

## **Pyro Geography and Indian Quest during Anthropocene to COVID-19**

**Siba Prasad Mishra<sup>1\*</sup>**

<sup>1</sup>*Civil Engineering Department, Centurion University of Engineering and Technology, Bhubaneswar, India.*

### **Author's contribution**

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

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### **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<sup>[1]</sup>. 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  $\approx 1.5$  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 CO<sub>2</sub> 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 <sup>[3]</sup>.Average fatalities due to forest fire were 71people/year but since 2015 it has been increased to 122 people/year, Link<sup>4</sup>.

FSI surveyed incremental surge in forest fires during 21<sup>st</sup> century as there were 8654 forest points (FP's), 30892 FP's, 35888FP's, in the years 2004-05, 2009-10 and 2017 respectively, Link<sup>5</sup>. 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 18<sup>th</sup> century were at places Peshtigo (1871), Chicago (1871), Boston (1872), San Francisco (1906), Halifax (1917), Tokyo (1923) and Texas City (1947), Link<sup>6</sup>.

### 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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), Link<sup>7</sup>.

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 20<sup>th</sup> century, (Fig. 2) [35,36] Link [8]. The 21<sup>st</sup> 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.

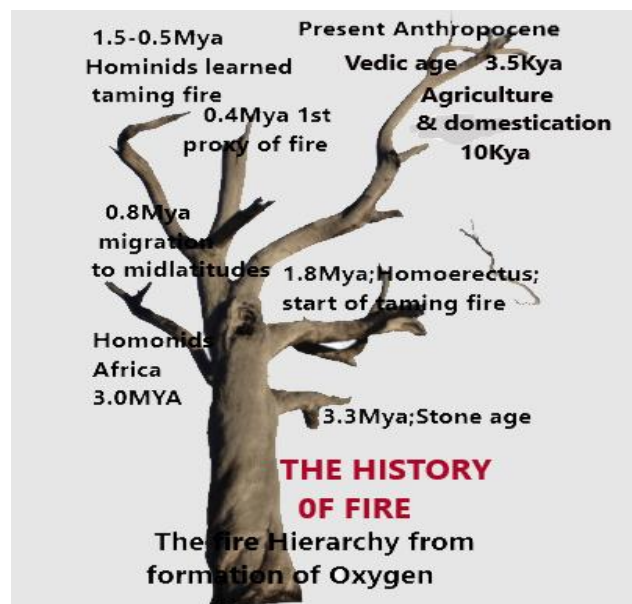


Fig. 1. The fire hierarchy from the Hominids evolved on earth

**Table 1. The 21<sup>st</sup> 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 <sup>th</sup> Mar to 8 <sup>th</sup> Aug 2003	200000Km <sup>2</sup> burned; CO <sub>2</sub> 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 <sup>2</sup> burnt & 5 Killed.	bushfire	Great divide complex	Victoria 2006; Bushfire - Great Divide Complex
Black Saturday (46 °C)	Stated 7 <sup>th</sup> 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 <sup>th</sup> Aug to 27 <sup>th</sup> Sept 2010	burning of 4 million ha burnt (State emergency called)	Forest fire	Drought; huge smoke & health problem	Bolivia: Wild Fires - Aug 2010   <a href="https://reliefweb.int/disaster/wf-2010-000163-bol">https://reliefweb.int/disaster/wf-2010-000163-bol</a>
Australian bushfire season	Aug 2012 to May 2013	Burnt >914,760 ha	Bush fire	640 houses burnt four Deaths	<a href="https://wikipedia.org/wiki/2012_Australian_bushfire_season">wikipedia.org/wiki/2012_Australian_bushfire_season</a>
Northwest Territories fires	from 3 <sup>rd</sup> July-2014	Burnt ≈ 34000 Ha	All type forests	S spread 5000Km <sup>2</sup> , health issues	<a href="https://en.wikipedia.org/wiki/2014_Northwest_Territories_fires">https://en.wikipedia.org/wiki/2014_Northwest_Territories_fires</a>
British Columbia wildfires	6 <sup>th</sup> 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	<a href="https://news.mongabay.com/2020/07/photos-show-scale-of-massive-fires-tearing-through-siberian-forests/">https://news.mongabay.com/2020/07/photos-show-scale-of-massive-fires-tearing-through-siberian-forests/</a>
Amazon rainforest wildfires	29th, Aug. 2019	Burnt 9060Km <sup>2</sup> hectares affected 43000Km <sup>2</sup>	Evergreen rain forest	Pantanal area	<a href="https://theconversation.com/historic-amazon-rainforest-fires-">https://theconversation.com/historic-amazon-rainforest-fires-</a>
Australian Bush fire	2019	Burnt 18000Km <sup>2</sup> of land	Bush fire	Killed 33, burn 2000 homes	2019-2020 Australian Bushfires - Center for Disaster; September 9, 2019
California wildfires	Aug-2020	18000Km <sup>2</sup> ,burnt	mixed ever green forests	Killed 31 & burn >1000 homes	<a href="https://www.theguardian.com/us-news/2020/dec/30/california-wildfires">https://www.theguardian.com/us-news/2020/dec/30/california-wildfires</a>
California's wildfire	July 2021	16255Km <sup>2</sup>	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 Link<sup>10</sup>. 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 Link<sup>11</sup>. About 36% of forest cover (657TKm<sup>2</sup>) 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 21<sup>st</sup> 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 22<sup>nd</sup> Mar. to 11<sup>th</sup> 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 NER 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.

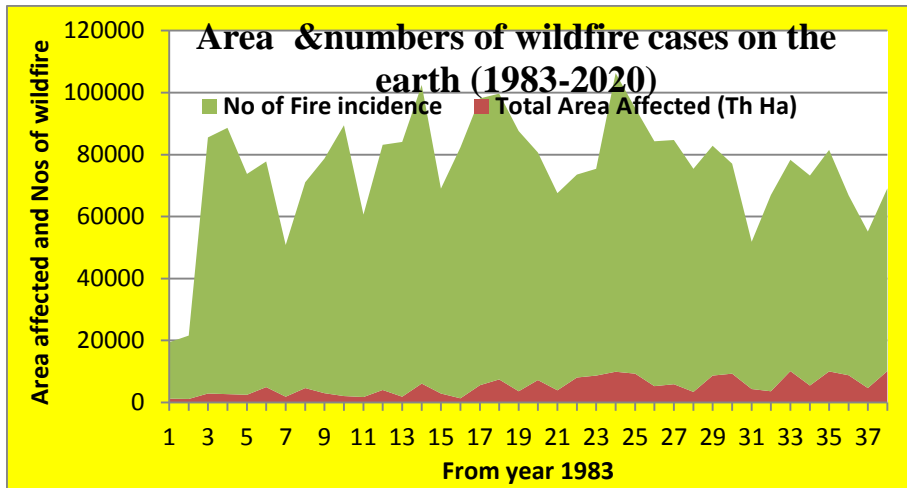
#### 4.2 Forest Fire Alerts in India

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), Link<sup>12</sup>

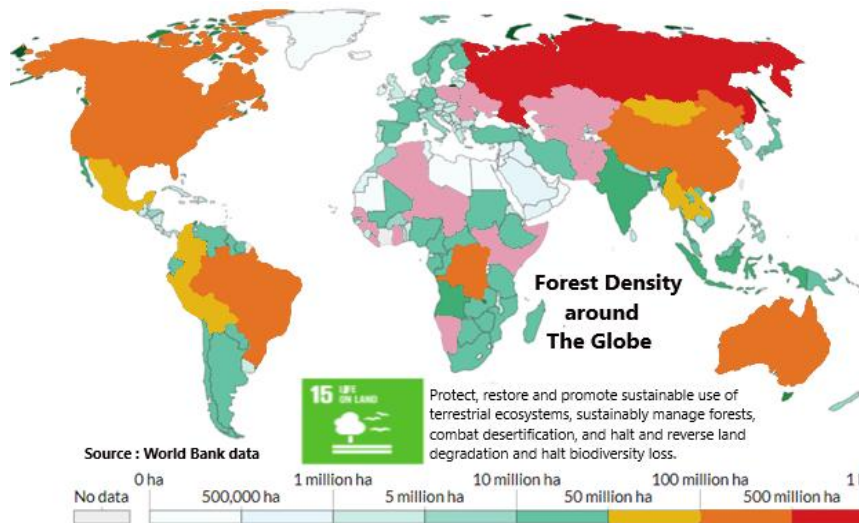
FSI has reported that there is still 35.71% of forests are yet to be exposed to wild fires in India. The forests in NER and the Deccan plateau areas in India are the worst affected from fire [40]. Out of about 712249 km<sup>2</sup> of forest shield, about 152421km (21.4%) is exceedingly prone to fire covering forests of NER 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 24<sup>th</sup> June, 2021 to 30<sup>th</sup> June, 2021, based on forest warning points FWI of FSI map is in Fig. 5. (FSI VAN AGNI:1.0; from Van Agni Geoportail)

The state MP covers 77000km<sup>2</sup> 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).

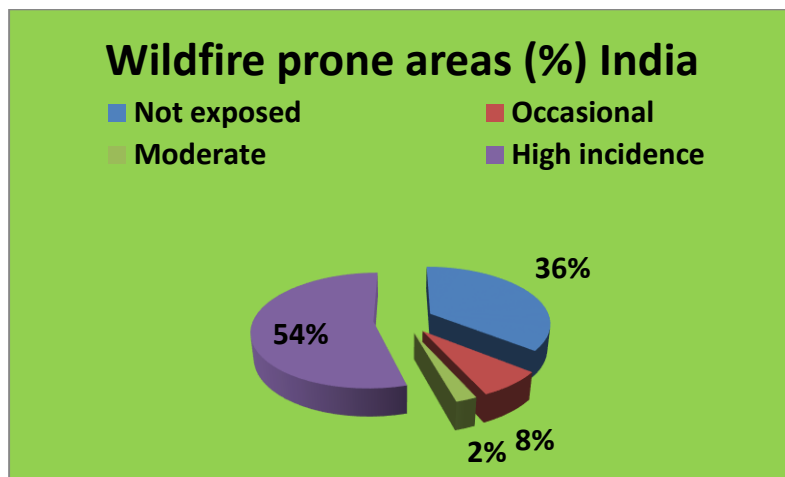
The India has total number of alerts during that period was with 43031 alerts in 2020. But in 2021 it was approximately doubled to 82170 alerts, the highest in last five years, Link<sup>14</sup> (Fig. 5).



**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 <sup>th</sup> 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 Uttarakh and 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 <sup>nd</sup> 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 Sanc-tuary 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, Link<sup>16</sup>.

### 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, Link<sup>17</sup>.

#### 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 .

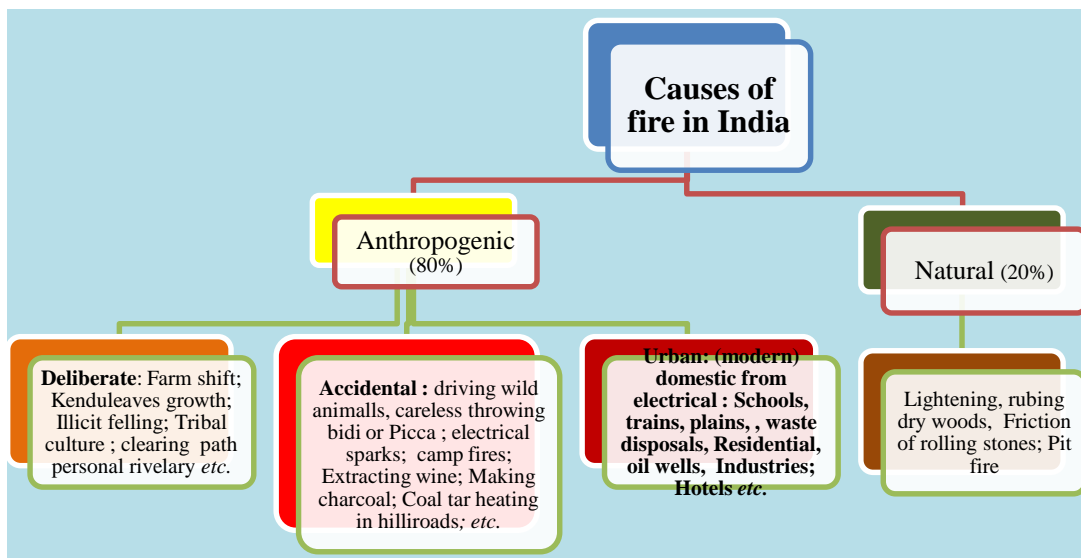


Fig. 5. The Forest Fire prone areas, India; FWI (VAN AGNI Geoportal)

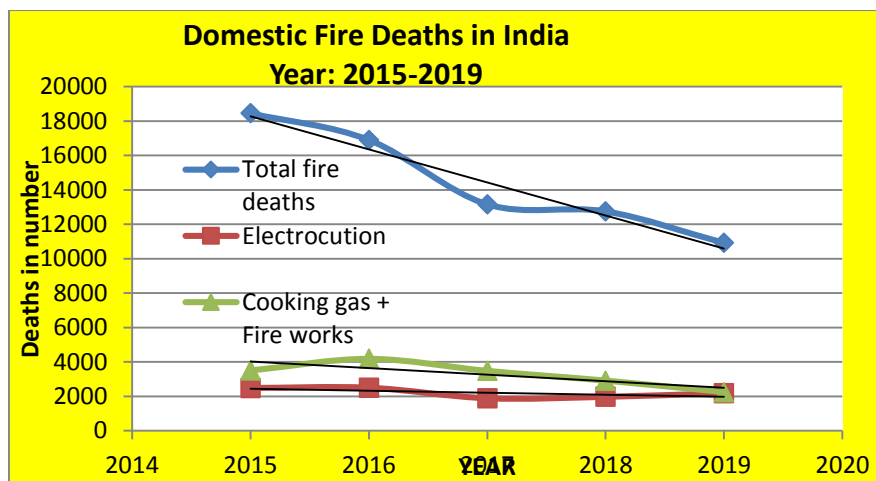
**Table 3. Major forests in India prone to fire along with numbers of forest fire alerts**

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: Link<sup>14</sup> and Link<sup>15</sup>



**Fig. 6. Causes of various souses 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 7<sup>th</sup>, (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) Link<sup>18</sup>.

#### 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 <sup>rd</sup> 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 <sup>th</sup> June 1997	59 deaths /100injured	Short ckcted/ 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 <sup>th</sup> 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 <sup>th</sup> 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 <sup>th</sup> 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 <sup>th</sup> 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 <sup>th</sup> Feb 2013	20dead/ 12injured	short-circuit blazed by 56 gas cylinders	<a href="https://nidm.gov.in/PDF/pubs/Fires_in_India_2020.pdf">https://nidm.gov.in/PDF/pubs/Fires_in_India_2020.pdf</a>
Puttingal Devi Temple Fire, Kerala	10 <sup>th</sup> Apr. 2016; 0300am	111dead/ ≈ 400 injured	high decibel cracker brusted	
Karolbag fire; New Delhi	12 <sup>th</sup> 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 <sup>th</sup> May, 2019	22died/ ≈ 35 injured by burning	Short ckt. in A/c; 4 <sup>th</sup> 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 <sup>th</sup> 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 <sup>st</sup> 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 <sup>rd</sup> Apr. 28 <sup>th</sup> 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 <sup>th</sup> , 2020; 09:14 IST
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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 18<sup>th</sup> 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. Link<sup>44</sup>

#### 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, Link<sup>45</sup>. 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.

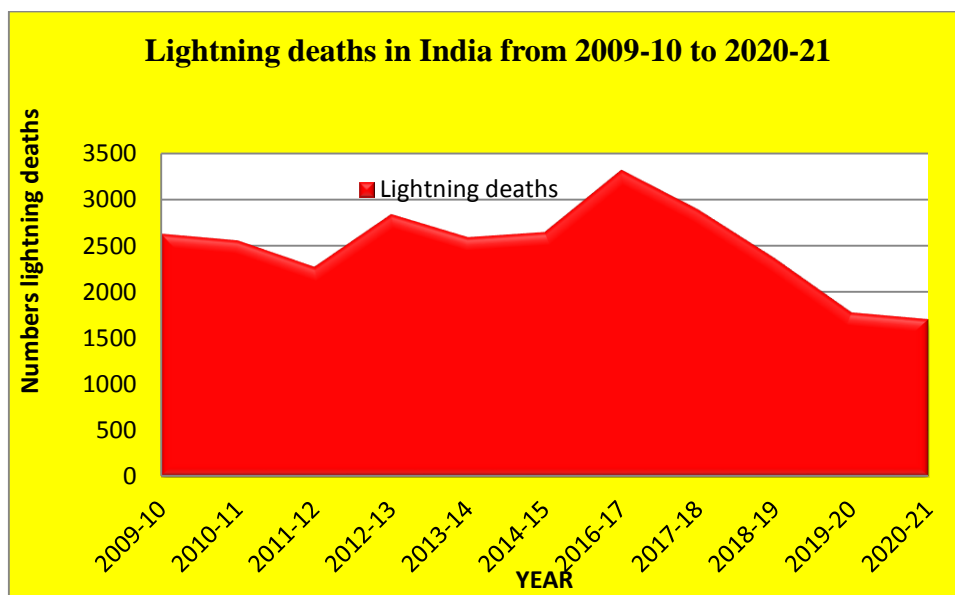


Fig. 8. The lightning deaths in India from 2009 to 2020-21

Source; NCRB report

The causes of surge in Hospital sector fires may be due to high O<sub>2</sub>-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, Link<sup>46</sup>. 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 km<sup>2</sup> 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 6<sup>th</sup> 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.

## REFERENCES

1. Pyne SJ. Fire in the mind: changing understandings of fire in Western civilization. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2016;371(1696):20150166.
2. Pyne SJ. From Pleistocene to Pyrocene: Fire replaces ice. *Earth's Future*. 2020; 8:e2020EF001722. Available:<https://doi.org/10.1029/2020EF001722>.
3. Crutzen PJ, Stoermer EF. The Anthropocene. *Global Change News*. 2000;41:17–18.
4. Zalasiewicz J, Cita MB, Hilgen F, Pratt BR, Strasser A, Thierry J, Weissert H. Chronostratigraphy & geochronology: a proposed realignment. *GSA Today*. 2013;23(3).
5. Mishra SP. The apocalyptic Anthropocene epoch and its management in India, *Int. Jour. Adv. Research*. 2017;5(3):645-663.
6. Twomey TM. Keeping Fire: The Cognitive Implications of Controlled Fire, Use by Middle Pleistocene Humans. Thesis: School of Social and Political Sciences, The Univ. of Melbourne. 2011;1-275.
7. Kebede A, Raju UJP, Koricha D, Nigussie M. Characterizing and monitoring drought over Upper Blue Nile of Ethiopia with the aid of copula analysis. *Int J Environ Clim Change*. 2018;283-294.
8. Stephen JR. Hominid use of fire in the Lower and Middle Pleistocene. *Current Anthropology*. 1989;30(1):1- 26.
9. Dennell RW. Hominid Dispersals and Asian Biogeography during the Lower and Early Middle Pleistocene) c. 2.0-0.5 Mya.Asim/ Perspectives. by the Univ. of Hawai'i Press. 2004;43(2):205-226.

10. Mallol C, Marlowe FW, Wood BM. Earth, wind, and fire: ethnoarcheological signals of Hadza fires. *J Archaeol Sci.* 2007;34:2035-52.  
DOI: 10.1016/j.jas.2007.02.002
11. Sandgathe DM, Dibble HL, Goldberg P, McPherron SP, Turq A, Niven L, Hodgkins J. Timing of the appearance of habitual fire use. *Proc Natl Acad Sci.* 2011;108.  
DOI: 10.1073/pnas.1106759108.
12. Gowlett JAJ. The discovery of fire by humans: a long and convoluted process. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences.* 2016;371(1696): 20150164.  
DOI: 10.1098/rstb.2015.0164
13. Mukhopadhyay D. Culture of Fire in the Forests of India. workshop proceedings, Pillar Human Resource Development Centre, Madurai, India. 2007;27.
14. Satendra, Kaushik AD. Forest Fire Disaster Management. NIDM, Ministry of Home Affairs, New Delhi, FFDM series. 2014;1:1-302.
15. Guha-Sapir D, Below R, Hoyois P. EM-DAT: International Disaster Database. Brussels, Belgium: University Cathol. Louvain; 2014.  
Available: <http://www.emdat.be>.
16. Doerr SH, Santín C. Global trends in wildfire and its impacts: perceptions versus realities in a changing world. *Philos Trans R Soc Lond B Biol Sci.* 2016;5;371(1696).  
DOI: 10.1098/rstb.2015.0345.
17. CTIF: Brushlinsky N, Ahrens M, Sokolov S, Wagner IP. Center for Fire Statistics, World Fire Statistics, Report-26, International Association of Fire and Rescue Services; Table-1.9,32; 2021.
18. Attwell1 L, Kovarovi K, Kenda JR. Fire in the Plio-Pleistocene: the functions of hominin fire use, and the mechanistic, developmental and evolutionary consequences. *Journal of Anthropological Sciences.* 2015;93:1-20.  
DOI: 10.4436/JASS.93006
19. Bowman DMJS, Williamson GJ, Price OF, Ndalila MN, Bradstock RA. Australian forests, megafires and the risk of dwindling carbon stocks. *Plant Cell Environ.* 2021;44:347– 355.  
Available:<https://doi.org/10.1111/pce.13916>
20. Valery G, Bondur Kristina A, Gordo Olga S. Voronova Alla L. Zima, Satellite Monitoring of Anomalous Wildfires in Australia, *Frontiers in Earth Science*; 2021.  
DOI: 10.3389/feart.2020.617252, 8
21. Ajin RS, Loghin AM, Vinod PG, Jacob MK. Forest fire risk zone mapping in Chinnar Wildlife Sanctuary, Kerala, India: a study using geospatial tools. *J Global Res* 2016;3:16–26.
22. Satish KV, Reddy CS. Long Term Monitoring of Forest Fires in Silent Valley National Park, Western Ghats, India Using Remote Sensing Data. *J Indian Soc Remote Sens.* 2016;44:207–215.  
Available:<https://doi.org/10.1007/s12524-015-0491-z>
23. Parajuli A, Gautam AP, Sharma SP, Bhujel KB, Sharma G, Thapa PB, Singh BB, Poudel S. Forest fire risk mapping using GIS and remote sensing in two major landscapes of Nepal, *Geomatics, Natural Haz. & Risk.* 2020;11(1):2569-2586.  
DOI: 10.1080/19475705.2020.1853251
24. Nikhil S, Danumah JH, Saha S, et al. Application of GIS and AHP Method in Forest Fire Risk Zone Mapping: a Study of the Parambikulam Tiger Reserve, Kerala, India. *J geovis spat anal.* 2021;5:14.  
Available:<https://doi.org/10.1007/s41651-021-00082-x>
25. Lamat R, Kumar M, Kundu A, et al. Forest fire risk mapping using analytical hierarchy process (AHP) and earth observation datasets: a case study in the mountainous terrain of Northeast India. *SN Appl. Sci.* 2021;3:425.  
Available:<https://doi.org/10.1007/s42452-021-04391-0>
26. Lou S, Liao Y, Liu Y, Bai Y: A daily burned area mapping method using AVHRR time-series data, EGU General Assembly 2021, online, 2021;19–30.  
Available:<https://doi.org/10.5194/egusphere-e-egu21-3976>,
27. Aparício BA, Sá ACL, Santos FC, Bruni C, Pereira JMC. Combining wildfire behaviour simulations and complex network theory to support decision-making: A case-study in a Mediterranean region, EGU General Assembly 2021, online, 2021;19–30.  
<https://doi.org/10.5194/egusphere-egu21-980>, 2021.
28. van Gerrevink M, Veraverbeke S. Evaluating the near and mid infrared bi-spectral space for assessing fire severity and comparison with the differenced normalized burn ratio, EGU General Assembly 2021, online, 2021;19–30.  
Available:<https://doi.org/10.5194/egusphere-egu21-2238>, 2021.

29. Banerjee C. New evidence pushes back by 30,000 years first use of fire, Times of India, TNN / Updated: Dec 2. 2020;14:55 IST
30. Srivastava A. Forest fires in India, Ecologists , informed by nature; 2020, Available:<https://theecologist.org/2020/sep/11/forest-fires-india>
31. Hussain A., Negi, AK., Todaria NP., History of Forest Fire around Globe, India and Uttarakhand-A Brief Scenario. J. Agric. Technol., 5(1): 7-14 (2018)
32. Glikson A. Fire and Human Evolution: The deep-time blueprints of the Anthropocene. Anthropocene. 2018;3:89-92. DOI: 10.1016/j.ancene.2014.02.002
33. Mishra SP. Defaunation during Great Acceleration Period of Anthropocene Epoch: India, World Applied Sciences Journal. 2018;36(3):506-518, DOI: 10.5829/idosi.wasj.
34. Bandyopadhyay C, Manna M. Fires in India: Learning Lessons for Urban Safety. New Delhi - 110001: National Institute of Disaster Management (NIDM); Ministry of Home Affair. 2020;1-109.
35. Krawchuk MA, Moritz MA, Parisien M-A, Van Dorn J, Hayhoe K. Global Pyrogeography: the Current and Future Distribution of Wildfire. PLoS ONE. 2009;4(4): e5102 Available:<https://doi.org/10.1371/journal.pone.0005102>
36. Mishra SP, Mishra S, Siddique MD. The Anthropocene Dialogues on Climate Change to Human Health of Homosapiens in India; Current Journal of Applied Science and Technology. 2020;39(24):13-30.
37. Hirschberger, Peter. Forests ablaze; Causes and effects of global forest fires. WWF; 2017 Available:<https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF-Study-Forests-Ablaze.pdf>
38. Srivastav K. Most forest fires in India on account of human activity. Mongabay; 2020. Available:<https://india.mongabay.com/2020/01/most-forest-fires-in-india-on-account-of-human-activity/>
39. Kraus PD, Goldammer JG. Forest Fires in India, workshop proceedings, Pillar Human Resource Development Centre, Madurai, India, Feb. 19th to 23<sup>rd</sup>. 2007;9.
40. MOEF&CC, Govt of India, National action plan on forest fire. Forest Protection Division. 2018;4, Available:<https://www.forests.tn.gov.in/app/webroot/img/NAPFF->
41. Pal I, Ghosh T. Fire Incident At AMRI Hospital, Kolkata (India): A Real Time Assessment For Urban Fire. J. of Business Management & Social Sci. Research (JBM&SSR). 2014;3(1)
42. Mishra SP. Lightning during golden spike of the Anthropocene epoch: the study of vulnerability, Odisha, India in the global context, Int. Jr. of Adv. Res. 2018;6(11): 150-170. DOI:10.21474/IJAR01/7982
43. Singh O, Singh J. Lightning fatalities over India: 1979–2011. Meteorological Applications. 2015; 22:770–778. DOI: 10.1002/met.1520
44. Chowdhury K. Fires in Indian hospitals: root cause analysis and recommendations for their prevention. Jr. of Clinical Anesthesia. 2014;26(5):414-424, Available:<https://doi.org/10.1016/j.jclinane.2013.12.014>
45. Whitlock C, Higuera PE, McWethy DB, Briles CE. Paleoecological perspectives on fire ecology: revisiting the fire-regime concept. The Open Ecology Journal. 2010; 3:6–23.
46. Moritz MA, Parisien M-A, Batllori E, Krawchuk MA, Van Dorn J, Ganz DJ, Hayhoe K. Climate change and disruptions to global fire activity. Ecosphere. 2012; 3(6):49. Available:<http://dx.doi.org/10.1890/ES11-00345.1>

## LINKS REFERRED

1. Link 1: <https://www.britannica.com/topic/Agni>
2. Link 2: <https://theecologist.org/2020/sep/11/forest-fires-india>
3. Link 3: ([www.wwf.org.co/en/?364633/Increasing-forest-fires-are-a-crisis-for-the-planet](http://www.wwf.org.co/en/?364633/Increasing-forest-fires-are-a-crisis-for-the-planet))
4. Link 4: <https://royalsociety.org/blog/2020/10/global-trends-wildfire/>
5. Link 5: <https://www.news18.com/news/india/india-has-already-witnessed-3-big-forest-fires-in-2021-odishas-simplipal-national-park-latest-to-fall-prey-3529265.html>
6. Link 6 : file:///F:/Fires\_in\_India\_2020



7. Link 7: <https://20%public.wmo.int/en/media/press-release/global-climate-2015-2019-climate-change-accelerates>
8. Link 8: [wwfeu.awsassets.panda.org/downloads/wffires\\_forests\\_and\\_the\\_future\\_report](http://wwfeu.awsassets.panda.org/downloads/wffires_forests_and_the_future_report)
9. Link 9: <https://www.un.org/esa/forests/wp-content/uploads/2021/04/>
10. Link 10: <https://www.un.org/esa/forests/wp-content/uploads/2021/04/>
11. Link 11: <https://fsi.nic.in/forest-fire-activities>
12. Link 12: <https://www.downtoearth.org.in/news/forests/forest-fires-in-india-alerts-since-april-1-nearly-double-that-of-2020-76559>
13. Link 13: <https://www.freepressjournal.in/indore/madhya-pradesh-reports-highest-visible-infrared-imaging-radiomete>
14. Link 14: [http://www.frienvi.nic.in/Database/Forest-Cover-in-States-UTs-2019\\_2478.aspx](http://www.frienvi.nic.in/Database/Forest-Cover-in-States-UTs-2019_2478.aspx)
15. Link 15: <https://www.downtoearth.org.in/news/forests/forest-fires-in-india-alerts-since-april-1-nearly-double-that-of-2020-76>
16. Link 16: <https://www.livemint.com/news/india/march-third-warmest-in-121-years-as-per-monthly-average-temperature-imd-116>
17. Link 17: <https://reliefweb.int/report/india/india-forest-fire-imd-ews-india-gwis-media-echo-daily-flash-12-april-2021>
18. Link 18: <https://factly.in/number-of-fire-accidents-in-the-country-reduced-over-time/>

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