

Forest Fires and Non-Timber Forest Products: Assessing Impacts and Management Strategies

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Abstract:- Forest fires pose significant challenges to the sustainability of Non-Timber Forest Products (NTFPs) worldwide. Understanding the impacts of these fires on NTFPs and devising effective management strategies are essential for maintaining the ecological integrity and socio-economic vitality of forested regions. This study examines the effects of forest fires on NTFPs and explores potential management strategies to mitigate these impacts. Key findings reveal direct damage to NTFP resources, changes in species composition and availability, alterations in ecological relationships, and implications for local communities dependent on these resources. The study underscores the importance of proactive management approaches, including fire prevention, post-fire restoration, and community-based resource management, to ensure the sustainable use of NTFPs in fire-prone forest ecosystems.

Keywords: Forest fires, Non-Timber Forest Products (NTFPs), Management strategies, Sustainability.

1. Introduction

Nestled in the heart of central India, Chhattisgarh stands as a testament to the country's rich biodiversity and ecological significance. With a vast geographical area spanning 1,35,194 square kilometres, this state boasts a diverse landscape comprising dense forests, expansive plains, and intricate river systems (Singh & Jeganathan, 2024). Notably, the recorded forest area covers 44.21% of the state, making a substantial contribution to India's overall forest cover. Through examining the distribution, composition, and difficulties of sustainable forest management (Siry., 2005), this study aims to clarify the geographic complexities of Chhattisgarh's forest and tree cover. The vast forest resources are essential to the health of the state as a whole, the maintenance of a variety of ecosystems, and the provision of jobs for nearby communities. As we delve into the geospatial data, we aim to shed light on the proximity of human habitation to forest areas, exploring the implications for both communities and the environment. Additionally, Chhattisgarh's ranking as the 10th largest state in India, geographically speaking, prompts an investigation into the challenges posed by its vast expanse and diverse topography (Ahmad et al., 2019, Ray et al., 2023).

This study rooted in a comprehensive analysis of Chhattisgarh's forest dynamics, seeks to provide valuable insights into the ecological health of the region. By understanding the nuances of forest cover distribution and the challenges faced, we endeavour to contribute to informed conservation strategies that safeguard the delicate balance between human development and environmental preservation in Chhattisgarh.

Furthermore, it is noteworthy that Chhattisgarh ranks among the top 5 states with the highest number of fire alerts in 2023-2024, underscoring the urgency of addressing forest fire management as an integral part of sustainable forest management practices in the region.

2. Forest Fires: Causes and Impacts

Forest fires are complex phenomena with various causes, including natural factors such as lightning strikes and human activities like agricultural practices, industrial operations, and arson. The difficulty with forest fires is that they usually occur in isolated, neglected, or mismanaged woods that are full of trees and dried timber, leaves, and other materials which act as a fuel that can catch fire (Alkhatib et al., 2014). Regardless of their origin, forest fires can have significant ecological, economic, and social impacts. Ecologically, fires can alter the composition and structure of forest ecosystems, leading to changes in species diversity, soil fertility, climate change and hydrological cycles (Flannigan et al., 2000, Jodhani et al., 2024). Economically, forest fires can result in the loss of timber resources, damage to infrastructure, and disruptions to ecosystem services such as water supply and carbon sequestration (Robinne et al., 2021). Forest fires often result from traditional practices such as traditional hunting practices by burning, destructive methods of Minor Forest Produce (MFP) collection like Boda (truffles) and Futtu, which inadvertently escalate into infernos, while also serving the purpose of keeping wild animals and pests at bay. Socially, fires can threaten human lives and property; displace communities, and impact livelihoods dependent on forest resources (Kittur et al., 2014). Forest fires in India are fuelled by a confluence of factors, including the exploitation of loopholes in the Forest Rights Act for clearing, encroachments along revenue areas, deliberate burning practices, and the spread of fires from agricultural areas. These challenges underscore the urgent need for proactive measures to safeguard Indian forests from the pervasive destruction caused by infernos.

Non-Timber Forest Products: Importance and Vulnerability

Non-Timber Forest Products (NTFPs) encompass a wide range of goods harvested from forests (Tamrakar et al., 2023), including food, medicine, fibres, edible mushrooms (Dixit et al., 2023), and ornamental plants. These products play a crucial role in the livelihoods of millions of people worldwide, particularly in rural and indigenous communities. However, NTFPs are vulnerable to various threats, including habitat destruction, overexploitation, pollution, and climate change. Forest fires pose an additional risk to NTFP sustainability, as they can directly damage or destroy valuable resources and alter the availability and quality of NTFPs in affected areas. The collection of Mahua flowers, crucial for Chhattisgarh's rural economy, engages numerous families during March and April annually. Nonetheless, the practice of floor burning poses a significant risk of forest fires, threatening both the ecosystem and livelihoods (Fig -1). Along with this, the pre-collection pruning of Tendupatta root stock in March is marred by villager's tendencies to opt for forest floor burning over proper pruning, significantly heightening the risk of forest fires. Previous studies on the impacts of forest fires on NTFPs globally have identified direct damage to resources, changes in species composition, and socio-economic implications for local communities (Asamoah et al., 2023).



Fig 1: Mahua flower before setting fire, after fire (Source: Chhattisgarh Forest department), Final collection.

Existing Management Strategies for Mitigating Forest Fire Impacts

Various management strategies have been proposed to mitigate the impacts of forest fires on NTFPs. These include fire prevention measures such as controlled burning, early detection and suppression efforts, and post-fire restoration activities such as reforestation and habitat rehabilitation. Community-based approaches involving local stakeholders in fire management and NTFP conservation have also shown promise in some regions. However, challenges remain in implementing these strategies effectively, including limited resources, conflicting land-use priorities, and inadequate coordination among stakeholders.

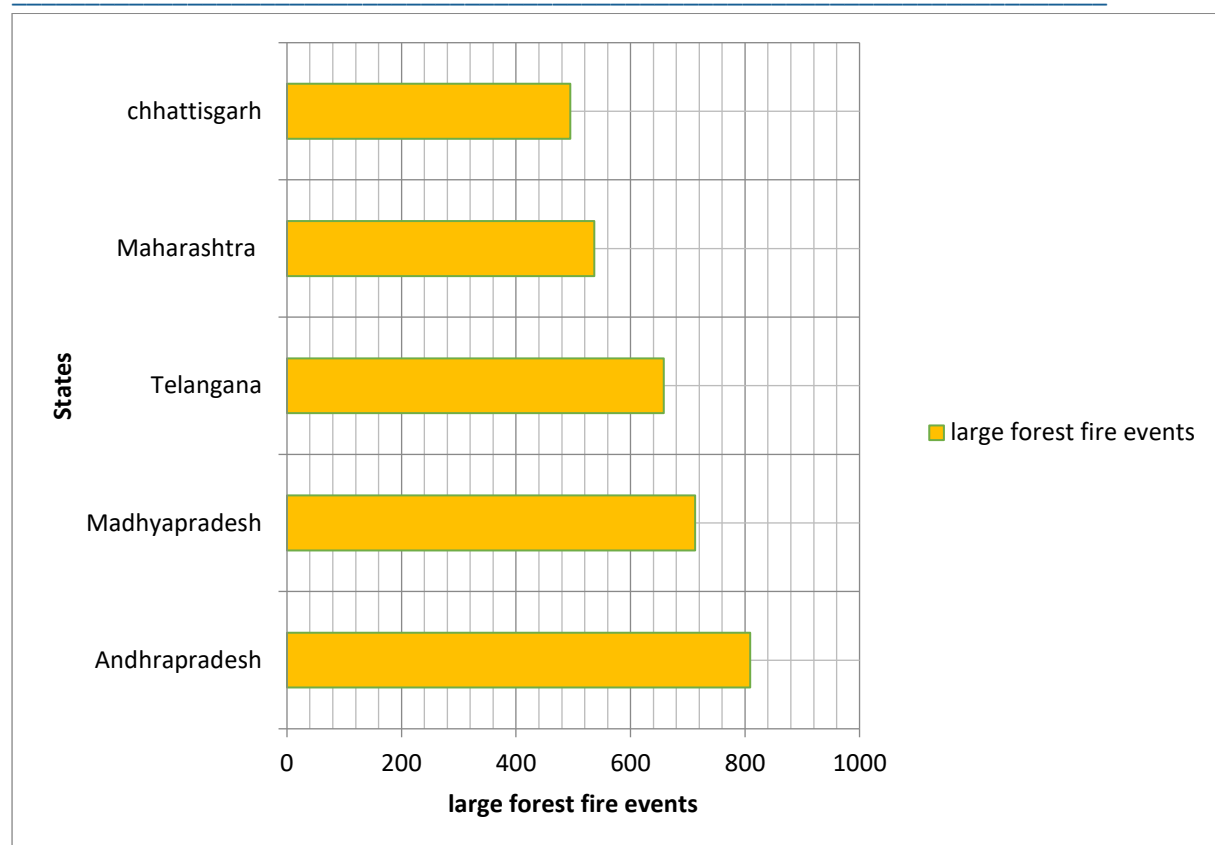


Fig 2. Top 5 states with highest no. of large forest fire events in 2023-24(Since 1st Nov 2023)

Source: Forest Survey of India, MOEFCC

3. Material and methods

Study site

The study was conducted in Kondagaon Forest Division in Chhattisgarh, India, Located between latitudes 19.6000° and 19.9000° N and longitudes 81.7000° and 82.1000° E, with coordinates 19° 36' 0.0000" N and 81° 40' 11.9928" E. The Kondagaon Forest Division encompasses diverse forest ecosystems, including dense forests, grasslands, and riverine habitats. The area is known for its rich flora and fauna, as well as its dependence on NTFPs for sustenance and livelihoods (Tamrakar et al., 2023). Additionally, the region has experienced a notable incidence of forest fires in recent years, making it an ideal study to examine the impacts of fires on NTFPs and explore management strategies for mitigating these impacts. Data collection for this research involved gathering information from multiple sources to comprehensively understand the dynamics of forest fires and their impacts on Non-Timber Forest Products (NTFPs) in the Kondagaon Forest Division, Chhattisgarh. Primary data sources included field surveys by questionnaire, interviews with local villagers, and government reports on forest fire incidents and NTFP harvesting activities. For household survey we have selected seven ranges, then randomly one beat was selected to choose 10 random households, Secondary data sources encompassed remote sensing data, and existing literature on forest fires, website data's of NTFPs and forest management practices.

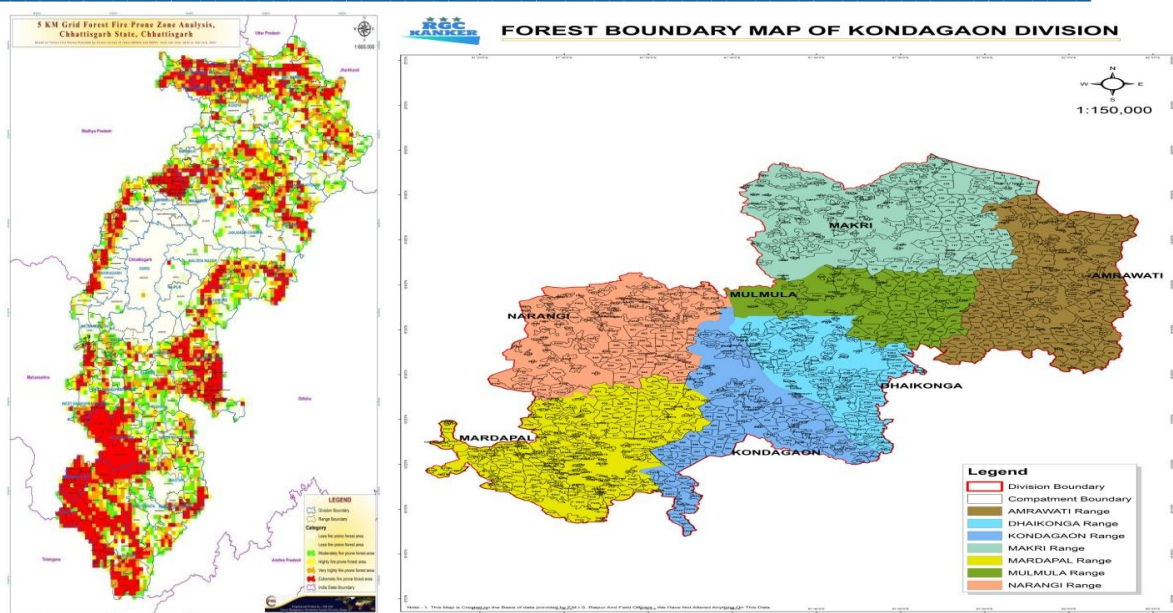


Fig 3: Identification of fire prone area of Chhattisgarh, Forest Boundary Map of Kondagaon Forest Division

(Source: Chhattisgarh Forest department)

4. Results

The data collected from both primary and secondary sources provided a holistic view of the relationship between forest fires and NTFPs in the region. This comprehensive approach allowed for a thorough analysis of the major reasons and impacts of forest fires on NTFP availability and livelihoods in the Kondagaon Forest Division.

Table 1: Range wise data of respondents of Kondagaon Forest Division, Chhattisgarh.

No.	Ranges of Kondagaon	Reasons given by Respondents			Other reasons
1.	Mardapal	5A	-	5B	Setting fire for Boda collection, Mahua collection, FRA encroachment, Deliberate burning practices
2.	Narangi	7A	1N	2B	Setting fire for Mahua collection, Tendupatta collection
3.	Amravati	6A	2N	2B	Setting fire for Boda collection Mahua collection, Tendupatta collection
4.	Makdi	6A	2N	2B	Setting fire for Boda collection, Mahua collection, FRA encroachment, Deliberate burning practices
5.	Mulmula	3A	4N	3B	Setting fire for Tendupatta collection
6.	Dahikonga	6A	-	4B	Setting fire for Mahua collection, Deliberate burning practices
7.	Kondagaon	4A	1N	5B	Setting fire for Boda collection, Mahua collection, FRA encroachment, Deliberate burning practices

*A=Anthropogenic, N= Natural, B= Both Anthropogenic & Natural

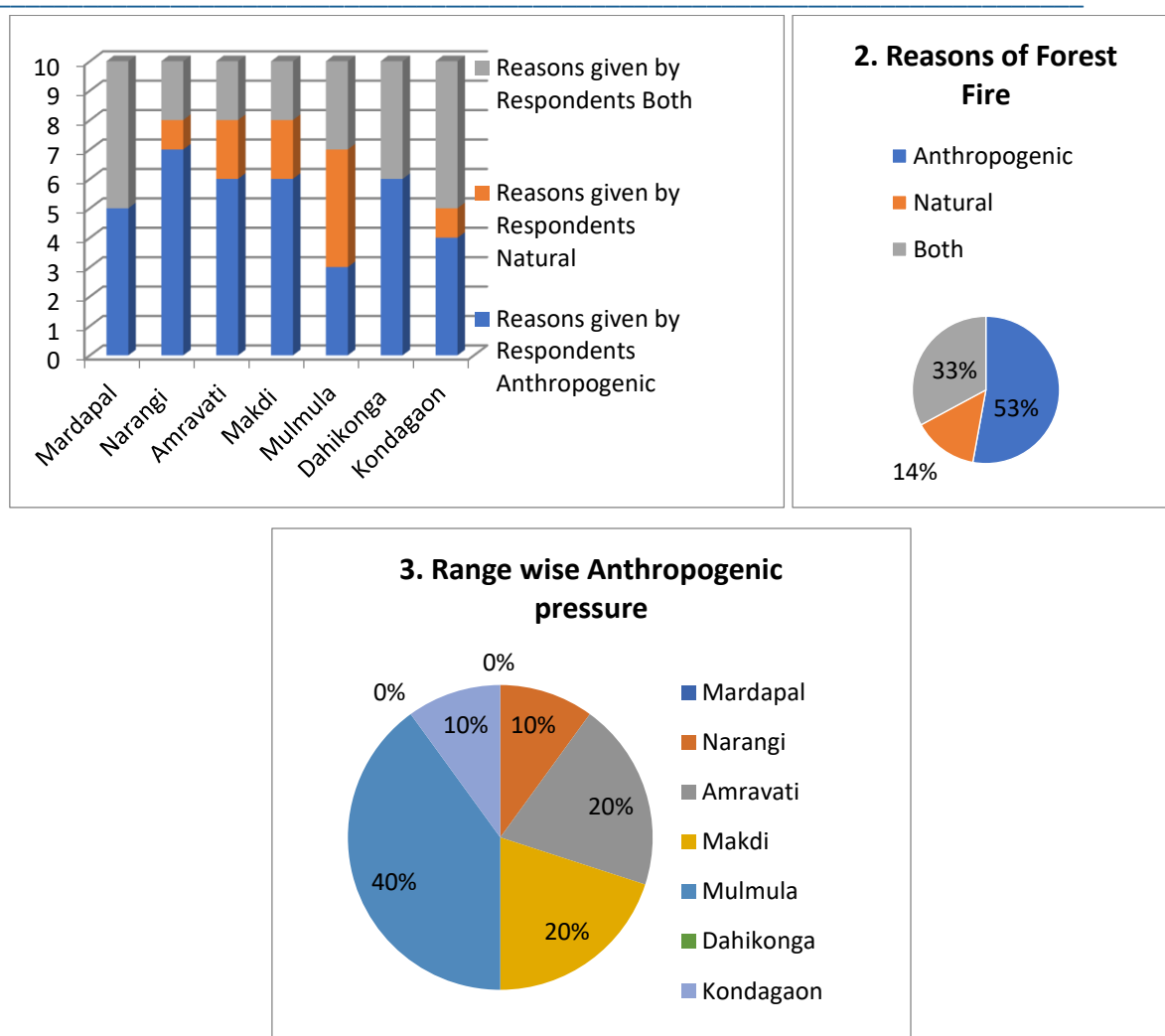


Fig 5: 1. Representation of reasons, 2. Reasons of forest fire, 3. Range wise Anthropogenic pressure

Impacts of Forest Fires on NTFPs

An evaluation of forest fire effects on NTFPs was done. Setting fire to collect Boda, Mahua and Tendupatta, FRA encroachment, and deliberate burning are the main reasons. The direct consequences encompassed the depletion of vegetation that produces non-timber forest products (NTFPs), a decrease in the variety of species, and alterations in the quality and accessibility of these products. Indirect consequences refer to the negative effects on non-timber forest product (NTFP) supply chains, economic losses for local people who rely on NTFP harvesting, and changes in biological interactions that impact pollination, seed distribution, and the appropriateness of habitats for NTFP species (Purnomo et al., 2024, Kittur et al., 2014).

Management Strategies Implemented

Various management strategies were implemented to mitigate the impacts of forest fires on NTFPs in the Kondagaon Forest Division. These included fire prevention measures such as controlled burning, establishment of firebreaks, and community-based fire monitoring (Purnomo et al., 2024, Kittur et al., 2014) and suppression efforts. Post-fire management strategies focused on habitat restoration, reforestation, and promotion of NTFP-friendly land management practices. Community involvement and capacity building initiatives were also emphasized to enhance resilience and adaptive capacity among local stakeholders. However, challenges remained in ensuring effective implementation and coordination of these strategies, including limited resources, institutional barriers, and conflicting land-use priorities. Ongoing monitoring and evaluation of management

interventions were deemed essential to assess their efficacy and inform adaptive management approaches in fire-prone forest ecosystems (Pandey et al., 2022).

5. Discussion

Relationship between Forest Fires and NTFPs

Fires and Non-Timber Forest Products (NTFPs) have a complicated relationship. Forest fires affect NTFP availability, quality, and socioeconomic value directly and indirectly. NTFP species may benefit from fire-induced regeneration and habitat renewal, but others may suffer direct vegetation destruction and ecological changes. Effective management and protection of NTFP species requires understanding their ecological needs and fire disturbance reactions. Recognizing forest fires' interdependencies with NTFPs emphasizes the need for integrated fire management that considers ecological and socio-economic factors (Saha et al., 2023, Agrawal et al., 2012).

Challenges and Opportunities for NTFP Management Post-Fire

Fire-prone forest ecosystems bring problems and opportunities for NTFP management. Local people relying on NTFP harvesting can lose money and livelihoods due to forest fires disrupting supply networks. Post-fire habitats may have altered species compositions and ecological dynamics, requiring adaptive management to restore NTFP-bearing ecosystems (Krah, 2020). Forest fires can promote fire-adapted species growth and habitat variability, which can benefit NTFP management (Genz et al., 2007). Fire ecology principles in NTFP management plans can help stakeholders benefit on these opportunities while addressing fire disturbance (Tamrakar et al., 2023).

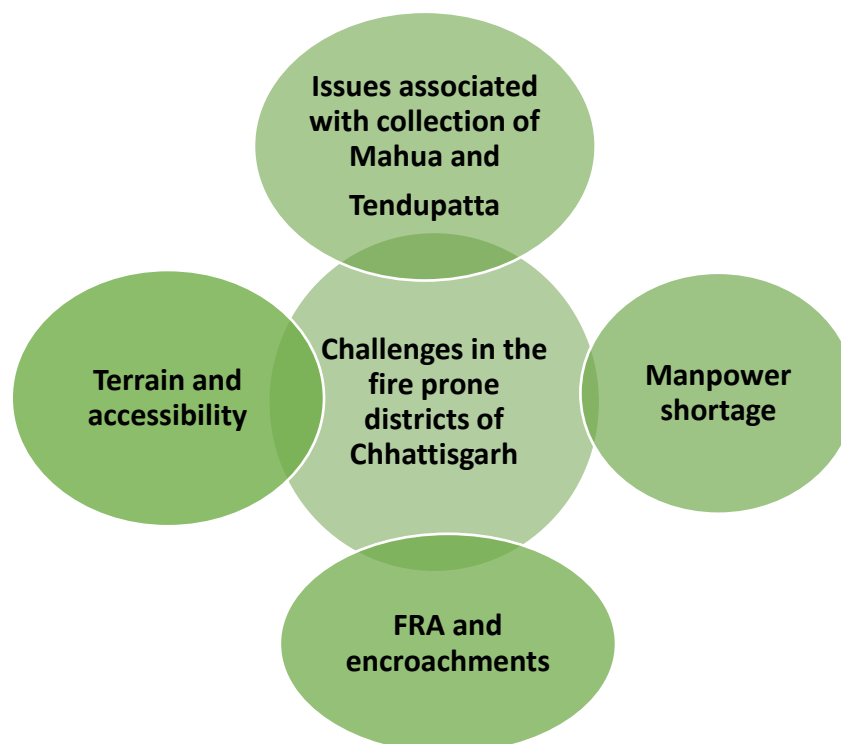


Fig: Challenges in the fire prone districts of Chhattisgarh

Community Engagement and Sustainable Practices

Fire-prone forest ecosystems need community engagement for sustainable NTFP management. Traditional local knowledge and practices can inform fire prevention, monitoring, and mitigation. By incorporating communities in decision-making and capacity-building, stakeholders may promote NTFP resource ownership and stewardship. Promote sustainable harvesting and alternative livelihoods to minimize pressure on NTFP

communities and improve fire resilience. Sustainable NTFP management and biodiversity conservation in fire-prone forest ecosystems require collaborative work that integrates traditional knowledge with scientific skills (Bahuguna et al., 2002). We can create holistic solutions that combine conservation and socio-economic development by partnering with governments, NGOs, researchers, and local populations.

6. Implications and Recommendations

Policy Implications

Fire-prone forests need policy interventions to prevent, detect, and extinguish fires. Early warning systems, fire control training for forest staff, and burning controls may help (Purnomo et al., 2024). Forest policies should highlight NTFP biodiversity and livelihood advantages. Forest management plans can encourage sustainable NTFP harvesting, community-based resource management, and conservation (Purnomo et al., 2024). Policies should strengthen local decision-making and resource management. This may involve devolving NTFP resources to local institutions, promoting capacity-building, and recognizing indigenous rights to traditional land and resources (Khalid et al., 2019, Laverack, 2006).

Practical Recommendations for Sustainable NTFP Management

Integrating fire risk assessments into land use planning processes can help identify and prioritize areas for NTFP conservation and sustainable management. This may involve zoning regulations, land-use agreements, and participatory mapping exercises to delineate areas of high conservation value and low fire risk (Pais et al., 2023). Facilitating certification schemes for sustainably harvested NTFPs can enhance market access and ensure that harvesting practices meet ecological and social sustainability criteria. This may involve capacity-building support for NTFP producers, market incentives for certified products, and public awareness campaigns to promote consumer demand for sustainably sourced NTFPs (Khalid et al., 2019). Establishing community involvement (Bahuguna et al., 2002) and multi-stakeholder platforms for NTFP management can facilitate collaboration and knowledge sharing among government agencies, local communities, NGOs, and other stakeholders. This may involve creating joint management agreements, establishing co-management arrangements, and promoting cross-sectoral dialogue to address conflicting interests and promote consensus-based decision-making (Purnomo et al., 2024).

7. Conclusion

This study shed light on forest fire dynamics and their effects on NTFPs in Kondagaon Forest Division, Chhattisgarh. Key findings include anthropogenic pressure is higher in maximum ranges, requiring awareness and better fire prevention in all ranges. Geospatial study showed clusters of recurring fire occurrences in dry deciduous forests and small grasslands (Bar et al., 2024), indicating significant fire risk.

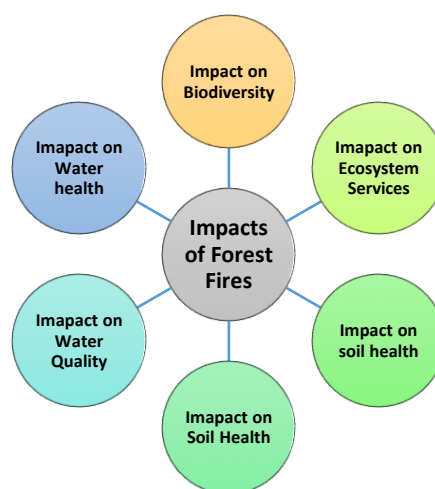


Fig: Impacts of Forest Fires

Many little hills and valleys in the study region are difficult for staff to reach and manage daily. Forest fire management also faces manpower shortages.

NTFPs are directly and indirectly affected by forest fires. They can destroy vegetation, change species composition, disrupt supply chains (Robinne et al., 2021), and cost local populations who harvest NTFPs money. The frontline requires better fire fighting gear and tools. Fire prevention, restoration, and community participation reduce forest fire damage to NTFPs. Execution and coordination of these tactics are tough. Wildfires can alter plant community structure and non-timber forest product availability and distribution (Smith et al., 2018).

Fire-adapted organisms may thrive or decline. This biodiversity change may impact ecosystems and NTFP harvesting (Robinne et al., 2021). Nitrogen loss, compaction, and erosion from high-intensity wildfires affect soil health and fertility. This degradation impairs NTFP species growth and regeneration, lowering their productivity and economic value. Johnson and Swanson (2016), Dixit (2022), Agrawal et al., 2012). Wildfires decrease water quality by clogging rivers with silt and nutrients. It can disturb ecological and socio-economic systems by damaging aquatic ecosystems and NTFPs like freshwater fish and aquatic plants (Williams et al. (2019). Wildfires can harm NTFP ecological services like food, medicine, and culture (González-Cabán, 2017). NTFP availability, quality, and cultural significance can profoundly impact local communities, especially traditional gatherers (Robinne et al., 2021).

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