forest Fire | 24 May 2020 | Srinagar of Pauri Garhwal district | 02 | 2020 Uttarakhand forest fires - Wikipedia |
| 5 | Kerela Forest Fire | February 2020 | Thrissur district | 03 | Three killed in forest fire in Kerala Latest News India - Hindustan Times |
| 6 | Telangana Forest Fires 2021 | March 22 to April 11 2021 | Adilabad, Asifabad, Bhadradi Kothagudem, Mahabubabad, etc | | Telangana records over 15,000 forest fires since start of summer this year Hyderabad News - Times of India (indiatimes.com) |
| 7 | Mizoram Forest Fire | 20 to 26 April 2021 | Lunglei, Mizoram | 0 | 48 hours on, forest fires rage across Mizoram Latest News India - Hindustan Times |
| 8 | Mussoorie Forest Fire | 14 April 2021 | Nata Estate in Lal Tibba (Mussoorie) | 0 | Fire breaks out in Muss oorie Forest Garhwal Post |
| 9 | Chhattisgarh Forest Fire | 15 Feb. to 22 nd Mar 2021 | Bijapur district, Udanti Sitanadi Tiger Reserve | 0 | 6,520 forest fires scorch Chhattisgarh in last 37 days Latest News India - Hindustan Times |
| 10 | Similipal Forest Fire | Mar to Apr 2021 | Mayurbhanj District, Odisha | 0 | 2021 Simlipal forest fires - Wikipedia |
| 11 | Bandhavgarh Tiger Reserve Forest Fire | March 29 to April 1 2021 | Vindhya Hills of the Umaria district, Madhya Pradesh | 0 | Bandhavgarh Tiger Reserve fire: Madhya Pradesh: Forest fire rages through Bandhavgarh Tiger Reserve Bhopal News - Times of India (indiatimes.com) |
| 12 | Nauradehi Sanctuary Forests Fire | March 28 to April 5 2021 | Sagar, Damoh, Narsinghpur, Raisen Districts, MP. | 0 | Madhya Pradesh: Fire in Nauradehi forests is uncontrollable even after a week (freepressjournal.in) |
| 13. | Ranchi Forest Fires | March 2021 | Jonha, Angara and Sitafall localities | 0 | Forest fire in Ranchi and surroundings poses threat to wild animals, environment - Hindustan Times |

4.3 Fires in India

India is warming drastically with climate change and shift in disaster flash points. India experienced the third warmest after 121 years in terms of monthly average maximum temperature in March 2021 reaching 40°C (IMD report). So the hot and warm climate had desiccated of woods and its vegetative cover of its forests. Once the ignition of fire started either naturally, the fire ablaze wild and aggressive, Link¹⁶.

4.4 Causes Fire Incidence in India

In country side the villagers, miscreants, and aboriginal community are in practice of burning their grass land, scrubs and forests floors for good growth of grass, fresh Kendu or mushrooms growth, destroy stumps of illicit fallings and mostly for terrace agriculture. In India the causes for wild fires may be caused natural, Anthropogenic. The human causes can be further split to deliberate, accidental or

settlement. The Fig. 6, show the causes of fire in India.

4.5 Forest Blazes India 2021

India has witnessed three large wild forest blazes in the year 2021 though there are many small fire points. The first one was in 13th January in Bijli Mahadev Hill, grasslands of the Kullu valley. The second was the forest fire in ecologically delicate Dzukou valley of Kohima in Manipur and Nagaland border on 29th Dec 2021. The 3rd but the largest was the Similipal forest fire from 4th March to 10th April 2021. Last five years in Similipal, there were small patches of blaze. But this year, the oustees from the STR were rehabilitated elsewhere (acting as the protector of the forest) could not oppose to fire miscreants. During Mid- February, the poachers, Mohua flower collectors and the firewood collectors caught fire to the bushes. The fire continued for months together and became wild. Uttarakhand is showing surges in wild forest fire which is still

in ablaze from 15th Oct., 2020 were still burning up to April 5, 2021, which was due to rise in temperatures and meager rainfall, Link¹⁷.

4.6 Fires in Crowd Congregation and High Rise Buildings

Crowd management during is complex in nature, which warrants proper planning of events and venues. About 83872 fire events were reported in India between 2014 to 2018 (Ministry of Home Affairs; Department of States; National Crime Records Bureau, 2018) India is having many religious gatherings round the year where the fire risk control is slack and paid less importance. The old temples and their premises have inadequate space to accommodate the present gathering. Since fire offerings are a part of homage, most of these gatherings suffer from fire hazards. Once the fire starts the stampede does the rest part of fatal sufferings .



Fig. 5. The Forest Fire prone areas, India; FWI (VAN AGNI Geoportal)

Table 3. Major forests in India prone to fire along with numbers of forest fire alerts

| Year | Forest (sqkm) | % total geographical area | Forest fire alerts in Different states India | | | | |
|-------------|---------------|---------------------------|--|-------|-------|-------|-------|
| | | | 2017 | 2018 | 2019 | 2020 | 2021 |
| M.P. | 77482 | 25.14% | 19980 | 7908 | 12217 | 11609 | 22797 |
| Odisha | 51619 | 33.15% | 8872 | 1793 | 5338 | 3098 | 5000 |
| Uttarakhand | 24303 | 45.44% | 819 | 254 | 113 | 72 | 8934 |
| Maharashtra | 50778 | 16.50% | 6527 | 3306 | 3863 | 3561 | 4835 |
| Telangana | 20582 | 18.36% | 1464 | 696 | 1744 | 3040 | 1968 |
| Jharkhand | 23611 | 29.62% | 5450 | 1014 | 1886 | 1530 | 5284 |
| India | 712249 | 21.67% | 78716 | 25701 | 43508 | 43031 | 82170 |

Source: Link¹⁴ and Link¹⁵

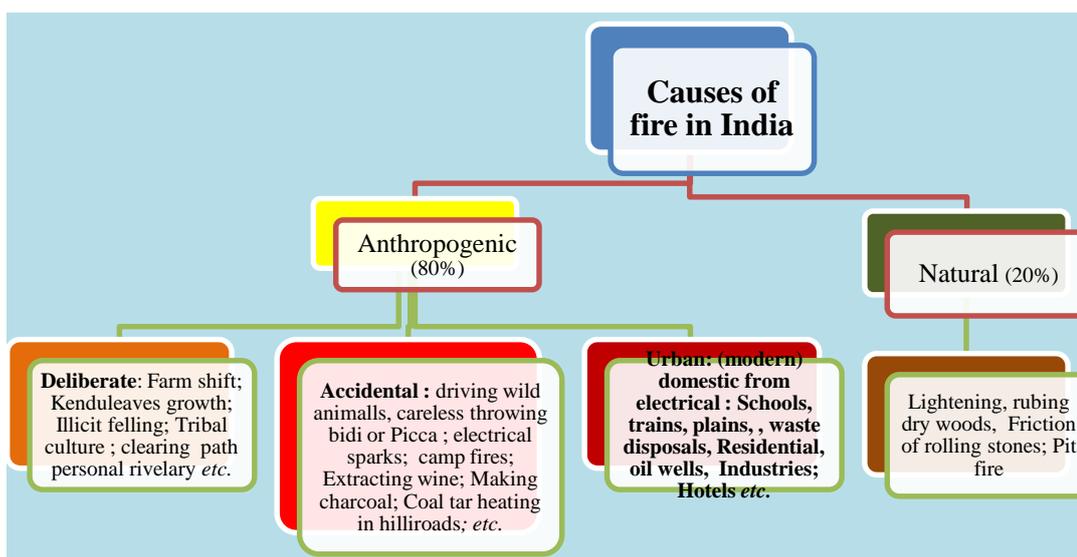


Fig. 6. Causes of various sources of fire hazards in India

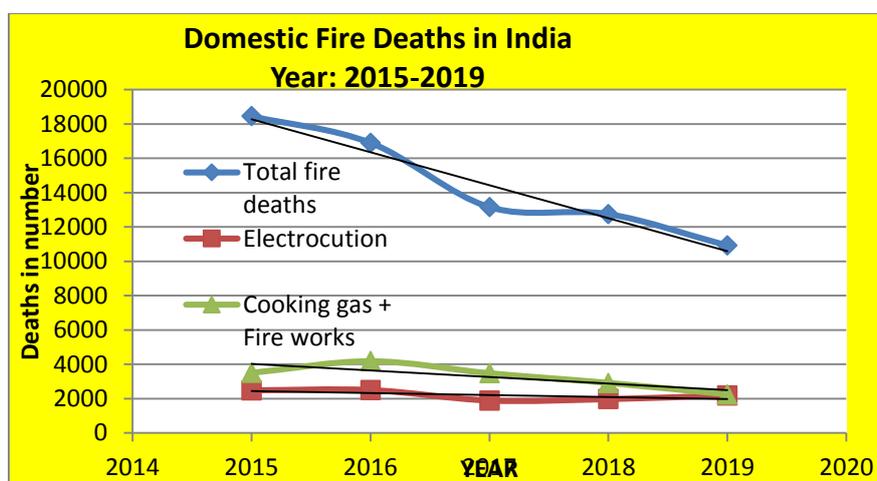


Fig. 7. Major Wild fire deaths in crowdie buildings; India (FY: 2015-2019)

(Source: <https://factly.in/number-of-fire-accidents-in-the-country-reduced-over-time/>)

As per National Crime Records Bureau (NCRB) reports Fires in Combustible Materials Factories including Cracker/Match Box Factories in the year 2014 and 2015 were 143 and 410 persons respectively (NCRB report 2016). From 2015 to

2019 the number of fire accidents statewide in India was highest in Maharashtra state and Odisha ranked 7th, (Fig. 7). There is decline in number of fire death for the last 6-7 years are due to construction of transport vehicles by fire

resistant materials, schools, buildings, mines, trains, vehicles, and factories which are considered as fire sources. These places are imposed to provide with fire protective equipment and measures on the risk, safety, and guidelines for fire-safety, (Table 4) Link¹⁸.

4.7 Electrocution Fire in Hospitals during COVID -19

Though 20th century to date, the pandemic COVID-19 has ceased all industrial activities and affected agricultural activities throughout India as safety measure. However the health care activities have surged up multidimensional, Fire accidents and forest fires have surged up multidimensional during this pandemic period

from March 2020 to till date. The fire hazards in the Hospital sector has surged up due to electrical short circuited or intra-operative fire, since last decade due to increase in numbers of corporate sector hospitals in India. They died in their beds with faulty wiring, high oxygen concentrated surroundings, without smoke detectors particularly in the emergency units, intensive care units (ICU's). They die illegally and at times due to overcrowding in the within premises, and in the upper floors without any help from the fire fighters. About 33 major events of or electrically initiated fires in hospitals (>100patient beds) were reported between Jan 2010 to Dec 2019. In 2011, the major fires in Indian hospitals from 2011 to 2021 is in Table 5.

Table 4. Some major fires incidences in crowded areas of India with fatalities and losses

| Place of fire | Year | Impact | Cause | Source |
|--|--------------------------------------|---------------------------------|---|---|
| Dabwali fire accident | 23 rd Dec 1995 | 442 deaths/ 150 burns | Short circuit/ stampede | Dabwali fire victims to get Rs 3.42 cr more/The tribune; Feb 21, 2018 01:02 AM |
| Uphar Cinema fire | 13 th June 1997 | 59 deaths /100injured | Short cktd/ choked in smoke | Uphaar Tragedy: The 23-year-old legal battle ends, leaving families heartbroken; Somya Lakhani; February 24, 2020 11:22:56 |
| Baripada religious gathering | 24 th Feb. 1997 | 206dead (thatched camp | electric spark | Mass deaths at religious conger gation in Orissa highlight Nag Choudhry, S., India today April 25, 2013 17:46 |
| Shree-Jee Shoe fac-tory Agra | 24 th May, 2002 | 42 +1 people died | Violation occupational safety | 42 die in Agra shoe factory fire Lucknow News - Times of India; May 25, 2002, 00:41 |
| Shri Kalubai Jatra,Wai, Maharashtra | 25 th Feb; 2005 | >300 people died | Stampede & fire Mandhar devi temple | Kalubhai temple mishap: More than 300 devotees killed; Joshi P., May 2, 2012 10:20 |
| Amuri Hosp. fire;Dhakuria, Kolkata,WB. | 9th Dec., 2011,2:3 0 am | About 73 deaths | Electrically short circuited | Fire in Kolkata's AMRI hospital: 73 killed, several injured; Times of India; TNN / Updated: Dec 9, 2011, 14:05 |
| Sivakasi Factory fire, Tamil Nadu | 5 th Sept. 2012, 12:15 pm | 54dead/ >40 injured | Failing safety stds; Chemical for fire-works caught fire | 54 killed in Sivakasi fire Deccan Herald; Decan Herald ; Sivakasi(TN) Sept 5, 2012, |
| Surya Sen St. fire, Kolkata | 27 th Feb 2013 | 20dead/ 12injured | short-circuit blazed by 56 gas cylinders | https://nidm.gov.in/PDF/pubs/Fires_in_India_2020.pdf |
| Puttingal Devi Temple Fire, Kerala | 10 th Apr. 2016; 0300am | 111dead/ ≈ 400 injured | high decibel cracker brusted | |
| Karolbag fire; New Delhi | 12 th Feb 2019; 8:54: | 17dead | A fire from Hotel Arpit Palace; negligence | Karol Bagh Hotel Arpit Palace fire HIGHLIGHTS - The Indian express; Feb 12, 2019 |
| Sarhana; Tak-shashila tution centre, Surat | 24 th May, 2019 | 22died/ ≈ 35 injured by burning | Short ckt. in A/c; 4 th loor, High rise building | Surat fire: 22 killed in coaching centre blaze, horrific visuals show kids falling off burning building; May 26, 2019 23:04 |

Table 5. Some cases of hospital fires and related deaths in India between 2011 to Apr-2021

| Sl. no | Name of the Hospital fire | Date | Causality | Source |
|--------|--|---|--|---|
| 1 | Mazumdar Shaw Hospital, Bengaluru | May 1, 2021 | no death | Bangalore Mirror Bureau / Updated: May 1, 2021, 22:19 IST |
| 2 | Prime Criticare Hospital, 3Thane | April 28, 2021 | 4 deaths | Mumbai Mirror Online / Updated: Apr 28, 2021, 08:20 IST |
| 3 | Ayush Hospital, Surat | April 26, 2021 | 4 deaths | 4-covid-patients-die-after-fire-breaks-out-at-surats-ayush-hospital: NDTV: April 26, 2021 4:41 pm IST |
| 4 | Vijay Vallabh Hospital, Virar | April 29, 2021 | 14 deaths | Vijay vallabh covid care hospital - The Economic Times; 28 Aug., 2021, 09:22 AM IST E-Paper |
| 5 | Well Treat hospital, Nagpur | April 9, 2021 | 4 deaths | Major fire at Nagpur Covid-19 hospital kills four, many injured; Indian Expresses: 10th April 2021 12:23 AM |
| 6 | Dahisar jumbo centre, Mumbai | April 4, 2021 | no death | Mumbai Mirror Online / Updated: Apr 4, 2021, 18:12 IST |
| 7 | Patidar Hospital, Ujjain | April 4, 2021 | no death | COVID patients, rescued from burning hospital in MP's Ujjai; New Indian expresses; 04th April 2021 06:48 PM |
| 8 | Safdarjung Hospital, Delhi | March 31, 2021 | no death | Delhi: Fire breaks out at ICU ward of Safdarjung Hospital, 50 patients evacuated; India TV news; Parasar A., March 31, 2021 13:02 IST |
| 9 | LPS Institute of Cardiology, Kanpur | March 28, 2021 | no death | A fire erupts close to the emergency unit of the LPS Institute of Cardiology in Kanpur; Dragtrex; 28 th Mar, 2021 |
| 10 | Civil General Hospital, Bhandara | Jan 09, 2021 | 10 deaths | Bhandara District General Hospital fire: 10 infants killed in massive blaze; Business Today; Jan 09, 2021, 9:51 AM |
| 11 | Patel Welfare Hos. Bharuch | 1 st May 2021 | 18 died | Fire in hospital's intensive care kills 18 in India's Gujarat; Reuters; 1-5-2021 |
| 11 | Government General Hospital, Guntur | Jan 06, 2021 | no death | Andhra Pradesh: Minor fire breaks out in Guntur Government General Hospital, all patients safe; MN Samdani / TNN / Jan 6, 2021, 23:22 IST |
| 12 | (a)Bhandar Hospital (b)Sunrise Hospital Mumbai; (c)VV Hospital Virar; (d) VV Hospital, Vira (M-htra) | 20th Jan, 26th Mar 23 rd Apr. 28 th Apr. (2020) | 10 Child 11 died 15died 4died (40died) | The perilous state of fire safety in Maharashtra's hospitals India Today Insight; Kiran Tare ;Mumbai May 3, 2021 21:18 IST |
| 12 | Chhatrapati Pramila Raje Hos.al, Kolhapur | Sep 28, 2020 | no death | Fire rages at Kolhapur's Covid hospital TNN / Sep 29, 2020, 04:41 IST |
| 13 | Uday Sivananda Hospital, Rajkot | Nov 27, 2020 | 13 deaths | Rajkot Hospital Fire: Seventh Tragedy in Gujarat Covid-19; News 18; MARCH 04, 2021, 23:41 IST |
| 14 | Sadguru Hospital, Cuttack | Sep 21, 2020 | no death | Over 100 Covid-19 patients rescued as fire breaks out at Odisha hospital; Hindusthan time; SEP 21, 2020 05:45 PM |
| 15 | SSG Municipal Hospital, Vadodara | Sep 08, 2020 | no death | Gujarat: Fire at government hospital in Vadodara, nobody injured; Sep 08, 2020, 09:05 PM |
| 16 | Guru Gobind Singh Hospital, Jamnagar | Aug. 25, 2020 | no death | Gujarat: Fire breaks out in government-run hospital of Jamnagar, no injuries, Nimesh |

| | | | | |
|----|---|--------------|-----------|--|
| 17 | Swarna Palace hotel (converted into isolation facility), Vijayawada | Aug 09, 2020 | 10 deaths | Khakhariya / TNN / Updated: Aug 25, 2020, 18:33 IST and Fire safety in focus at State's hotels-turned-COVID centres; The Hindu; Aug 10 th , 2020; 09:14 IST |
|----|---|--------------|-----------|--|

Prior major Hospital electrocution fire hazards were occurred in Amuri Hospital, Calcutta on Dec 2011 at 0300A.M causing 89 deaths, [41], and 23 patients died/ 100people suffered on 18th Oct 2016. The above study reveals that the initiation of fire was at ICU's, Emergency medicine or surgical wards due to electrical short circuit mostly from Air conditioners. More over the cases of Hospital fires have increased during the pandemic years i.e. 2020 and till date i.e. June, 2021.

4.8 Sex Wise Fire Fatalities in India

Gender wise; There were 12748 fatalities in India due to fire in 2018, out of which 7244 (56.82) were women. The females are the worst affected from gas burns and scalds due to cooking gas accidents. There were 2672 cooking gas explosion deaths (1967 were women) in 2018 where as it was 3260in 2017. In case of electrocution fire accident deaths, there were 1970 deaths 1368 were men during that period. Link⁴⁴

4.9 Lightening Deaths in India

The share of electrocution, and accidental fire deaths in India was 3.0% and 3.1% out of all

accidental deaths in India during 2018, Link⁴⁵. Electrocution fatalities have surged in India due to the climate change and more lightening activities in the states occupying foot hills of Himalayas and peninsular India, [42]. There were 1771 natural lightening deaths in India in the year 2019.-20. From 1979 to 2011there were 5259 fatalities reported due to lightning strikes [43]. The annual lightning deaths in India as per NCRB data is in Fig. 8, <https://www.news18.com/news/opinion/how-far-are-we-from-making-our-country-fire-safe-2486987.html>.

5. DISCUSSION

At present, the forests of India are under fire with variable frequency and the dynamics of forest vegetation depends on the biogeographic zone where the forest is located and is mainly anthropogenic. Therefore, assessing the forest fire possibilities is to understand the drivers such as the socio-economic status of ethnic people, their culture, the use of forests by stakeholders as a short-term and long-term goal after the fire. The objectives may be the achievement of ecosystem goods and services, the requirements of a living bell, and the conservation of habitats and biodiversity.

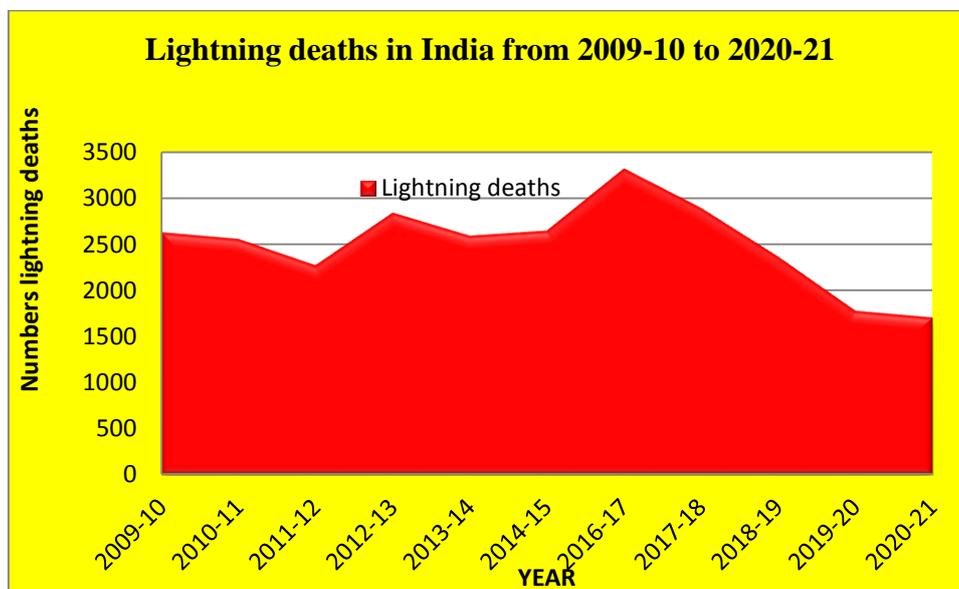


Fig. 8. The lightning deaths in India from 2009 to 2020-21

Source; NCRB report

The causes of surge in Hospital sector fires may be due to high O₂-rich air in the ICU units and emergency wards of the hospitals where maximum fire occur. It may due high oxygen saturation and even any small ignition from any sparks is enough to catch fire [44].

The action plans to be implements are groundwork and enactment of a National Action Plans pertaining to fire protection, timely reviewing the working plan and related code of practice, Mas education, Continue developing early warning systems, and asses fire danger rating periodically, systematic implementation of civic cultural practices for fire prevention by modernizing the fire-fighting, and response systems. Emphasizing on the economic bearings of fire and implementation of silvi-cultural practices to rejuvenate the past blazed forested [40].

The forest fires are anthropogenic and stimulus to terrestrial carbon cycling that invite the ecosystem to risk, and jeopardy, [38]. The assessment of their frequency and three-dimensional distributions become evident. The pervasive impact of Fire on the people in Anthropocene and their societal vales biogeography, and ecosystem functions has inspired technocrats for finding the ecosystem players/ drivers and make alert for the future impact of wild fire [45,46].

National fire protection association (NFPA) prepared 300 codes and standards elucidating the probability and exceptional impacts and risks of fire which should be followed in tropical forests of India, Link⁴⁶. The Illegal structures builds and absence of execution of guidelines (Beyond Codes/Standards) for erection of temporary structures violating the safety norms, casual attitude of users and overcrowding should be banned. For safe exit from crowdie place there must not be illegal extensions, obstructions, over capacity, and closed exits violating the fire code and without preparedness. There is need for preparation and enactment of the national action plan, timely reviewing the enactment within the 186 km² of the hotspot zone for the fire hazard.

6. CONCLUSION

The wild fires had destroyed in past the prodigious cities like Rome or London. Current wild fire in Australia, California, the Amazon, and Uttarakhand forests has traumatized the world, and its biodiversity in past and so also at present.

Fire and human coexists time immemorial. The man las learnt how to tame fire. The people lost their livelihood and collected most of their forest essential health products from mask, sanitizers, medicines etc during present COVID-19. Forests are natural buffer zone that was diffusing zoonoses. Deject forest fire; invest on sustained fire protective kits, and save the earth from 6th mass extinction (LIU Zhenmin, Economic & Social affairs, UN). The present requirement is to make innovative technology to avoid hospital fire which has cropped in during last two years.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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