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# Community Based Forest Fire Management for Conservation of Fragile Mountain Forest in Nepal

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## ABSTRACT

Forest fires are more common in the Hindu Kush-Himalayan region during windy summer season from February to May. In Nepal, uncontrolled forest fire is increasing every year. The wildfires in mountain ecosystems are a major driver for destruction of pristine biodiversity, forests, ecosystem properties, and deterioration of social and economic conditions in some land-use systems and natural vegetation types. "Atmospheric Brown Clouds" (ABC) are consequences of socioeconomic changes, an expression of escalating air pollution and a major driver of regional climate change. To address this issue in Nepal, a study proposed to explore the problems and options in the country. A number of case studies were conducted for a trend analysis through participatory approach and fire occurrences index. In 2009, 46 people died due to forest fire including 14 militaries and many Community Forest User Groups (CFUGs) member and firefighting crew were injured. More than 60 per cent fires occur in the April and about 80 per cent fires in the March and April. In 2014, a fire broke out in a jungle, in a remote community, killed five persons and left 9 people injured. There was also a deceased five-year-old child. The forest fire has been an issue to address through proper preparedness and managing during fire alarm situation every year. More than 30% forest of Nepal is being managed by Communities. An Initiation to manage forest fire through communities at lower level has been appreciated positively. Occurrences of forest fire inside community managed forests have been reduced dramatically through community mobilization and equipment support in Terai foothills. The fourteen Volunteer Fire Management Groups (VFMG) have been supporting to suppress and aware the forest fire reduction and management including their communities. A promising result has been visualized through about more than 70 percent forest fire risk reduction by this approach.

## INTRODUCTION

Wildfires in high altitude ecosystems of Hindu Kush-Himalayas (HKH) region in recent years have become a major driver for destruction of pristine biodiversity, including the habitats of many rare species. They are also affecting cultural heritage sites and land-use systems that provide the basis for livelihoods to a population of around 150 million people living in the mountain region. Most importantly, the secondary consequences of wildfires include the destruction of soil protecting vegetation cover, affecting water regimes for a population of 1.4 billion (UNEP 2007). These fires are often border crossing in nature and initiated political discourse in trans-boundary smoke haze pollution (Sharma and Goldammer, 2010).

In Nepal, the total area covered by forest is about 40 per cent and more than 24,000 communities -based forest user groups are also managing about 1.8 million hectares (about 30 per cent) of the forest areas, with resulting protection of the environment and biodiversity. In addition, the community-managed forest areas, through sustainable management approaches, serve as supplies of basic forest products such as fire wood, timber and medicines (Boerner, 1982 and Boerner et al, 2009). Since several opportunities have been started generating international resources to support Nepal's forest sector by provisions like Carbon Trading, Reduction in Climate Change and Payment for Environmental Services, these measures are not sufficient for reducing threats in the forestry sector management such as forest fires. Forest fires have become a major challenge for the forest management authority since several years (DoF, 2014).

Forest fires are more common in the Hindu Kush-Himalayan region during windy summer season from February to May. In Nepal, uncontrolled forest fire is increasing every year. The wildfires in mountain ecosystems are a major driver for destruction of pristine biodiversity, forests, ecosystem properties, and deterioration of social and economic conditions in some land-use systems and natural vegetation types. "Atmospheric Brown Clouds" (ABC) are consequences of socioeconomic changes, an expression of escalating air pollution and a major driver of regional climate change (Sharma and Goldammer, 2010). In 2009, 46 people died due to forest fire including 14 militaries and many Community Forest User Groups (CFUGs) member and firefighting crew were injured. More than 60 per cent fires occur in the April and about 80 per cent fires in the March and April. In 2014, a fire broke out in a jungle, in a remote community, killed five persons and left 9 people injured. There was also a deceased five-year-old child (Sharma, 2014 pers.comm).

The forest users groups have emerged as a strong institution at the grass root level to drive collective action for common cause. However, we are not without problems. Forest fire has been prolonging problematic areas for forest management. The denser the forests, the higher are the fire risks. As a developing country, Nepal does not have the resources to afford to maintain a fleet of equipment and trained fire fighters to go out to the mountains and attend the fire hazards. Moreover, the dry period of February

to May is also the hottest months in Nepal. The rivers flow at their minimum. Springs and wells dry out. When fire breakout, it only stops after all the fuel in the forest have even burnt and that only happens when the fire reaches the mountain tops.

The forest fire has been an issue to address through proper preparedness and managing during fire alarm situation every year. More than 30% forest of Nepal is being managed by Communities. An Initiation to manage forest fire through communities at lower level has been appreciated positively. Occurrences of forest fire inside community managed forests have been reduced dramatically through community mobilization and equipment support in Terai foothills.

## **FIRE AND ITS MANAGEMENT PROBLEM**

Fire is considered the main cause of forest destruction in Nepal. Forest fire management is an indispensable part of our natural resources management efforts despite there is no systematic approach to address the problem. The Department of Forests (DoF) is responsible for implementing forestry sector policies and monitoring their impact in the government managed and most community based forest managed areas. Although, the DoF has sufficient human resources for forest management support, most available work forces have lacking managerial and supportive knowledge capacities in fire management in the field. Therefore, the basic level of forest management bodies, the community based forest groups, are lacking their knowledge and equipment for fire control and management for their forest patches. For the capacity for monitoring, evaluating and implementing the effects and

Fire is used as a management tool to administer a wide range of ecosystem worldwide. Forest fires occur in almost all types of ecosystem. Some of these ecosystems are extremely sensitive to fire, but without subsequent ignition that leads to extensive wildfires, they can recover (Kraus and Goldammer, 2007). Throughout the last century, great efforts and vast resources have been applied to understanding and managing fire in forest. However in tropics recently, demographic and land use changes have made fire a matter of serious concern (Coachrane, 2003; Goldammer, 1990). Many studies have addressed the influence of such disturbances on soil properties. The role of forest fire on forest soil is very complex and less studied in comparison to its aboveground effect (DeBano et al., 1998). Fire can influence a variety of soil physical and chemical properties of soil including the loss or reduction of structure and soil organic matter, reduced porosity, and increased pH (DeBano, 1990; Certini, 2005). Change in soil properties after fire produces varying responses in the water, vegetation dynamics, and fauna of ecosystems.

The wide range of effects is due to the inherent pre-burn variability in these resources, fire behavior characteristics, season of burning, and pre-fire and post-fire environmental conditions such as timing, amount, and duration of rainfall (Clark, 2001). These changes can also result in various indirect impacts including increased hydrophobicity (water repellency), which results in decreased infiltration and increased runoff that often results in increased erosion (DeBano, 2000). The effects of fire on soils directly depend on fire intensity and the duration of combustion. Depending on the fire severity, these changes in soil properties may be beneficial or deleterious to entire ecosystem (Delano et al, 1998). The objective of this thesis is to summarize the overall possible impact of forest fire on physical, chemical and biological properties of soil from available literature and to find the gap in the studies carried out on forest fire and soil in different ecosystems.

Forest fires have many implications for biological diversity. At the global scale, they are a significant source of emitted carbon, contributing to global warming which could lead to biodiversity changes. At the regional and local level, they lead to change in biomass stocks, alter the hydrological cycle with subsequent effects, and impact plant and animal species' functioning. Smoke from fires can significantly reduce photosynthetic activity (Davies and Unam, 1999, FAO, 2002) and can be detrimental to health of humans and animals. In forests where fire is not a natural disturbance, it can have devastating impacts on forest vertebrates and invertebrates - not only killing them directly, but also leading to longer-term indirect effects such as stress and loss of habitat, territories, shelter and food. The loss of key organisms in forest ecosystems, such as invertebrates, pollinators and decomposers, can significantly slow the recovery rate of the forest (Boer, 1989). Fire ecology is concerned with the processes linking the natural incidence of fire in an ecosystem and the ecological effects of this fire. Many ecosystems, particularly, prairie, savanna, chaparral and forests have evolved with fire as a natural and necessary contributor to habitat vitality and renewal. Many plant species in naturally fire-affected environments require fire to germinate, to establish, or to reproduce, or all three.

## **STUDY METHODS**

This study has assessed the information from secondary sources including primary source too. A glimpse of the forest fire situation of Nepal has been collected through several case studies from a few districts of Terai region of Nepal. Regarding primary sources a few local informants were interviewed informally and self-researcher have observed several fields during fire season in several Terai districts along the national high way areas. In general, the study is more representing the Terai Arc Land Programme districts from the central Nepal to the far western region; however, the study has focused to present the results from Kanchanpur district. The primary sources of the about two months monitoring report of Fire Monitoring Unit of the Kanchanpur DFO was a rich information to conclude the paper including a few cases for impact and forest fire management. For impact assessment a study was carried out and inventoried in the forests and also analyzed different parameter such as regeneration status, leaf litter availability, PH value test and so on. A descriptive and qualitative analysis has been followed for the result presentation including conclusions. However, it limits the generalization throughout the country.

## FOREST FIRE CAUSES, IMPACT AND MANAGEMENT

Major causes of the forest fire in Nepal are anthropogenic which includes Forest fire is considered as a major cause of forest destruction in Nepal. About 90% of forested area in the plain is burned out one to three times every year (Sharma, 1996) the majority of fires are surface fires. About 400,000 ha forest area burned annually (Bajracharya, 2006 cited in Sharma and Goldammer, 2010). During the dry season (March to May) most tree species in Terai totally shed their leaves. The great amount of dry leaves and small twigs which accumulate on the forest floor accompanied by grass and under-growth species which turn in dry during the time serve as fuel for the outbreak of forest fires.

Forest fire is considered as a problem in forest management systems. In mixed forest of Sal in Terai (flat area in southernmost east to west belt of Nepal), the fire season starts from mid-March and the fires burn the forests 1-3 times till the end of May. This rampant destruction of forest cover in the past was due to logging concessions, Encroachment and development of infrastructure such as roads, hydropower plant sand mining. Nevertheless, the practices of shifting cultivation and intentional forest fires are still common in Nepal. Where, forest is estimated to cover about 40 percent of the land area. Forest fire has increasingly become a frequent and problematic phenomenon in Nepal. Fires have a major impact on National Parks in particular where protection of the flora and fauna and their habitats is the primary aim. Since plant variety and abundance, flowering, fruiting, and leafing phonologies of trees and soil nutrients status are essential features for ecological niches of wild animals, studies on impacts of forest fire on these factors are essential to properly manage the bio-diversity in such areas.

### Case one: Sukhani Community Forest, fire impact and management

Sukhani Community Forest is situated in the ward 3 of Danabari Village Development Committee (VDC) in Ilam and the ward 6 of Khudunabari VDC, Jhapa district. It was started managing by the forest users in 2001. There are 437 households in the user Groups. The forest area is 638.5 ha and it is divided into three management blocks. The block 3 (Thaltahle Dhap block) is regarded extremely sensitive to the fire, the block 2 (Amlachhap Block) is moderately sensitive and Block No. 1 Thamdanda Block) is perceived least affected to fire. In their operational plan, the poaching is considered the main cause of forest fire. A study was carried out about their approach of forest fire management and the forest fire impact to the forests. Firstly, regeneration was found better in fire affected zone than unaffected area. So fire can be one of the options as management tool for regeneration promotion. The fire affected zone was found better than unaffected area for Sal regeneration. Secondly, non-preferred species (by Local people) were grown more at affected site than at undisturbed area. Thirdly, leaf litter quantity was also found higher in fire unaffected area than fire affected area. Finally, the PH values, average OC%, Average N% were found slightly higher in the fire affected area but not significantly different (t-test,  $p=0.05$ ). The potassium and phosphorus values were found slightly lower in fire affected area but not significant (t-test,  $p=0.05$ ).

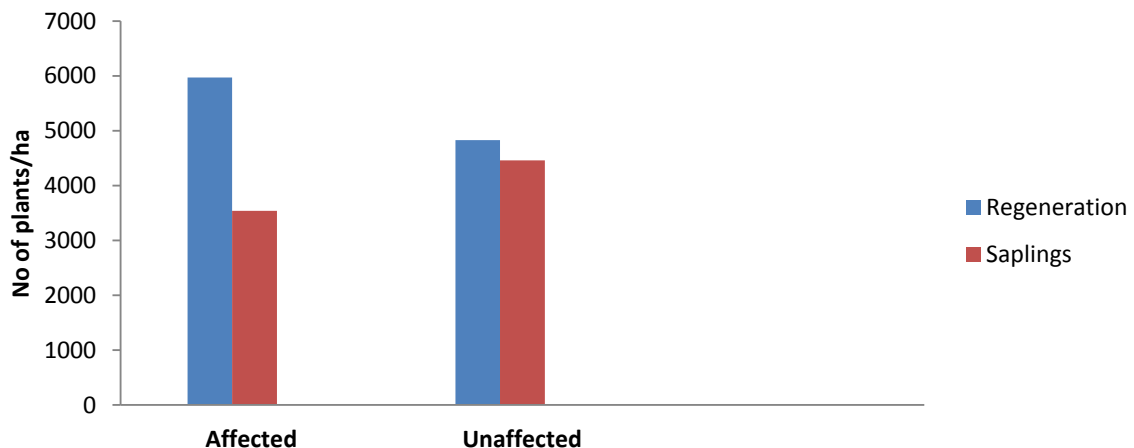


Figure 1: Regeneration status of a forest (Sukhani Community Forest)

### Initiation and results in community based forest fire management

**Case two:** The Terai Arc Land (TAL) Programme area covers 14 districts from Rautahat to Kanchanpur in Nepal and also the Chitawan Annapurna Landscape area covers 19 districts. Moreover, the TAL is home to flagship species like the Asiatic wild elephants, rhinos, and tigers. In Nepal, TAL encompasses 23,129 sq km of 14 districts including 75 percent of the remaining forests of lowland Nepal including Churia hills and four protected areas. This landscape has the second largest population of

rhinos and one of the highest densities of tiger populations in the world. A World Wide Fund (WWF) recognized Global 200 eco-region; TAL covers three Ramsar wetland sites and two World Heritage Sites. TAL was prioritized by HMG/N as a priority program in the 10th Plan (2002-2007) (Forestry Nepal, 2014). Because of these reasons, the forest fire management has been a crucial intervention area in such region. For this, an initiation the training to community volunteers was carried out in both TAL and CHAL areas. The Table 1 shows the trained volunteers in eight clusters for fire management. All 215 volunteers are more or less active to control and manage the forest fire. The volunteers received the know how to extinguish the forest fire and preventive measures and also got a few quantities of equipment such as jump shoot, swatter, water tank, torch, gloves, rake and other accessories.

**Table 1: Trained Fire Management Volunteer Groups in 2012**

S. N.	Volunteer Group	District	Programme area	Male No.	Female No.	Total
1	Rangapur Collaborative Forest	Rautahat	TAL	15	12	27
2	Halkhoriya Collaborative Forest	Bara	TAL	7	13	20
3	Baghauda User Committee, Chitawan National Park	Chitawan	TAL and CHAL	21	11	32
4	Barandabhar Protected Forest	Chitawan	„	12	15	27
5	Sundevi Users Committee, Suklaphata Reserve	Kanchanpur	TAL	22	9	31
6	Rani Ban and Pathari CF	Kaski	CHAL	21	6	27
7	Baijanath and Barandibhar CF	Kanchanpur	TAL	19	8	27
8	Jum Danda Jhhapre CF	Tanahu	CHAL	8	16	24
<b>Total</b>				<b>125</b>	<b>90</b>	<b>215</b>

**TAL:** Terai Arc Landscape Programme : **CHAL:** Chitawan Annapurna Landscape Programme

**Case three:** The volunteers are now actively engaged to control and communicate the fire incidents around their vicinity. Specifically, Baijnath cluster of Kanchanpur district did a good job during fire season in 2014. The chair of the group Mr.

**Box 1: Forest fire management by community forest**

A **Janajagaran CF** having 246.75 ha forest area caught fire during mid-night on May 10th, 2014. They also spotted the forest fire point at that time, however, they could not go inside the forest against the forest fire due to windstorm and only they could reach in the next morning and made control at around 8 am in the morning. About 50 ha forest areas were burnt and damaged the saplings and regeneration growth of *Shorea robusta* forest. The group has only two water sprays and two watchers for forest fire vigilance. As a preventive measure, they used to burn out the dry leaf over the side drain of the forest road and also make fire line inside their forests. On this scenario, they have also been saving the forest land from the fire except the last season fire of 50 ha. Their initiation controlling the fire is self motivational for conservation and management of community forests.



**Plate 1: Fire on the forests ( Photo : P.Koirala, 2014)**

Ramindra Chhetri always made communication live during the whole season and whoever informed them they supplied the equipment and also volunteers to control the fire and from their efforts 32 community forest users group managed and took ownership to manage the forest fire in their community forests. However, they could not fully control their neighbour forest land of Churia (government managed forests). According to them, they could control about 75 per cent of the incidents with their capacity within two to three hours. But during night season, they could not go to the forests. In **Ganesh and Bachhela CF**, they mobilized more than 200 volunteers for fire control during peak season in April and May 2014 whether they just spotted the fire on their forest and nearby the national forests.

**Case four: in Nawalparasi district**, in the community forests, about five per cent forest land have only been affected by the forest fire. The community members have constructed fire line inside the forests and also mobilized women members to patrol the forests during peak season (DFO Nawalparasi, 2014).



**Case four: in Kanchanpur district**, from mid-April to mid-June an assessment was done through Fire Monitoring Unit established at District Forest Office in 2014. There was a promising result the office received that only 12 percent forest areas have been burnt one to thrice times in the several community forests. On contrary, the fire monitoring unit had collected more than 50 times fire incident occurred in the non accessed or open access forest zone which is also regarded as government managed forests. At the same time about almost all 6500 ha forest land (considered government managed forest land) had been burnt at least once during the fire season. The adjoining community forest users also tried to manage the forest fire to the government managed forests too. About 2000 ha forest lands were made under their observation from the 26 community forest user groups. For this we could say about 50 to 200 workdays were used to control and manage the forest fire on their forest land including government managed forest land in Kanchanpur during fire peak season. The two tables below show best results in the district.

**Table 2: Occurrence of forest fire and their damages in community forests from mid April to mid May, 2014**

S.N.	Community Forests Name	Total Forest area ha	Frequency of Fire Incident	Damaged Area ha
1	Amar Suda 6, 7,8	305.17	3	7
2	Janjyoti Pipladi 3	166.95	1	0.5
3	Baijnath Shankarpur 4	60.15	3	15
4	Ganesh Suda 7	412.39	1	12
5	Gwalabari Krishnapur 2	198.82	1	10
6	Hariyali Krishnapur 3, 4, 5, 6	195	1	20
7	Bashant Jhalari 9	498.93	1	30
8	Ekata Krishnapur 8, 9	117.28	1	10
9	Mahakali Krishnapur 6, 9	197.57		
10	Sita Nagar Shreepur 1	53.12	1	2
	<b>Total</b>	<b>2205.38</b>	<b>13</b>	<b>106.5</b>

The success in fire management was achieved through community forest user mobilization from respective executive committee and motivational factors generated from the local forest users. Also, the DFO set a fire monitoring unit inside the office complex and assigned to communicate the forest user groups and subordinate staffs to take action immediately with potential response team and equipments wherever available. The district had only supplied four equipment sets for fire management (back pack tank, helmet, rake, shovel, jump shoot, glove, boots, first aid kit, swatter and so on). Among there only swatter and water tanks were commonly used to extinguish the flame on the forests, because most of the forest fire were ground or surface in nature in the gentle slope and plain areas. On the hills, there was no more crown fire except coniferous forest land. The major methods using by the local people are temporary and permanent fire line construction inside or ridge, control burning on the along trail and ditches, beating by bushes and also using by provided modern equipments such as Swatter, Back Pack Water Tank and other equipments. Institutionally, the users have made a network among them and inform quickly after spotting the fire on the forests to users and neighbouring members including forestry staffs and nearby Police posts. The team is called volunteer fire fighting team.

**Table 2: Occurrence of forest fire and their damages in community forests from mid May to mid June, 2014**

S.N.	Community Forests Name	Total Forest area ha	Frequency of Fire Incident	Damaged Area ha
1	Baitada Daijee 4	484.6	2	4
2	Janjagaran Parashan 1 -9	246.75	2	58
3	Gwashi Krishnapur 3	496.78	1	1
4	Dilashani Dekathbhuli 3&4	125.36	1	15
5	Janjagaran Dekathbuli	200	2	20
6	Mahakali Krishnapur 6,9	197.57	1	300
7	Ekata Krishnapur 8&9	117.28		
8	Shinghpur Krishnapur 5,6&7	198.29		
9	Pragatishil Krishnapur 8&9	119.03	1	3
10	Amar Suda 6,7&8	305.17	1	0.5
11	Siddhanath Bhimdutta Brahmdev	497.98	1	0.5
13	Amar Suda 6,7 &8	305.17	3	22
15	Shanti Bhimdutta 10	183.75	1	0
16	Shahid Smarti Bhimdutta 3	291.95	1	0
17	Bachella Daijee 3	308.31	2	0
	<b>Total</b>	<b>4077.99</b>	<b>19</b>	<b>637</b>

## CONCLUSION AND RECOMMENDATIONS

The forest fire problem is very serious in these years because of climate change impact in the Hindukush regions. The forest fire threat to humans is still very high in Nepal because the mountain regions have very less access to the technical and support

system of government and other agencies in forest fire management. The government initiation has also not so much effectively implementing throughout the country with limited resource and technical support. Therefore, more than 18000 communities having about 30 per cent forest land are managing the forests and if their management is networked and mobilized with a little technical and logistic input in forest fire could make a success move in the forest fire management. Most ground and surface fire can be controlled or fire management can be handled through community forest user group members' mobilization. The experience shows that there is only ultimate solution for forest fire management in the country is through community based forest fire management. For this the report recommends supporting proper equipments and skills for using fire as a management tool and climate change risk reduction. Similarly, the study also recommends to mainstream into implementing instruments of Nepalese Forest Fire Management Strategy, 2010. The experience of the Kanchanpur and Nawalparasi could be a base model for the further implementation of fire control system development through community based forest fire management.

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