DISTRESSED LIVES AND LIVELIHOOD IN BIOSPHERE RESERVES DURING ANTHROPOCENE; SIMILIPAL FOREST BLAZE -2021

***Abstract*:** Inland *Biosphere reserves are mainly focusing on conservation of forests for a sustainable biodiversity that has. alerted the ecologists, and forest managers. The reserving forests were under jurisdiction .of the state forest department. The aboriginal tribes were the forest savers, so the damages by the wild fire were less in past.*

Present investigation includes the wild forest blazes in India during 2021 with special attention to the Similipal forest fire 2021 in Mayurbhanj district, Odisha. The socio-biological impacts of the forest fire on the aboriginal communities are searched. The soft-wares used in the present study were ArcGIS, QGIS, GPS Visualizer, USGS Earth Explorer, Google Earth Pro-Paint, Bhuvan, Accu-Weather, and ERDAS IMAGINE 11 for analyzing, image processing, and presentation.

The assessment of the anthropogenic burnt area has been about 1000 Km^2. The involvement of the ethnic communities is found to be the protectors of the fire in past are now oustees. The wild blaze management in forests can be done by public private partnership mode. The mass consciousness can be adopted involving the particularly vulnerable tribal group like, the Vana Suraksha Samiti, under the Forest Rights Act of the state government.

***Key words*:** *Forest fire, indigenous plants, Pyrocene, Indian forest, Wildfires, Urban fires*

1. INTRODUCTION

Inland biosphere reserves are primarily converging on safeguarding of natural forests, and biodiversity sustainability. Reports of continuous wild fires have alerted the ecologists, environmentalists, and forest managers about the forest's sustainability. The present practice of preserving forests lies solely under the forest department in India and is under debate (Adeney et al., 2009[1]). The wild tropical forest fires in Australia, Amazon forests in Brazil, Southeast Asia along with associated climate changes have challenged the vast vegetation cover of the earth.

During 21st century, ecosystems are subjugated by the Anthropocene Homo sapiens. The nature and the climate have been seriously degraded. The population growth rate has reached the apex. Providing life in a comfort zone that partly depend on the bio-system and fulfill demand of the 7-8billions of people is one herculean task. The rapid growth of urbanization, industrialization, agriculture, urged for the sacrifice to the forest's areas. The natural forests are put to ablaze triggering natural fire hazard and causing loss of biodiversity and habitat loss (Firreira, et al., 2020[2]).

Similipal Biosphere reserves (SBR); in Mayurbhanj district of Odisha is housed in Chhotta Nagpur biotic zone of the Mahanadi bio-geographical region, Baripada, and Rairangpur. The Similipal Tiger Reserve (STR) of 1956 was declared as biosphere reserve in 1994. The inner core of the reserve is 845 Km^2, circumscribed by buffer zone comprising of 2129 Km^2, and transition area of 2595 Km^2. The total area that includes Similipal tiger reserve (Similipal sanctuary), the reserved forests, and the transition area is 5569 Km^2 as per wild life department, Government of Odisha (GoO) data, http://odisha wildlife.org/similipalbiosphere.html.

From Feb. 11th to Mar 15th, 2021, about 348 fire points (F.P.'s) within the Similipal Tiger Reserve (STR), Baripada Division (1242 FP's), Karanjia Division (964FP's), and Rairangpur Division 926 were detected as per FSI. From mid- March, there was onsets of tropical hard summer in interior Odisha, making the forests to become dry and vulnerable to catch fire. Present study envisages the one among the major fire incidences that had burnt the SBR in the year 2021.

1.2 Review of literature

Forest blazes are important ecological incidents that affect the decay and growth of its flora, fauna and avifauna by prompting diverse aspects of growth, and expansion of vegetation, like flowering, seed diaspora, sprouting, seedling, and changing plant mortality,(Pyne, 2010[3], Vaderevu, et al., 2019[4], Ferreira et al., 2020[2], Tan et al., 2020[5]).

Wild forest blazes threateningly influence the physio-chemical, biological, mineralogical, soil geographies that trigger loss of vegetation, enhance soil erosion. Wildfires enhance the geo-bio system by altering lines of gully erosion, impacts soil. The forest fire disrupts the interrelation of the ecosystem. It also distract the various environmental cycles, modify the air composition by instigating change of climate (CC) and mean sea level rise (MSLR) *etc*., *(*Cruzen et al., 1993[6], Adams, 2013[7], Valderrama, et al., 2018[8], Pouuyan, et al., 2021[9]).

Forest fire risk zone mapping, demarcation of high risk zone, and numerous fire management actions has been done by various forests researches, by evaluating various parameters like type of land cover, slope and aspect of vegetation, topography, geology, landscape wetness index, and distance from human habitation areas, anti-poaching camp sheds *etc.* using soft-wares like Arc GIS, Q-GIS, ERADAS and many other software's by downloading satellite images from time to time, (Dong et al., 2005[10], Sowmya et al, 2010[11], Manaswini et al, 2015 [12], Ajin et al., 2016 [13], Satis et al., 2016[14], Valderrama, 2018[8], Parajuli et. al., 2020[15], Nikhil et al., 2021[16], Lamat et al., 2021[17]).

Various studies on the endangered species on genome scale in various reserved forests and zoonotic sanctuaries are done over tigers, elephants, plant browning and early drying, edge effects on diversified vegetation. Changes in massive fires are encountered by the Indian forest and forms fire prone ecosystems are regular and age old issue in forests in hills of Western Ghats, Eastern Ghats, hills of Himalaya's, forests in north east region (NER) states, Nilgiri and Similipal forests (Doerr et al., 2016[18], Koulgi et al., 2019[19], Mishra, 2021[20], Fule et al., 2021[21]).

The SBR, in Mayurbhanj district in Odisha enjoys Savanna climate, dense and deciduous forests. In past the SBR was worst affected by annual forest fire in the years 2006, 2009, 2013, 2016 and 2021 destroying huge forest cover (*Imagery Resources Sat-1 data*), (Mishra B. K. 2010[22], Saranya et al., 2014[23], Swain et al., 2019[24]). Similipal possesses hill-inland topography largely comprised of forests ecosystem out of which 71% belongs to aboriginal and ethnic group. The importance of the forests is its ethno-medicinal plants. The forest conflagration 2021 has lost the livelihoods of the Lodha and Mankadia tribal people, who are part to the vulnerable tribal group (PVTG) in Odisha, (Panda et al., 2011[25], Upadhaya et al., 2012[26], Sahoo Hk, 2021). The Bandhavgarh Tiger Reserve (BTR) in MP was also severely affected by the fire incident in April, 2021 (https://india.mongabay.com/2021/05 /with-more-forest-fires).

The Similipal reserve forest has fire incidences every year during Mar-Apr 2021 that cause colossal damage to the Similipal biosphere reserves (SBR), Similipal tiger reserves (STR), and Similipal National Park. Present study envisages the investigation of current wild forest fire in Odisha, India and throughout the globe.

2. METHODS AND METHODOLOGY

The reporting of global fire emission data base (GFEDB) was recorded from 1982 to 2017. Later with the help of MODIS (AVHRR) Change Detection and Classification (CDC) system is made by time-series model, which gave Landsat data monitoring land cover change along with the fire severity (Lou, et al, 2021[28]). Multi-criteria result oriented support system like Analytical Hierarchy Process (AHP), and geostatistical methodology namely Getis-Ord Gi statistics, and Mann Kendall trend test have been used to study the impacts forest fire and associated hazards

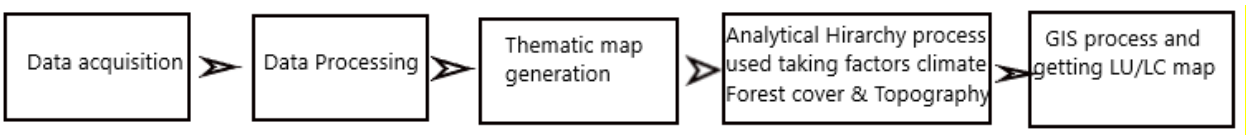


Fig 1: Methodology used for spatial analysis of the Similipal wild fire hazard in 2021

The data for the months of February 2021 to May 2021 was downloaded from satellite Landsat- 8. The soft wares used in the present study were ArcGIS, QGIS, GPS Visualizer, USGS Earth Explorer, Google Earth Pro-Paint, Bhuvan, Accu-Weather, and the ERDAS IMAGINE 11 for ArcGIS for analyzing, image processing, and presenting the results. Some auxiliary data were taken from the Survey of India (SOI) topo-sheets and used for geo-referencing (1:50,000 scale). The methodology is shown in Fig-1.

From various bands, the band 1 – 7 was taken for separate four composite maps. Those maps were fused by the process of mosaic in GIS. The shape file of the study area was inserted and the required area was masked out from the mosaic map. Consecutive months were compared by image analysis tool for the changes in the land use and land cover of the study area. The difference in maps was classified by ISO cluster unsupervised classification tool with a specified number of classes. Finally, the raster calculator was used to calculate the LULC changes.

2.1 Past Fires in Similipal

The fire burnt area in the year 2013was 2175.9 Km^2 (59.6 % of total vegetation cover). Fire burnt area was 1916 Km^2 in 2004. It has been assessed that the highest area damage was in the year 2013. It was 1014 Km^2 and 1017 Km^2 during the year about 2009 and 2013 respectively. Records reveals about Similipal witnessed major forest fires in the year 2006 and 2016 in 21st century, (Saranya, et al 2014[23])

2.2 Forest fire alerts in India 2021

FSI has reported that there is still 35.71% of forests in India are yet to be exposed to wild fires. The forests in NER and the Deccan plateau areas in India are the worst affected from fire (MOEF&CC, GOI, 2018[29]). Out of about 712249 Km^2 of forest shield, about 152421 km^2 (21.4%) is exceedingly prone to fire covering forests of NER states, Chhattisgarh, Odisha, Uttarakhand, and Madhya Pradesh (maximum 77000 Km^2). The Forest Fire Alert System and Danger Rating are done by using FAST 1.0, 2.0, and 3.0 from the MODIS data. The forest warning points FWI of FSI map is in FSI VAN AGNI: 1.0**;** from Van Agni Geoportal Fig-2**.** Using Visible Infrared Imaging Radiometer Suite (VIIRS), the Global Forest watch (GFW) has alerted. MP had highest number (22797) fire points (FP's) during, April 1-14, 2021 which was double of 2020-2021 (Table 1). https://www.downtoearth.org. in/ news/ forests / forest-fires-in-india-alerts-since-april-1-nearly-double-that-of-2020-76.

Table1: Major forests in India prone to fire along with numbers of forest fire alerts

Place	Forest (Km^2)	% Total geo-graphical 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
India	712249	21.67%	78716	25701	43508	43031	82170

Source: Global Forest Watch using Visible Infrared Imaging Radiometer Suite (VIIRS)

2.3 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. However, the state Odisha ranks first in the list of forest blaze episodes of 1201 numbers in month of March that with 23,325 fire spots in India from March 1, 2021, as per FSI fire alert system (SNPP), (Adityan, 2021), (Fig -2)

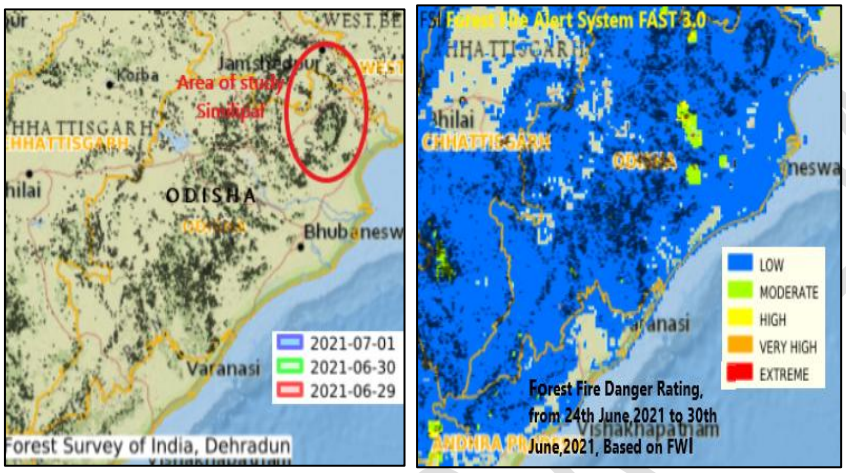


Fig 2: The MODIS Odisha fire architecture, and danger rating , from 24th June,2021 to 30th June,2021, Based on FWI (VAN AGNI Geoportal)

2.5 Role of Indigenous communities

The SBR tribal communities are mainly of 13. The Particularly Vulnerable Tribal Groups (PVTGs) out of 62 tribal communities in Odisha constituting about 58.7% of Mayurbhanj Population. The indigenous communities are staying in 1265 villages whereas 60 of them are located in sanctuary and one village in core area. One of the vulnerable 110 Khadia tribal families of the Khejuri village were relocated 100km away on 24th Jan 2020.They were savers of fire in SBR prior, https://www.ejatlas.org/print/simlipal-national-park-conflict-over-conservation-project.

2.6 Forest fire alerts for SBR

During Mid- February, the poachers, Mohua flower and the firewood collectors ignited fire to the bushes which continued for months together (https://reliefweb.int/report/india/india -forest-fire-imd-ews-india-gwis-media-echo-daily-flash-12-april-2021). FSI had also recorded 23000 points all over Odisha from 1st to 7th March after a dry spell for one long spell as per Government of Odisha on 8Th Mar., out of which 686 were active and large and 23,185 fire points (FP'S) in 2021, (Senapati A, 2021). Between 11th February and 15th March there were 348 fire points detected inside (STR), 1242 in Baripada Division, 964 in Karanjia Division and 926 in Rairangpur Division as the SBR constitutes four divisions STR (South and North), Baripada, Karanjia and Rairangpur (FSI data) (**Fig-3**).

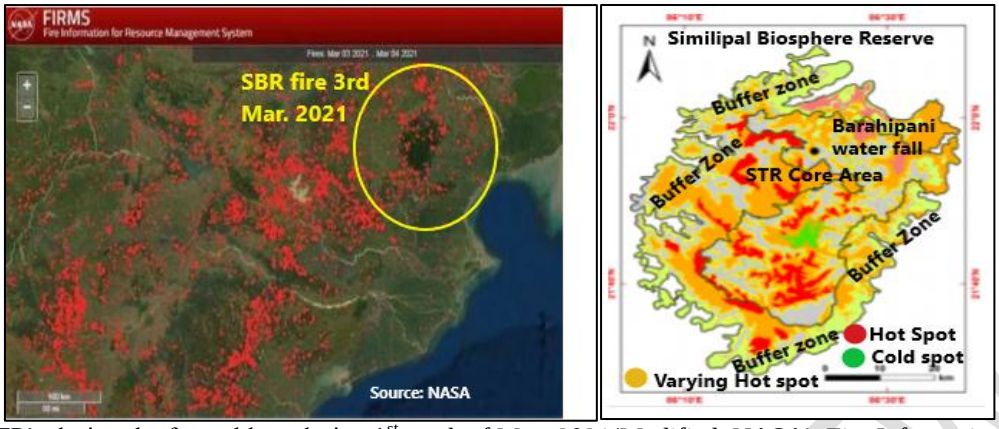


Fig 3: The FP's during the forest blaze during 1st week of Mar -2021(Modified: NASA's Fire Information; Blakeslee RJ, 2019[32].https://www.hindustantimes.com/india-news/nasa-satellites

The Forest Department (FD) of Government of Odisha claims fire are common to deciduous Sal forests within the STR. Absence of rainfall and dry leaf litters combined with wind and soaring temperature aggravates wild fire. The wildfire in SBR is mainly anthropogenic. The Community Forest Rights (CFR) under Forest Rights Act (FRA), reported the areas observed least damage in SBR wild fire 2021. The aboriginal communities within the sanctuary of Kuanrbil of Gudgudia (Gram Panchayat) GP extinguished a fire instantly after notice on 4th Mar. 2021. Similarly on 7th March, inhabitants of a Kolha village, under Barehipani GP controlled fire caught near their village in absence of any government officials. No wildfire detected in Baunshanali GP in CFR areas.

3. THE WILDFIRE AT SIMILIPAL-2021 (ODISHA)

From mid- March, there was onsets of tropical hard hit summer in interior Odisha, making the forests to become dry and vulnerable to catch fire. The state Odisha was protracted dry spell, (due to less active monsoon) between the years 2016 to 2021. The jungles of the province were escorted by extensive wildfires within its biosphere reserves or deciduous forest areas. The USGS earth explorer was used to download data from Landsat -8 (30m resolution) and having Pixel size as unsigned integer 16bit pixel length with spatial reference WGS_1984_ UTM_Zone_45N (Fig 4 (a), (b), (c) &(d)).

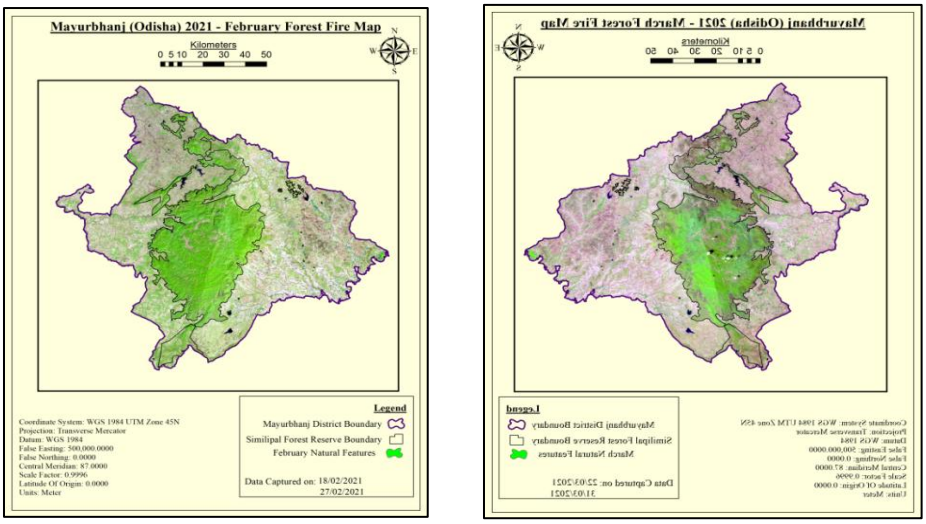
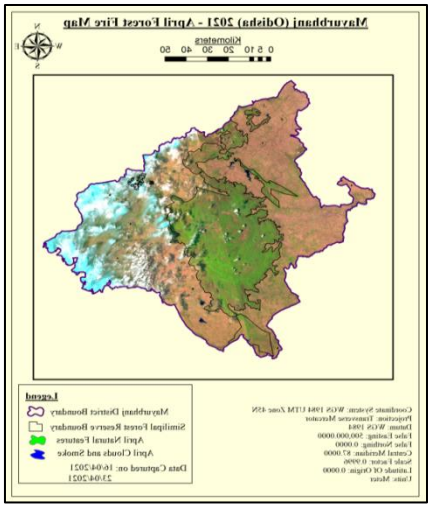


Fig 4 (a): Imagery Similipal Forest Feb-2021 Fig 4 (b): Imagery Similipal Forest Mar-2021



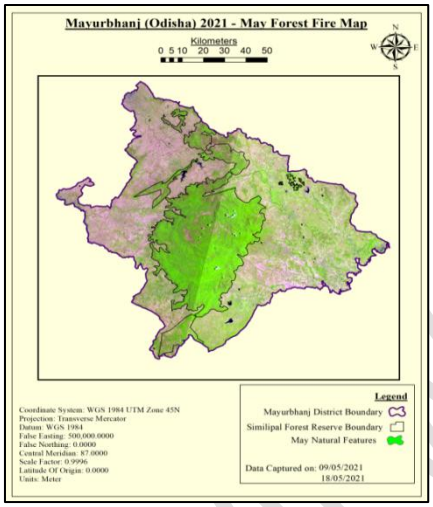


Fig 4 (c): Imagery Similipal Forest Apr-2021 Fig 4 (d): Imagery Similipal Forest May-2021

3.1 Proceeding of wild fire in SBR

The start of the fire was from 11th February, 2021 in small negligible patches. The fire became wild by first week of March. The custodian, the Better to write Department of Environment and Forest (DoEF), Government of Orissa (GoO) had taken it seriously from 4th March 2021 onwards.

By 4 March 2021, fires in Similipal had been burning for over 10 days. The DOEF, Odisha reacted by deploying over 1000 persons include fire and forest guards as well as 40 fire trainers and deployed blower machines to control the fire. The challenges to quench the wildfire became a herculean task as high temperatures were exacerbated.

On 5 March 2021, DOEF, GoO, reported that that the blaze was brought under control. The FSI had recorded 233 active forest fires within the SBR on that day.

On 9 March 2021, The Government of Odisha (GoO), constituted a task force to fight with the aggressive fire on PPP mode. The fire was in less aggression by conjoint effort of the rainfall in the area and public participation. The fires were still ongoing in various parts of the SBR. The rainfall on 10th March had brought part relief to the SBR, but many areas were still in blaze. The changes in land cover in consecutive months Feb.-Mar, Mar-Apr, and Apr-May are also recorded in **Fig-5.**

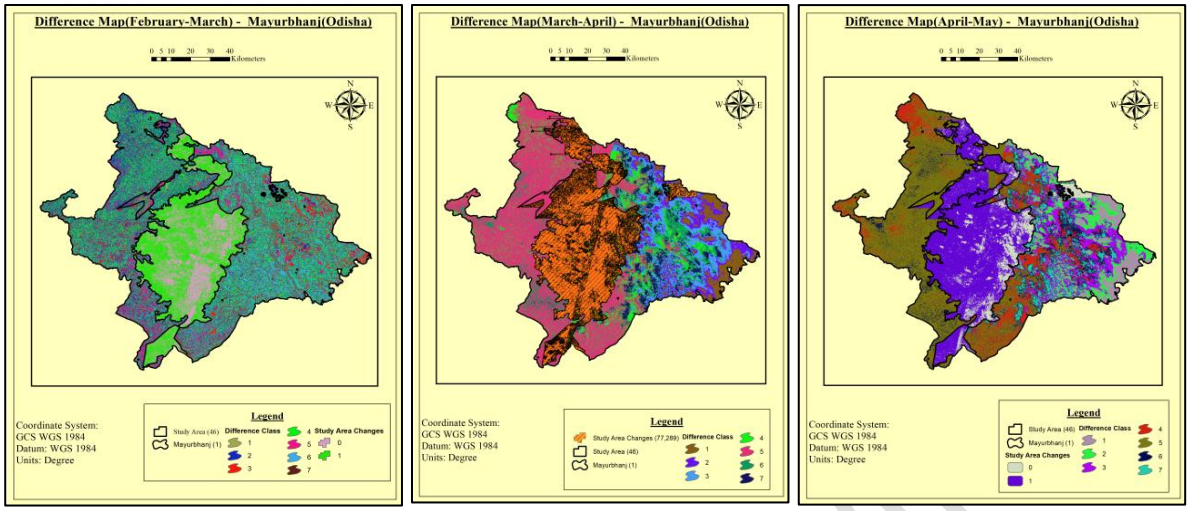


Fig 5: The changes in land cover of Mayurbhanj during Feb.-Mar, Mar-Apr and Apr-May-2021

The fallen leaves of winter and drying of deciduous forests conjointly contribute to initiation of fire. This period is conducive for ignition caused mostly anthropogenic and rarely natural. The human causes are clearing of fallen Sal leaves to collect Mohua flower whereas the natural causes is associated with lightening or raised temperature. The factors of the present year SBR forest wild fire high temperatures during the summer months of April and May being ignited by local inhabitants. The factors for wild fire in forest may be due to lightening or excess heat. The prolonged fires and higher temperatures are likely to disturb the surrounding ecosystem, wild honey output in SBR and badly affect the daily livelihood of tribal communities..

3.2 Estimation of forest area burnt during 2021

The forests of Similipal witnessed about 399 fire points in the outskirt different villages bordering the woods zone and imperiling life of the forest habitats. The fire was started near the village Khejuri in STR. Further the fire propagated to Balama, of Similipal. Later the fire extended to Polamdar, Maruadibandh, Sinduria, and Badasal etc. of Kuladiha forests (272.75 Km^2) of Balasore.

Table 2: The progressive study of the forest fire disaster in Similipal areas; in months Feb-Mar; Mar-Apr and Apr-May-2021

State/ District	Data set used	District area (Km^2)	Month/2021 Trial Dates images	Area change month wise 2021	Land cover change Area (Km^2)
Similipal bio-sphere reserve Mayurbhanj, Odisha, India	Landsat 8 OLI /TIRS C2 L2; WGS_1984_UTM_Zone_45N	10418	Feb-18th -27th		
		10418	22nd to 31st; Mar	Feb to Mar:	1084.31
		10418	16th to 23rd Apr	Mar to Apr:	754.41
		10418	09th to 18th May	Apr to May	630.75

The land cover changes include the mining, pre-sowing and developmental activities during the forest fire period, there shall be some error to estimate the burnt area during the wild forest fire which can be about 5% of the land cover change, Hence the land cover change due to the fire can be considered as 1000 to 1050 Km^2 (**Table 2)**

4 RESULT AND DISCUSSIONS

Forest Survey of India (FSI) has reported that the frequencies of forest fire points (FP's) in Indian forest domain are increasing regularly causing ecological disaster. Since 2004-05 there were 8654 FP's which was escalated to 30892 in the FY2009-10 and recently surged to 35888 in the FY2017, (FSI-2021) reported in News-18, the national news daily, www.news18.com/news/india/india-has-already-witnessed-3-big-forest-fires-in-2021. Forest fire risk zones need identification. Those are the initial strategic points where the fires may propagate and blaze, so that the forest managers can plan to moderate the rate.

The forest near village was ablaze reported by the public in 2021 was near the village Khejuri, a rehabilitated village within STR. The aboriginal tribal groups act as the acumen for the forest department, abate the poachers and timber mafia. Tribal were the first responders to the wildfire near village Khejuri. On forest management ground they were dislocated from their old place that invited fire Similipal forest in 2021. (https://india.mongabay. com/2021/ 03/communities-or-forest-department-similipal-fires-rake-up-debate-on-ownership-of-national-park). Absence of post-monsoon rains in Odisha in 2020 has exacerbated to a drier winter particularly during February which acted as a podium to the wild forest fire in the SBR in 2021

The controversy stands about ownership of the reserved area park should be in the hands of the forest department, the local community, or in Public Private Partnership (PPP) mode. Similipal, the Asia's second-largest biosphere reserve, located in Mayurbhanj district in Odisha's was under fire since February 11. So much damage had never occurred as the forest was the bonafied property of its stake holders, the ethnic tribal. The Forest Department GoO as custodian only can be official but not possess any belongingness to protest the poachers to ignite the nature. The 2nd largest biosphere of Asia is under jeopardy due to illegal mining, exploring natural resources, poaching, hunting and illegal fire blazes (Laha et al 2021[31]).

Fire season of forests in Similipal is between the months from Jan to April in the year. The fire is ignited by the aboriginal people in a controlled manner by the tribal people fresh Kendu leaves used for Bidi making or collection of Mohua flower and Sal seeds out of their past experience and does not allow fire to be wild. Human presence and people's participation with awareness has augmented the development of the forests inside SBR. Relocating rehabilitating these fire protectors, without considering their involvement in conservation of the biodiversity in SBR are is to be reconsidered. The sectors affected are the vegetation, economy of the stake holders, the habitats and the soil of the area till the forest rejuvenates.

5. CONCLUSION

The SBR action plan and their implementation need to be modified its management strategies that have been realized after the wild fire on March 2021. As custodians of their forest, the son of the soil, should not be abruptly displaced. Recording of forest fire, date, monitoring for the conservation efficacy, the species count, identify the endangered, critically endangered, extinct need updating for the biodiversity management of the SBR. Management of the biosphere reserve must be done on PPP mode, to protect the tribal people's rights and obligation to their ancestor's forest land. Researches are warranted about the ecology, sustain fire regimes, strengthen preservation activities and maintain the present records for future guidance. The small scale maps (1:1000) are required for fire zone mapping, the species habitation zoning showing their seasonal path of movement, the firefighting routes. Maps of 1:1000 scales created by using drone survey and GIS, DGPS survey techniques are essential as learnt from the present fire disaster. The spatial database offers excellent opportunities to understand the ecological impact of fires on biodiversity and is helpful in formulating conservation action plans.

***Abbreviations*:** SBR**:** Similipal Biosphere Reserve**;** STR**:** Similipal Tiger Reserve**;** GIS: Geographic information system; RS: Remote sensing; GoO: Government of Odisha; MSL: Mean Sea Level; PVTG: Particularly vulnerable tribal group; VSS: Vana Suraksha Samiti; FD: Forest Department; FRA: Forest Rights Act; GFEDB: global fire emission data base; MODIS: Moderate Resolution Imaging Spectro-radiometer sensor; MOEF&CC: Ministry of Environment, forests and Climate Change; AVHRR: Advanced Very High Resolution Radiometer; FSI: Forest

Survey of India; AHP: Analytical Hierarchy Process; CDC: Change Detection and Classification; SOI: Survey of India; LULC: Land use and land cover; International Organization for Standardization; NER: North Eastern Region; VIIRS: Visible Infrared Imaging Radiometer Suite; GFW: Global forest watch; FP's: Fire points; SNPP: Simple Network Paging Protocol; CFR: Community Forest Rights; NASA: National Aeronautics and Space Administration; LIS: Lightning Imaging Sensor: NRT: Near Real Time; GP: Gram Panchayats; PPP: Public private partnership; DGPS: Differential Global Positioning System FP's: Fire points; M.P.: Madhya Pradesh.

6. DECLARATION

- **Competing interests**: Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge.
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- **Authors' contributions**: Dr. S. P. Mishra and A. Mishra wrote the main manuscript text and Mr. Chandan. Kumar and Saswat Mishra prepared figures. Dr. D. K. Sahu reviewed the manuscript.

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