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A Review of Implementation of Policy Instruments on Forests Fire in Nepal

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Abstract

Forest fire is one of the major disasters occurring in Nepal causing huge loss to the ecosystem, people and economy. They are mainly caused due to different anthropogenic activities. In Nepal, the forest fires occur during the dry season mainly from March to May. Nepal has roughly 29.5 percent forest area that are prone to forest fires and it is estimated that about 375 thousand hectares of forest were burned over one and half decade from 2000-2014. The forest fire risk is higher in the Terai and Siwalik regions than in any other region. To prevent and mitigate the forests fire incidences, the Government of Nepal has formulated and executed different policy instruments. In this regard, this paper aims to review the implementation of policies, strategies, Acts and regulations related to forest fire management at different levels of governance. Although federal and provincial governments' different policy instruments have considered forest fire and its management, these are not effectively implemented. It is not prioritized in terms of resource allocation, institutional capacity building, disaster preparedness and early warning. In addition, there are unclear and overlapping roles and responsibilities among three tiers of governments to effectively implement the policy provisions. Considering the consequences of the forest fire, governments at different levels need to devise an effective mechanism involving all stakeholders for implementing preventive and curative activities, strengthen institutions and build the capacity of human resources, and increase the level of resource allocation to implement the provisions of various legal and policy instruments.

Key Words: forest fire, implementation, Nepal, policy instruments, review

Introduction

Forests are renewable natural resources that provide various ecosystem services (Parajuli et al. 2023) such as carbon sequestration, erosion control, oxygen supply, and conservation of soil and water (Zhang et al. 2022). Over the years, forest has been destroyed as a result of forest fires (Agbeshie et al. 2022), and it has been found that the majority of the trees are burned or degraded by forest fire in comparison to any other natural disasters like insects, parasites, frost, etc. (Alexander 2013).

Forest fire has been recognized as one of the disasters that is uncontrollable, causes disruption in the ecosystem, and leads to the endangerment of biodiversity by destroying the flora and fauna of the forest (Bhusal and Mandal 2020). They are caused predominantly by anthropogenic activities, which account for more than 10 times of the natural factors (Khanal 2015; Parajuli et al. 2015; Matin et al. 2017; Bhujel et al. 2022). These activities include agricultural practices, campfires, hunting and poaching, changing land

cover, deforestation, and throwing cigarette butts (Bowman et al. 2009; Wang et al. 2021). In addition to anthropogenic factors, precipitation, and temperature have been regarded as the primary factors that cause forest fires (Flannigan et al. 2005; Holden et al. 2009; Matin et al. 2017), along with the accumulation of forest fuels such as dead and living biomass. Additionally, topographic factors such as aspect, elevation, and slope are also considered major drivers of the prevalence of forest fires (Estes et al. 2017).

Forest fires have a wide-ranging impact on terrestrial ecosystems. Forest fires cause a reduction in the production of flora, alter the regeneration rate, and cause the loss of endemic and endangered fauna species (Sati and Bandooni 2018). They also lead to the destruction of human settlements (Parajuli et al. 2015), the loss of livelihoods, and economic problems in the affected areas (Carta et al. 2023). The disaster also generates significant amounts of carbon emissions that causes worsening of climate change and global warming (Oris et al. 2014). Several strategies, including monitoring and assessment methods, early detection of forest fires, preventive measures such as prescribed burning, fuel management, and community-level awareness, are essential to reducing forest fires in the country (Ascoli et al. 2023). With that, active engagement of the community (Krah et al. 2020) along with capacity building will help build a resilient community practicing forest fire safety regularly. Similarly, building international relationships and collaboration is another strategy to increase knowledge and expertise in forest fire management (Carta et al. 2023).

In the past few decades, the number of forest fires has significantly increased globally, especially in countries like Australia, South Europe, and the United States (Varela et al. 2019). In developing countries like Nepal, forest fires have been highly pronounced over the years. Nepal particularly faces forest fires during the months of November to June, which is the dry season in Nepal, and within these months, most of the forest fires occur from the months of March to May. In the last 15 years (from 2003 to 2017), much of the forest has been lost due to forest fires in South Asia (Reddy et al. 2020). Of these, Nepal has roughly 29.5% forest regions that are prone to experiencing annual forest fires (Reddy et al. 2019), and about 3,75,000 hectares of forest were burned over the period from 2000 to 2014

(Khanal 2015). In comparison to other regions in Nepal, it has been reported that forest fire risks are more prominent in the Terai and Siwalik regions (Matin et al. 2017).

Different authors have analyzed the forest risk zones in Nepal. Parajuli et al. (2020) showed forests in the TAL (Terai Arc Landscape) of Sudurpashchim, Lumbini, Bagmati, and Madhesh provinces to pose a higher risk of forest fires, while found a lower risk in Koshi Province. A significant amount of accumulated biomass in the forests, limited rainfall, and high surface temperatures could contribute to higher risk in these areas (Matin et al. 2017). Among the seven provinces of Nepal, Sudurpashchim province is considered one of the drier regions (Department of Forest Research and Survey 2015) and at a higher risk of wildfires (Singh et al. 2020). The Terai and Siwalik regions of Sudurpashchim are considered high-risk zones in comparison to other provinces, which can be attributed to the forest's significant fuel accumulation and an ongoing trend of its extended hottest days in the regions. Similarly, Bhujel et al. (2022) showed that the districts in Lumbini and Bagmati provinces have a higher risk of forest fires, while Karnali and Gandaki provinces have a medium risk of forest fires. Fig. 1 shows the number of occurrences of forest fires in different districts of Nepal over a decade (2012-2023) that have been obtained from the Forest Fire Detection and Monitoring System in Nepal website
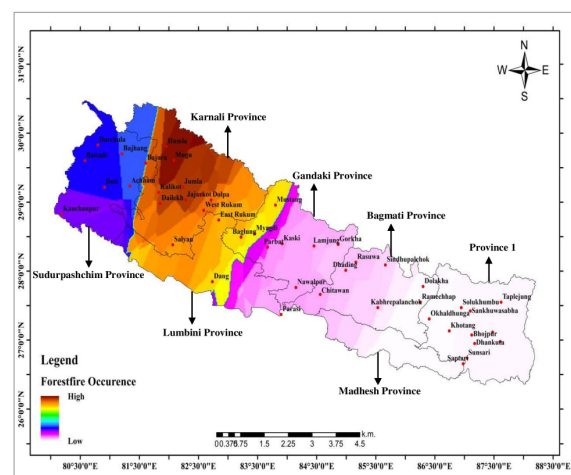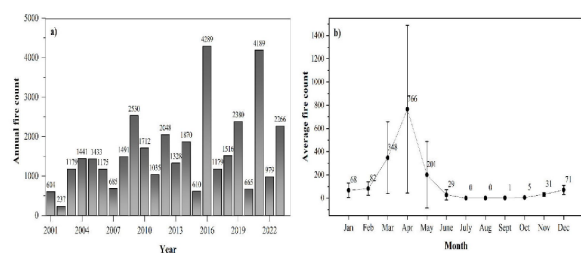

Fig. 1. Nepal map showing the occurrence of forest fires over a decade (2012-2023). The brown areas indicate districts with a higher occurrence of forest fires, while the white areas indicate districts with a lower occurrence of forest fires.

(spatialapps.net), and the data on forest fires is from the VIIRS (Visual Infrared Imager-Radiometer Suite) sensor. In the past ten years, the number of forest fire occurrences in Lumbini and Karnali provinces has increased, particularly in Dolpa, Humla, Bajhang, Jumla, and Jajarkot districts of Nepal. Among the provinces in Nepal, Lumbini (annually 545 incidences with 72,090 ha burnt area) and Sudurpachhim (annually 524 incidences with 26,366 ha burnt area) provinces have been reported as highly vulnerable provinces to forest fire between the period from 2001 to 2020 (Parajuli et al. 2020). On the other hand, Gandaki province (annually 204 incidences with 3,890 ha burnt area) is the least vulnerable to forest fires (Bhujel et al. 2022). The data on forest fire count from 2001-2023 was downloaded from the Fire Information for Resource Management System (FIRMS) website, Fire Information for Resource Management System (FIRMS) Earth data (nasa.gov), analyzed the trend of forest fires over the years. Fig. 2 shows an increasing forest fire incidences over the last 23 years. During 2001 to 2023, forest fires recorded the highest in 2016, which destroyed over 590,000 hectares of forests area (Pandey et al. 2022), with more than 60 wildfires in 22 districts (Subedi et al. 2022). Similarly, the forest fire count in 2021 was 15 times the count in 2020 (Chitrakar 2021). Forest fires mostly erupted in the drier months of March and May, with more than 30,000 forest fire occurrences in these months. April had a maximum average forest fire count of 766, which indicates that this month's forest fire is the most vulnerable in comparison to other months.

UN-ISDR, the Wild land Fire Advisory Group (WFAG), the Global Wild land Fire Network (GWFN) and its secretariat, the Global Fire Monitoring Centre (GFMC), and the Regional South Asia Wild land Fire Network (RSAWFN) are some of the organizations that are working on forest fires in Nepal and worldwide (Mathema 2016). Preparation of short-term, medium-term, and long-term plans to understand fire behavior, find the burnt area, and determine emission scenarios to manage forest fires has been a challenge for policymakers and associated stakeholders (Sibanda et al. 2011). There are many shortcomings concerning institutions, policies, and legal frameworks that need to be addressed for the management of forest fire disasters in the country (Government of Nepal 2010). In addition, a lack of fire data on forest fires is also a major management issue for Nepal (Khanal 2015). To do this, there is a need to strengthen the policy and legal framework, build institutional capacity, and enhance collaboration among the stakeholders involved in the management of forest fires in Nepal.

Developed countries have formulated approaches, tools, and techniques to tackle forest fires, like firefighting organizations, forest fire alert activities, early warning systems, and awareness raising training. However, in developing countries like Nepal, although various institutions are working and implementing programs to combat forest fires, there is still a lack of capacity building like training, resources, and technology and a lower level of awareness, due to which timely management of fires has not been possible. Similarly, citizens are unaware of major policies that have been implemented to minimize forest fire activity throughout the country. The aim of this paper is to critically review the evolution of the policies and governance structures, the unbundling of power at the three tiers of government, and the identification of ambiguities in the policies and practices in Nepal, and also suggests possible measures for improving forest fire management in Nepal.

Materials and Methods

This study reviews secondary sources of data and information on forest fires. Academic search engines like Google Scholar, Research Gate, Elsevier, Springer, and Academia have been used to get information. The collection of the data includes identifying peer-reviewed articles, reports, and publications from various academic databases and repositories. Literatures related to laws, policies, and

Fig. 2. Forest fire occurrences in Nepal from 2001-2003. (a) Annual count of forest fires. (b) Average monthly count forest fire.

strategies on forest fire of Nepal have been reviewed and analyzed. In addition, grey literature such as public documents, governmental project reports, national adaptation plans, etc., including a number of national and international studies that focused on forest fires, climate change, and adaptation, was also reviewed (Fig. 3).

Published reports, journal articles, and research papers were gathered for the study related to forest fires, while papers unrelated to forest fires were excluded from the review. Keywords specific to forest fire were searched (Fig. 4) with keywords such as "forest fire," "forest fire in Nepal," "impacts of forest fire," "causes of forest fire," and "policy and forest fire in Nepal," which were employed to capture literature relevant to the study.

This paper is based on recent policy documents, including acts, regulations, operational guidelines, and governance structures related to forests, climate change, disaster

risks, and forest fires in Nepal. These include Forestry Sector Strategy 2016, Forest Act 2019, Forest Act 1993, Forest Regulation 2022, National Forest Policy 2019, Disaster Risk Reduction and Management Act 2017, Forest Fire Management Strategy 2010, Periodic Plans and Annual Programs, along with provincial and local-level policies, Acts, and rules related to forests and forest fires. Moreover, key gaps and ambiguities relating to the barriers to controlling forest fire incidences were also identified by analyzing the multiple policies and governance impacts on forest fires.

Forest Fire Related Policy and Legal Instruments

Regardless of forest fires posing a significant threat in Nepal, enough attention has not been given for tackling this issue. In addition, there is also a lack of staff, capacity, equipment, and laws and their enforcement to minimize the risk of forest fires in the country. This section provides detailed information on the governance structure in forests and forest fire areas at the three tiers of government in the federal, provincial, and local structures. The roles and responsibilities of different actors at different levels of governance, such as governments, users' groups in community forests have been reviewed and presented in Fig. 5.

Forest fire related policy initiatives in Nepal

Several policies have been formulated in Nepal to address the issues of forest fires, involving multiple stake-
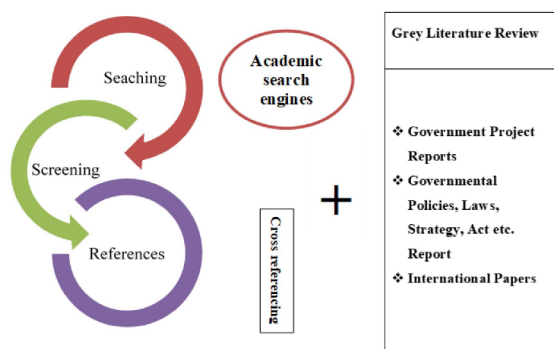

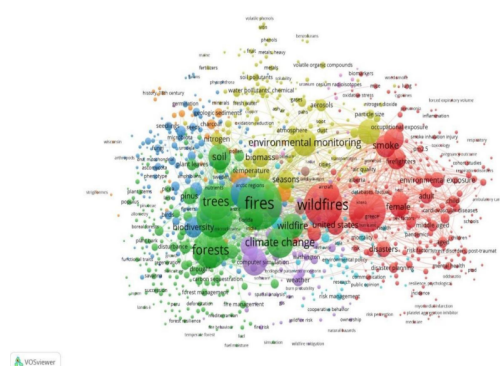**Fig. 3.** Schematic diagram of reviewing method.

Fig. 4. Network visualization of keywords that link up to forest fires, with the big circles showing commonly searched keywords and lines denoting how strong the link strength is between two keywords.
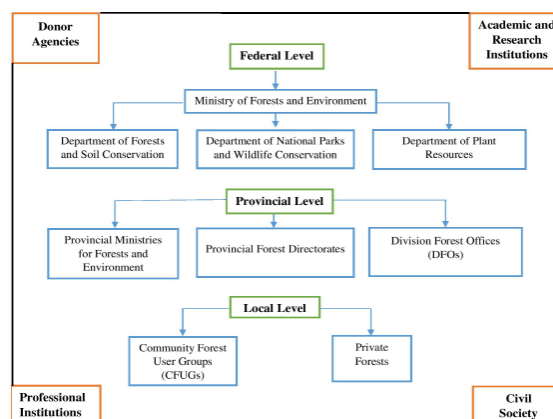

Fig. 5. Governance structure of forestry sector in Nepal.

holders at various governmental levels, including key actors like government agencies, local communities, non-governmental organizations (NGOs), international partners, and research institutions. The forestry sector of Nepal (Fig. 5) consists of a federal Ministry of Forest and Environment that is responsible to formulate national forest policies and regulations for overall management of forest resources of the country. The provincial government likewise formulates provincial policies considering the provisions of national policies. There is a forest ministry in each seven provinces, under which there are seven provincial forest directorates and 84 Division Forest Offices (DFOs) subordinate to provincial ministries (Ministry of Forest and Environment 2019). The Community Forests User Group (CFUG) Constitution, which outlines the rights and responsibilities of forest users, governs the formation of CFUGs and their official registration at Division Forest Offices (DFOs). With assistance from forest experts, they also draft operational plans and Forest Management Plans, which are likewise approved by DFOs (Acharya et al. 2022).

Federal level policies

The Forest Fire Management Strategy 2010 is a document that has attempted to improve policy and institutions so as to increase participation in forest fire management (Government of Nepal 2010). The main areas where the Forest Management Strategy 2010 works are: 1) institutional, political, and legal development and advancement; 2) learning, information, skill development, and technological advancement; 3) community-based fire management and research; and 4) collaborative fire management, network building, and international partnership. The strategy has given major priority to preventing uncontrolled forest fires and assuring the involvement of the community and associated institutions in fire management. However, the document lacks a clear forest fire organizational framework within the department structure. Additionally, there is no implementation plan to support the strategy. The Forest Sector Strategy 2016 has been developed with new strategies that prioritize the need for the development of tools and techniques to minimize the damage due to forest fires, pests, and diseases. This proactive approach provides a strong commitment to environmental sustainability and ensures the preservation of natural resources for future

generations.

The Forest Act 2019 mentions penalties for the person who commits the offence of doing anything that sets forest fires. The implementation of this provision of the Act is extremely difficult in identifying the offender after the occurrence of a forest fire. Clause (d) of Section 49 of the Forest Act 2019 specifies that any person who is responsible for intentionally setting fire in the national forest and also who is engaged in action that leads to fires is the offender. Regarding the penalties, Article 50 states that those individuals found guilty under clause (d) of Section 49 may need to face imprisonment for up to three years (Nepal Law Commission 2019). However, the measures like utilization of technological advancements and social infrastructure construction are not mentioned and properly adopted for identifying the cause of forest fires or arresting culprits.

Similarly, Forest Regulation 2022 is one of the legal documents that mentions the provision to control forest fires in Article 120. It specifies that the Division Forest Officer (DFO) should adopt preventive measures against forest fires and also take immediate management action if a forest fire occurs. DFO can also provide/suggest a method to control the forest fires. The regulation mentions the roles and responsibilities of the government at different levels; the local government shall provide necessary aid and support for forest fire control; the provincial forest ministry can delineate the forest fire risk-prone areas and adopt necessary measures to prevent and control the forest fire; and the federal government can provide relief to victims of forest fires and treat the affected person. In contrast to Forest Regulation, National Forest Policy 2019 addresses lowering emissions through sustainable forest management for impending carbon trading but does not directly address the preventive measures to be adopted for forest fire.

The Nepalese government has created a number of institutional and legislative frameworks to organize and oversee activities related to disaster risk reduction and management including the development of an early warning system that would help in developing and implementing a forecast-based preparedness and response plan. The National Policy for Disaster Risk Reduction 2018 is one of the policies that mentions regular monitoring and forecasting of natural hazards such as floods, landslides, droughts, thunderbolts, windstorms, hot waves, cold waves, fires, epi-

demics, and glacier lake outbursts. Along with the policy, the Disaster Risk Reduction and Management Act 2017 has categorized wildfires as non-natural disasters. This Act mentions that different committees at the federal, provincial, district, and local levels can formulate plans to manage the disasters within the country. These plans include preparedness and response capacity building at local levels, disaster risk sharing, financing, and transfer, and inter-local level cooperation for effective disaster risk reduction and management (DRRM). However, this act doesn't mention plans and activities to minimize forest fires at different levels.

Different periodic plans (three-five-years) also mention forest fires and measures to be adopted to minimize the damage so occur. The Third Five Year Plan (1965-1971) was the first plan to mention the damage caused by fires and to recognize fires as destructive factor to livelihood and land management. Moreover, the Eleventh Plan (2007-2009) recognized the need for decentralization and giving power to the local governments that would help to prevent and mitigate fires. The plan focused on the role of the central government in making policies, setting standards, and implementing projects, while local governments would work on other tasks. Alongside, the Fourteenth Plan (2016-2018) recognized forest fires as one of the challenges and outlined strategies for managing fire lines, developing organizational structure, and increasing community participation. The plan aimed to enhance resources and management capacity for forest fire control, aiding in the mitigation of climate change impacts and effects on natural resources. The recent Fifteenth Plan (2019-2023) also mentions the prevention and control of forest fires, which ultimately aim to help improve forest health. Mentioning of forest fires in different plan documents has been a crucial step taken by the government to mitigate forest fires and maintain the health of forests. For proper management and mitigation of forest fires, resources and leadership skills must be increased. Proper execution of this plan will result in enhanced fire management, which will ultimately help reduce the impacts of climate change and natural disasters (Somlai et al. 2018).

The Nepal Criminal Code Act, 2017 additionally contributes indirectly to the control of forest fires. One of its clauses (clause 242) states that theft of any property committed while taking advantage of fire will result in a sen-

tence of two to seven years in prison and a fine of NPR 20,000 to 70,000. Through this code, people would be warned not to set fires, as they would be punished with fines and possible prison sentences.

Looking at the legal and policy regime and plans and programs, it is highly essential for Nepal to continue strengthening its forest fire management strategies and prioritize this issue. This can be achieved through coordinated efforts across different tiers of governments, government agencies at different levels, communities, and international partners. Through the implementation of preventive, readiness, and response measures, Nepal can effectively protect its valuable natural resources and lessen the detrimental impacts of forest fires on ecosystems, livelihoods, and public safety.

Provincial level and local level policies

Forest fire has been included as one of the violations in Article 68 of the Provincial Forest Act 2020 of Koshi Province, Article 50 of the Provincial Forest Act 2021 of Gandaki Province, and Article 50 of the Provincial Forest Act 2021 of Lumbini Province. The policy mentions that those who start or cause a forest fire in a provincial or national forest will be punished with imprisonment for up to three years or may also have to pay a fine of up to NPR sixty thousand. The act of fining have also been a legal tool for damage control, as they make the person liable for the recovery of the damage done. Karnali Province Forest Act 2022 has also made provisions for forest fire prevention and control; it declares any related act as an offence and punishes the offender. The Provincial Forest Act 2021 of Lumbini Province has an additional provision that includes the prevention and control of forest fires, as it assists different stakeholders in developing strategic plans and other activities to prevent and control forest fires. On the other hand, the Provincial Forest Act 2020 of Madhesh Province, Provincial Forest Act 2019 of Bagmati Province, and Provincial Forest Act 2021 of Sudurpaschim Province don't mention about the forest fires.

Provincial policies have not made provisions other than punishments for offenders. All provinces must make it a top priority to prevent and control forest fires by integrating strong regulations, procedures for enforcing them, and community involvement strategies into their frameworks

for managing forests. By promoting increased awareness, cooperation, and responsibility at the regional level, Nepal can strengthen its resistance to forest fires and save its valuable natural resources for future generations.

At the local level, some municipalities and rural municipalities have enacted the "Disaster Risk Reduction and Management Act," which considers fires and forest fires as non-natural disasters and has provisioned a Municipal Disaster Management Committee for the effective implementation and management of activities related to disaster management within the municipality. This committee can identify both natural and non-natural disasters and formulate necessary guidelines, working procedures, and standards for the mitigation and management of such disasters. Although the community and people engage in protecting the community forests and are recently working together to prevent forest fires and address issues within the respective community forests across Nepal, there are no local-level policies and Acts formulated so far directly addressing forest fires.

The major drivers of forest fires has been linked to the low interest of Community Forest User Groups (CFUGs) towards the management of the community forest, along with declining collaborative action, which can be due to poor forest-people relations, weak governance of CFUGs, and significant regulatory burdens placed on CFUGs (Tiwari et al. 2022). In recent years, community members across Nepal have actively engaged in controlling forest fires along with protecting the forest, minimizing harvest activities, and conserving biodiversity, all in close coordination and collaboration with the forest officers (Chaudhary et al. 2016). While forest fire management has been considered a responsibility of key actors, such as the Nepal Army, the Division Forest Office (DFO), and police officers, Paudel et al. (2019) alert the need to recognize local knowledge and the involvement of the community to formulate and implement policies related to forest fires.

Forest Policy 2015; Forestry Sector Strategy (2016-2025); and National Climate Change Policy 2019, all of these policies consider the need for people's participation in forest conservation activities, including local practices and technologies and knowledge to control forest fires in Nepal. Forest Regulation 2022 likewise recommends the CFUGs to adopt preventive measures to forest fires and, if they oc-

cur, take the necessary steps to control them, including the formation of a voluntary group or unit to control forest fires by the CFUGs. There is a need for people and communities to follow the environmental rules and regulations to protect the environment (Najicha et al. 2021), but some CFUGs have not been able to fulfill the required institutional obligations, such as general assemblies and financial audits.

Moreover, a lack of transparency and accountability among the decision-makers has resulted in delayed planning and execution of forest management activities, leading to an increasing risk of forest fires. Encouraging community-level involvement through participatory and inclusive approaches and adaptable regulatory frameworks is critical for sustainable forest management (Laudari et al. 2024). Therefore, the promotion of sustainable forest management techniques and the mitigation of fire risks need to be encouraged. This can only be achieved through regulatory flexibility that recognizes changing socio-economic dynamics and empowerment of local forest managers.

Institutions Working on Forest Fire Management

The National Disaster Risk Reduction and Management Authority (NDRRMA) has been involved in implementing programs and activities that minimizes the risk of forest fires in Nepal. These activities include an awareness campaign on forest fires and risk reduction, training on forest fire risk management, and acquiring firefighting equipment and supplies. In addition, this Authority is responsible for developing and revising forest fire management strategies, assessing loss and damage, and creating action plans for forest fire resilience (International Centre for Integrated Mountain Development 2019). Other institutions, like the Department of Forests and Soil Conservation (DoFSC), along with technical assistance from the International Centre for Integrated Mountain Development (ICIMOD), have been operating the detection and monitoring system in Nepal since 2019. This has helped to develop fire risk zone maps and tools that ultimately help forest managers track fire-prone areas and develop strategies to manage forest fires (Sharma and Pokhrel 2022). The DoFSC, on the other hand, involved in implementing policies related to forest

sectors and monitoring their impacts in government and community-based forest-managed areas. Despite having human resources to assist forest management, the majority of workers lack a managerial and supportive understanding of forest fire management. Because of this, forest management organizations and community-based forest groups lack the skills and equipment to control and manage fires in local forest areas (Koirala 2016).

The Ministry of Forest and Environment has the ambition to reduce or mitigate GHG emissions from forest fire through Sustainable Forest Management (SFM) (Government of Nepal 2021). The forests under active SFM practice have been observed to have low fire incidences while, at the same time, resulting in other socio-ecological and environmental benefits compared to unmanaged forests (Paudel et al. 2019). SFM is also one of the government's key strategies to offset CO_2 emissions from other sources and recognizes it as a major area for climate change adaptation and mitigation options (Ministry of Forest and Environment 2019). This management approach includes active and timely management of the forests, which will help mitigate the risk of forest fires in the long term.

Being a member country of the South Asia region, Nepal is engaged in the management of forest fires and training programs on fire safety, fire prevention, and suppression conducted by the Asian Forest Cooperation Organization (AFoCO), along with the Global Wild land Fire Network, since 2014. These programs are mainly focused on increased community participation and community-led fire management (Sharma and Pokhrel 2022). The Regional South Asian Wild land Fire Network was established in 2007. After its foundation, regional consultations were organized in Nepal in 2012 and 2016 for the development of a cohesive local-to-global fire management initiative (Global Fire Monitoring Center 2017). Following consultations, several recommendations and conclusions were made, such as the need to strengthen national fire management advisory committees, create an integrated finance mechanism for proper management of forest fires, establish a Fire Management Resource Centre in South Asia and promote active participation in dedicated thematic networks, including annual meetings and activities of the Pan-Asia Wild land Fire Network, the Global Wild land Fire Network, International Wild land Fire conferences,

etc. These recommendations were made to involve various stakeholders in forest fire management, improve preparedness, and develop effective policies to address forest fires.

Nepal Forest Fire Management Chapter (NFFMC) has been a local NGO working in Nepal since 2008. It was founded to comply with the activities and objectives of the UNDRR Wild land Fire Advisory Group (WFAG), the Global Wild land Fire Network (GWFN), its secretariat, the Global Fire Monitoring Centre (GFMC), and the Regional South Asia Wild land Fire Network (RSAWFN). The NGO works to help build capacity at the community level and provides a platform for policy dialogue, research, and development in wild land fire management at the national level. Along with that, it works to raise awareness at all levels (Nepal Forest Fire Management Chapter 2024). It oversees the implementation of wild land fire management programs that focus on three key areas: preparedness (including early warning, awareness, risk assessment, training fighting groups, arranging firefighting tools, controlled burning, etc.); response (including early detection, firefighting, firefighter safety, etc.); and recovery (including damage assessment, revegetation of burned areas, shelter, food, water, medicine, counselling to the victims, etc.). Few works on forest fires in Nepal have been carried out by the Japan International Cooperation Agency (JICA), as it provides some support, including firefighting equipment in Nepal (Somlai et al. 2018). The institution has been involved in providing technical assistance and training programs to build the capacity of local government and volunteers in disaster preparedness and response, along with community engagement programs.

Nepal has addressed the issue of forest fires by initiating several programs and working together with regional, national, and international organizations. To achieve sustainable forest fire control and maintain the resilience of Nepal's fire ecosystems, continued efforts, improved collaboration, and the incorporation of new strategies will be crucial.

Key Gaps and Ambiguities in Managing Forest Fire

Very few policies related to forests and natural resources mention forest fires in Nepal, although it has been one of

the burning issues in the country. Huge losses in wildlife, vegetation, humans, and the economy occur every year due to massive forest fires. According to Bhujel et al. (2017), Nepal experienced 35,374 fire occurrences and 1,723,920 ha of total burned land between 2000 and 2016. Additionally, it was estimated that the value of the forest resources lost due to the fire was USD 107,798. During 2020-2021, a loss of NPR 1,890,000 (USD 15,241) was accounted from forest fire. In total, 71 human lives have been reported to be lost during 2007 to 2020 in different parts of Nepal. Every year, damage to about 172,041 hectares of forest results in a loss of 7.07 million tonnes of biomass and emission of 3.30 million tonnes of carbon (Bhujel et al. 2022). However, forest fire management remains a low priority of the government at different levels. The National Climate Change Policy 2019 just mentions saving forests and biodiversity from forest fires, but it does not include strategies that could help address incidences and emissions from forest fires and wildfires in Nepal (Ministry of Forest and Environment 2019). Similarly, education, awareness-raising, capacity-building, and the development of wildfire management technology in school-level curriculum and government training courses are all anticipated in the Forest Fire Management Strategy, 2010. However, such activities are not being organized and implemented as expected. To do this, there is a need for a participatory and action-oriented approach that involves all stakeholders, i.e., the public, private, and community, to manage the wildfire at all levels.

With regard to the research activities conducted on forest fires, only a few studies have been conducted that directly work to identify the major sources and preventive measures for forest fires (Pandey et al. 2022). The Forest Research and Training Centre (FRTC) has solely been conducting forest fire-related studies throughout the country, although the root causes and practical alternatives of the forest fires are not being explored to a greater extent. There is a need to identify root causes, possible solutions for forest fires, and their practical alternatives.

The Department of Forests and Soil Conservation, on the other hand, is the only institution having a forest fire control room which tracks forest fire incidences in Nepal (Department of Forest and Soil Conservation 2021). Moreover, only a limited number of firefighting gears are

distributed every year to different parts of the country, which is not enough to effectively fight against the forest fire. Similarly, the current focal person and UNISDR-Regional South Asian Wild land Fire Network Coordinator have been advocating for the establishment of a targeted, recruited, and funded unit within the Ministry. However, officers have limited knowledge and training, which cannot meet the needs of local people on fire management. There is a need to make provisions for district-level fire control, suppression, management, and training equipment.

Although there is limited equipment and necessary materials are available that are required for forest fire control in the country, the required necessities relating to forest fire control have not been prepared and listed. Procurement of any goods/equipment should be done by following the detailed procedure guided by the Public Procurement Act of Nepal. The procurement of necessities for forest fire control is different and of specialized nature which may not effectively govern by the Public Procurement Act. In addition, less than 0.35% of sectoral public finance is allocated for wildfire management annually in Nepal (Pandey et al. 2022). This percentage of allocation is very low, as forest fire management needs more priority in comparison to other aspects. In short, it can be said that the current implementation of forest fire management programs is not functioning well in Nepal, and effective measures need to be taken at all tiers of government to prevent and control forest fires across the country.

Consideration Needed on Major Aspects

Forest fire has been a serious issue in Nepal in terms of the loss in the economy and environment. Concerning mitigating forest fires, management interventions are mandatory, especially for a naturally rich and geographically diverse country like Nepal. Efforts have been made by the governments at different levels in the areas of formulating policies, Acts, regulations, and strategies to prevent and control forest fire incidences. However, these efforts are not well coordinated and prioritized in terms of public resource allocation, capacity building, and logistic arrangements.

The Department of Forest and Soil Conservation is currently supporting CFUGs around Nepal and providing technical support to manage forest fires. However, most

CFUGs lack knowledge on controlling forest fires, as some end up losing their lives while fighting forest fires (Bhujel et al. 2017). There are some groups that seem to have much knowledge about the importance of fire lines, forest fire occurrences, and methods to suppress forest fires. Educating, providing training and awareness, and increasing communication seem to be key ways to mitigate forest fires in Nepal. There is also a need to manage forest fires related infrastructure, take effective preventive measures, and initiate and educate local people on forest fire management (Parajuli et al. 2022).

Traditional methods to monitor and detect forest fires are mostly dangerous as they include human resources as the main tools to suppress forest fires (Venugopal 2012). The institutional capacity to address the issue of forest fires has been limited due to the lack of systematic recording of wildfires in Nepal (Ministry of Forests and Soil Conservation 2016). The use of advanced monitoring and assessment tools for fighting forest fires will help with early detection and increase the response time to mitigate the risk. Wildfire hazard mapping, along with assessing the spatial and temporal distribution of forest fires, will delineate areas at risk of forest fires and ultimately help the authorities make adequate plans and prevention measures for forest fires (Subedi et al. 2022). One of the other possible interventions to minimize the risk of forest fires is the establishment of fire stations in areas with road access (Ranabhat et al. 2022). These major technological developments would help suppress forest fires in the early stages, making their effect as minimal as possible in the long term.

Various studies have shown that in Nepal, about 58% of forest fires are caused by intentional burning by poachers, grazers, and collectors of non-timber forest products (NTFP), while about 22% are caused by negligence and 20% by accidents (Kunwar 2006; Singh et al. 2020). One of the main causes of forest fires is human activities such as throwing cigarette butts, campfires, and burning garbage (Bhujel et al. 2021), which are deliberate in nature (Kunwar 2006). Specific to the forest fire that breaks out by discarding burning cigarettes in the forest, it could be regarded as an act of negligence rather than calling it intent (Elvan et al. 2021). As most of the policies state to punish the person who intentionally causes a forest fire, this particular concern needs to be prioritized as it is difficult to call someone an offender as it is an act of negligence rather than intentional. Penalties and enforcement of regulations, along with conducting regular patrols in fire-prone areas to identify and catch the individuals engaging in this behavior, are highly important to control forest fires due to smoking and throwing cigarette butts in the forest. Along with that, as the major causes of fires are anthropogenic in nature, there is a need to involve the community in the prevention, suppression, and restoration of the forest. Training and education on forest fires could help reduce forest fires; therefore, the government should manage to allocate some portion of the budget to forest fire prevention.

There is a need for MoFE, DoFSC, and provincial-level forest directorates to work in unity and try to collaborate at the community level to tackle forest fires. Appropriate monitoring of forest fires, dissemination of information, and policies and programs could help mitigate forest fires in the long term (Thapa et al. 2021). To lessen the effects of forest fires in the future, pre and post-fire management strategies need to be effectively implemented. Additionally, it is necessary to incorporate forest fire prevention aspects into national and provincial-level adaptation plans and prioritize it in terms of resource allocation and human resources development. Governments should also concentrate its efforts on raising funds from different sources and utilizing it efficiently for the prevention and control of forest fires.

Conclusion

Forest fires, with anthropogenic activities being one of the primary causes, pose a significant threat to forests ecosystems, biodiversity, people and human settlements, and the economy. Developing nations like Nepal encounter difficulties in controlling forest fires owing to issues with education and awareness, institutional capacity, financial resources and effective implementation of the policy instruments. In the past years, efforts have been made by various organizations in Nepal to address forest fire issues through training programs, awareness campaigns, and the formulation and implementation of forest fire management strategies in terms of adopting preventive and curative measures. However, key gaps and ambiguities persist in policies and practices that hinder effective management of forest fire.

These include gaps in the proper implementation of policies, overlapping and unclear roles and responsibilities of three tiers of governments, capacity of the human resources and institution to education and awareness raising and carry out research activities, mainstreaming issue in local level plans and programs, and allocating necessary financial resources.

To address these issues, the government needs to prioritize forest fire management at all levels in terms of resource allocation and capacity building, formulate practical policies and strategies involving all relevant stakeholders and developing early warning and disaster preparedness measures, and forging effecting coordination, collaboration, and partnership and developing related mechanisms at all levels to prevent the forest fires and mitigate the effects if it occurs.

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