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## NEPAL

### Forest fire in the Terai, Nepal Causes and Community Management Interventions

#### Summary

Forest fire, largely caused by human, has changed the Terai forest ecosystems. Of the total, 58% forest fire were deliberate burning by grazers, poachers, hunters and non-timber forest product collectors. Forest fire due to negligence (22%) and accident (20%) also had a significant share. The major causes of the fire were carelessness of passer-by, smokers and picnickers for the former and illiteracy, ignorance and fun for the latter. Analysis affirmed that most of the fires that occurred due to the aforementioned reasons were related to agricultural activity. Forest fire occurrence and awareness level of local community is, therefore, always intertwined. Public understanding of the environmental services of ecosystems is expected to help minimize the forest fire incidences.

#### Introduction

Wherever there are people, there are fires, as the two have been culturally linked for centuries. Because of the nature of the farming system (small-scale and temporal) and the absence of other appropriate means of land preparation, fire is usually resorted as a way of preparing fields for crop cultivation (FAO, 2003). It is the least expensive land clearing method, and for most of the small households the only available one (Kunwar, 2004a). It has also been used for promoting annual grasses for grazing livestock, facilitating cultivation, and assisting in hunting and land clearing. Local people set fires deliberately for their livelihood particularly for agriculture and non-timber forest products (NTFPs) collection (Sharma, 1996; Bajracharya, 2002). It plays a useful role in the life cycle of a forest.

Forest fire destroys many more trees than all other natural calamities: parasite attacks, insects, frost, etc. (Alexandrian et al. 1999). It results in fuelwood shortage, displacement of people and many socio-economic problems worldwide. It not only destroys living forest vegetation, but also consumes the dead vegetation and destroys the litter. As soon as the soil has been made bare by fire it is reoccupied by invading plants of one kind or another (Toumey and Korstian, 1959). It is one of the prominent causes of forest destruction in Nepal where fire is traditionally linked with rural people's livelihood (Anonymous, 2003). Nepal's Terai (tropical) forests are decreasing at an annual rate of 1.3% (DFRS, 1999), and this is due to massive deforestation, forest encroachment, illicit felling, premature and over harvesting, overgrazing, firing, etc.

Although fire under control may be a beneficial, uncontrolled fire is always harmful. Fire is, therefore, neither innately destructive nor constructive; it simply causes changes. Whether these changes are viewed as desirable or not depends upon their compatibility with overall objectives (Wade and Lundsford 1990). In this connection, the present assessment was undertaken to identify and reveal the causes and community management interventions of forest fires in Terai, Nepal.

#### Methods

This study was carried out by analyzing primary data and reviewing, compiling and collating the existing literatures. The primary data were collected through rapid rural appraisal (RRA) and participatory rural appraisal (PRA) methods. Field observation, group discussion, informal interview, meeting, schedule survey, checklist and scaling and ranking were employed as tools for primary data collection. Field visits were carried out during April-June 2004. The study sites were Basanta Kailali, Khata Bardia, Mahadevpuri Banke, Lamahi Dang, Dovan Palpa, Chitwan and Kapilbastu districts extending between 27°00' to 29°07' N latitude and 80°03' to 80°00' E longitude.

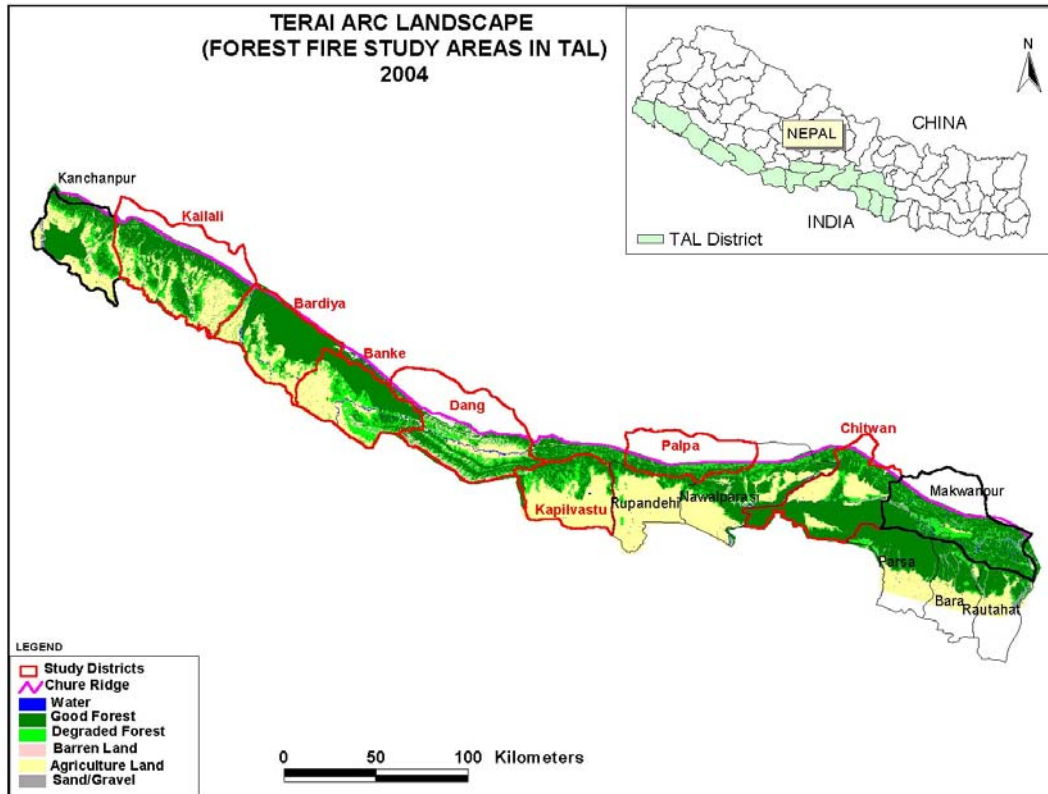


Figure 1. Forest fire study areas in the Terai Arc Landscape (TAL), Nepal

## Results and Discussion

### Peoples and livelihood

Population of the Terai seems to be growing rapidly due to high rate of migration from hills and mountains. Annual population growth rate in Kailali district is 3.89% followed by Banke district 3.01% while the national population growth rate is 2.25% (HMGN, 2003a, b). Terai, particularly, is the most heterogeneous area in Nepal comprising diverse ethnic groups such as Tharu, Bote, Kumal, Mushahar, Satar, Dhimal, etc. The occupation of the ethnic groups is farming followed by traditional use of NTFPs, fuelwood, fodder, wild fruits and vegetables, and fishing. Livestock farming is the secondary occupation in which people are raising buffaloes, cows, goats, sheep and pigs. All these livelihood portfolios are linked with forest fire to some extent.

Forest fire has been a major agent of land cover change in the Terai (Kunwar, 2004a) but it can also have a devastating long-term effect on ecosystems that are not adapted to such patterns of burning. Forest of Terai is composed of tropical deciduous types. Most of the tree species of these forest types shed their leaves during dry season (March to May). Large amount of dry leaves, small twigs and litter which accumulate on the forest floor accompanied by undergrowth species, grasses, weeds and alien species served as fuel for the outbreaks of forest fire.

### Causes of forest fire

Natural fires, which start directly or indirectly due to natural cause beyond the normal capacity of man to control, were absent in the present study. All the forest fires were human induced which fall under following categories.

#### **Forest fire due to intentional purpose**

Analysis revealed that 58.06% of the total causes of forest fires were deliberate (Figure 2). It was followed by negligence (22%) and accidental (20%). With growing human populations that have moved into forest-urban interface areas, increasing number of fires were human induced, inadvertently caused for example, by discarded cigarette butts of illegal loggers, passer-by, cattle herders and

grazers, NTFPs and fuelwood collectors. Forest fires were started deliberately by livestock owners, shepherds, grazers who ignite forest to promote new green flushes of growth for their animals which was a key threat in Terai. All these causes are linked with agriculture.

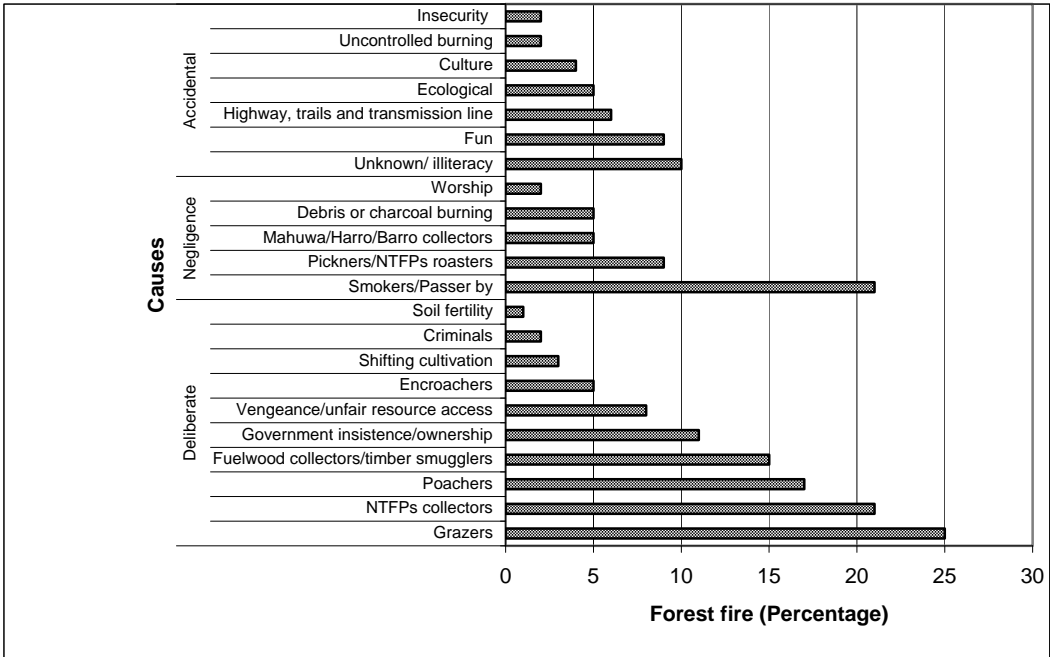


Figure 2. Forest fires in Nepal by causes



Figure 3: Forest fire in Radhakrishna CFUG, Kailali

Some forest fires are set by hunters and poachers to clear vegetation for a better sight of prey namely wild pig (*Sus scrofa*), hare (*Lepus nigricalis*), deer (*Axis axis*), wild fox (*Cuon alpinus*), etc. The fire is also set for the growth of tender shoots which entices the wildlife. It has been used to scare wild animals, snakes, mosquitoes, insects, to clear footpaths and to control pests. Other reasons behind the deliberate burning are removal of plant species in competition with desired timber species and control of soil-dwelling pathogens and weeds.

Many time people set fire for NTFPs collection. NTFPs contributing to rural people's livelihood are bidipatta (*Diospyros melanoxylon*), mushrooms, mahuwa (*Madhuca indica*), etc. Collectors of biddipatta set fire in summer to promote a better flush of leaves. Fire is also set by ethnic groups to collect phutki mushroom (*Schleroderma* sp.), vegetables, bankas (*Eulaliopsis binata*), khajuri (*Phoenix humilis*), etc. People ignite fire for encouraging a lush growth of grasses, facilitating the collection of mahuwa flowers, clearing land for cultivation, smoking out beehives, cooking and keeping warm.

Elsewhere in developing countries, clearing the area for cultivation, especially shifting cultivation is a common practice (Heikkilä et al., 1993). Shifting cultivation, locally known as *Khoria*, has been and continues to be a way of life for many of the ethnic groups both in hilly areas and in northern Terai of Nepal since the time immemorial. Particularly, it is common in Chitwan, Dhading, Makwanpur, and hilly areas of Palpa district. Since the period for slash and burn generally coincides with the dry and windy months of the year, incidences of fire spreading beyond the boundaries of designated plots into the adjoining forests are not uncommon. It is the leading cause of forest destruction and firing in the northern parts of India (Saigal, 1990).

Farmers also use fire to eliminate crop residue, and to convert the forest to agricultural land. Fire removes the organic matter and provides an ash bed, which facilitates the growth of grasses. Therefore, local people set fires to gather ash, which is locally used as manure. They also set fires for hunting and masking illegal logging. Hoffmann et al. (1999) and Vayda (1999) argued similarly.

Urban population is also dependent on forest resources; they create a huge pressure on forests. Pressures from fuelwood collectors and timber smugglers are also important to set fire in forest. Accentuating such pressures is intensified migration as people move about looking for alternatives. Inexperience and carelessness of urban dwellers might inadvertently set forest fire. Transmigrants usually do not have a good knowledge of their new environment, and may use fire inappropriately. Forest fire may also be lit for a variety of reasons including private vengeance.

People with a complaint against the forest officials sometimes start fire maliciously. Such a situation is created, as people are dissatisfied with the way of forest department staff's use of power to control resources. Another causes of forest fire are the conflicts that arise with perverse policy (e.g. community forests' revenue sharing mechanism, collaborative forest management, delaying handover the forest to community, lack of tenure security, ownership and incentives) and external forces (e.g. demographic changes, high migration) (Figure 4).



**Figure 4:** Forest fire in Hariyali CFUG, Kailali



### **Forest fire due to negligence**

Carelessness of smokers and of passerby is a pertinent source of forest fire in the Terai. Grazers and the fuelwood collectors, sometimes unintentionally throw the burning butts of cigarette inside the forests. The burning buds can easily catch fire on the dried leaves and twigs, especially in summer season. Some people or children set fire for roasting the NTFPs (pine cone), prey (birds, small animals, etc.) and do not put it out which can outbreak. Forest fires are also caused by ignorance of poachers, encroachers, and charcoal traders (Upreti, 2003).

Mahuwa (*Madhuca indica*) flowers, sal (*Shorea robusta*) flowers, harro (*Terminalia chebula*), barro (*Terminalia bellirica*), tata (seed of *Bauhinia vahlii*), etc. pickers burn the dry leaves under the trees to get a clean patch of floor to facilitate desired NTFPs collection. While the intention is only to clear the small underneath patch of single tree, fire can outbreak. Since the collection of NTFPs is done during March-May, the hot and dry season aggravates the situation further.

Traditional communities use fire as a tool for burning organic matter and agricultural residue to prepare the ground for next crop cultivation. Such fire can spread from agricultural lands to the forest, from the forest to the agricultural lands, or from the forest or agricultural lands into villages and vice versa. Abandoned cooking fire in the forest and burning garbage have also been reported by local people and concession staffs to set forest fire. Annual roadside clearing and debris burning (usually from March to June) can also cause forest fire (Aryal, 2004).

### **Accidental forest fire**

Some people use fire in forest for encroachment and agricultural purposes. When this is done without precautions and coincides with high climatic risks (such as wind, hot and dry climate), forest fires are practically inevitable.

Prescribed burns that get out of control also cause some forest fires. Managed fires do from the activities of smallholders for forest clearing, while uncontrolled fires can also occur in natural forests because of escaped fires from land clearing and illegal logging. However, all fires that spread from the source do not necessarily result in calamity; they may burn out at some distance away, often crossing into a different vegetation type (Frost, 1992). Degraded forests are more susceptible to fire than primary forests, and newly logged areas even more so. For their safety from fire, local people create firebreaks around their homestead (locally called *Pargelnu*); this also improves visibility.

Some forest fires of Terai are also associated with fixed installations (highways, transmission lines, trails) and some are directly related to human activity. Security problems and burning for fun also contributed to the forest fire. Least income and unemployment, which is as high as 80-90% in the Terai (Shrestha et al., 2003), compel people to resort logging, fuelwood collection, hunting and most importantly the collection of NTFPs. All these activities increase the number of deliberate and accidental forest fire.

Uncontrolled fire due to ecological factors namely hot temperature, low humidity and precipitation and high fuel accumulation are common in Terai. In addition, topography and duff/fuel moisture percentage also strongly influence the possibility of forest fire. The intensity of uncontrolled fire increases substantially with the invasion of fire-prone aliens. Uncontrolled, these aggressive plants tend to reproduce rapidly (Kunwar, 2003), pile up the fuel for fire outbreak and become impenetrable to firefighters, multiplying the risk of danger. Neighbourhood and tribal communities visit the temples situated in forests to offer prayer and sometimes they do not put out the fire properly after cooking which then spreads when the wind blows.

### **Nature and intensity of forest fire**

The occurrence, intensity and nature of forest fire are scientifically less understood, and the studies are scanty and non-conclusive in Nepal. Timely information on the location can help in preventing, planning and management of forest against fire.

The collected statistics of forest fire are not complete for all countries (IFFN, 2003). The recently published global burnt area product 2000 derived from space borne sensing system is the first step obtaining the benchmark data on the extent of global wildland fires for year 2000 (JRC, 2002). Initial

analysis indicates that approximately 351 million hectares globally were affected by fire in the year 2000 (JRC, 2002).

About 90% of the Terai forests were affected due to fire (Sharma 1996). Such casualty was also reflected in earlier observations of Goldammer (1993). It is very difficult to obtain the quantitative information of forest fire incidences in Nepal. According to Bajracharya (2002), forest area burnt annually in Nepal is in the order of more than 400,000 ha. However, Department of Forest (DoF), responsible institution of the government of Nepal for forest management, is yet to keep records of forest fire. Contrarily, some CFUGs have initiated keeping the records of forest fire statistics and combat locally. Present study also made efforts to measure the burnt area of community forests of Terai during the years 2003 and 2004 (Table 1). In total 14% of the community forests of study area were burnt in 2003 and 24% in 2004. Despite the institution of community forest management system, human disturbance continued in various forms, including setting fire (Kunwar, 2004b), and increased the forest fire incidence. The increase in forest fire damage in the second year was also due to the pressures of fuelwood and NTFPs collectors, poachers and hunters, etc supplemented with dryness, high rate of migration and encroachment.

**Table 1.** Total burnt area of community forest in the year 2003 and 2004. Source: 2004 field survey.

| Study area         | Total area (ha) | Total number of Households | Burnt area in 2003 (ha and %) | Burnt area in 2004 (ha and %) | Total burnt area (ha and %) |
|--------------------|-----------------|----------------------------|-------------------------------|-------------------------------|-----------------------------|
| Basanta, Kailali   | 1594            | 2918                       | 279 (17)                      | 199 (12)                      | 478 (30)                    |
| Khata, Bardia      | 8261            | 2615                       | NA                            | NA                            | NA                          |
| Mahadevpuri, Banke | 1422            | 744                        | 30 (2)                        | 30 (2)                        | 60 (4)                      |
| Lamahi, Dang       | 2665            | 2743                       | 195 (7)                       | 800 (30)                      | 995 (37)                    |
| Dovan, Palpa       | 889             | 409                        | 75 (8)                        | 135 (15)                      | 210 (23)                    |
| Chitwan            | 4751            | 6220                       | 924 (19)                      | 1644 (34)                     | 2568 (54)                   |
| Kapilbastu         | 817             | 1711                       | 130 (16)                      | 46 (6)                        | 176 (21)                    |
| <b>Grand Total</b> | <b>11684</b>    | <b>14745</b>               | <b>1633 (14)</b>              | <b>2854 (24)</b>              | <b>4487 (38)</b>            |

Decreasing trend of forest fire incidence in community managed forests in Basanta Kailali, Mahadevpuri Banke and Kapilbastu districts was due to establishment of community managed fire lines and trench lines (Figure 5). The extent of forest fire in government-managed forests was astonishing. It was assumed that the annual fire damage in government-managed forest was as much as ten times than that of community managed forest. The severely affected government managed forests were from Dang, Banke, Kailali and Kapilbastu districts.

Most of the forest fire incidences occur between March and May in the Terai. Once the monsoon is established, usually by the June, the fire problem disappears. Long year's experience of Sagarnath forest project showed that forest fire peaks in April. White (1988) reported a constant threat of fire from January to May. We found 59.75% medium fires (5-100 ha) followed by 27.65% small fires (1-5 ha) and 12.76% large fires (100-< ha).

### Community management interventions

Fire management planning requires the coordination of a vast array of forest information as well as data on silviculture, forest management and land use. It manages fuel loads through controlled burning, grazing or cutting. Forest fire is considered as a forest management tool in some countries, and it can be a useful conservation management tool particularly in Terai deciduous forest (Kafle 1997) but in Nepal no such practice has ever been introduced.



**Figure 5:** Community managed trench lines in Radhakrishna CFUG, Kailali

Local communities play a significant role in preventing and suppressing harmful fires because they have clear understanding of local conditions and circumstances important for successful fire management. They also possess valuable knowledge of place, fire history and fuel loading. Local site-specific knowledge of and experience with terrain, past fire behaviour and locations for emergency fire lines, could save lives, time and money during emergencies. As public awareness grows, it is hoped that forest users actively participate in forest fire management activities and maintain forest biodiversity. In general, when communities have sense of ownership, they are more inclined to take interest and action in the management of fire. The abandonment of rotational shifting cultivation practice or traditional rights (free grazing) over resource access makes fire management more difficult.

Considering the priorities of users, blockwise grazing or no grazing system has been adopted to control fire in community forests. Construction and maintenance of fire lines around and inside the forest are common method of aliening fuels, which can segregate, stop and control the spread of fire. The construction of trench line was the most noteworthy and effective mean of fire management. Trench lines helped to provide multiple services: they act as firebreaks, forest boundary, water reservoir and control illegal transports. These lines were originally made to reduce the conflict with wildlife and grazing animals in forests (WWF Nepal, 2003).

Silvicultural operations comprising pruning, tree thinning, prescribed burning, controlled grazing and species selection, all of which minimize the fuel volume, were also the pivotal interventions for lessening the fire risk. Selective logging increases the growth and survival of trees and reduces the amount of debris subjected to rotten and fire. CFUGs also carry out controlled burning and collect litter and fuelwood for domestic uses, both of which minimize the fire risk.

When a fire outbreaks, CFUGs make an attempt to control it. A first objective in fire control is to stop peripheral spread and thus keep area burnt at a minimum (Davis, 1959). Users do not delay suppressing the forest fire even if it is in government-managed forests. Local forest guards or firefighters (forest users) are often the first to respond to forest fires. There were one to four forest guards in each CFUGs in accordance to the need and capacity of forests and user groups. CFUGs have also set co-operation for fire suppression. All these activities noticeably share to prevent and minimize the forest fire.

CFUGs accustom to having penalty and rewarding system for their forest management. Penalties are generally imposed on individuals, or collectively on the entire community, for deliberately or accidentally causing forest fires. The charge was identified through user's concession and channelled to the CFUGs' fund. The system of providing or rewarding 10-50% of the penalty amount to the criminal catchers was also observed.



Degree of recovery and need for rehabilitation interventions depend on the intensity and frequency of burning (Schindele et al., 1989). It is necessary to recover the burnt areas as soon as possible for lessening the harms of forest fires. Fencing the burnt areas and lessening the disturbance for auto recovery and regeneration are the most effective effort although they are not adopted so far in Terai areas of Nepal.

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#### **IFFN Contribution by**

Ripu M. Kunwar  
Centre for Biological Conservation Nepal (CBC/N)  
GPO Box 19225  
Kathmandu  
Nepal

E.mail: [ripu@wlink.com.np](mailto:ripu@wlink.com.np)

and

Sarala Khaling  
WWF Nepal Programme  
Kathmandu  
Nepal

e-mail: [sarala.khaling@wwfnepal.org](mailto:sarala.khaling@wwfnepal.org)