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# Resource Dependence and Local People's Attitudes Towards Conservation: A Case Study From Katarniaghat Terai Ecosystem

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## ABSTRACT

The Katarniaghat Wildife Sanctuary (KWS) in Terai ecosystem is under heavy biotic pressure due to resource use by local communities. This paper examines extent of resource dependence and attitudes of local communities towards KWS. There are 10 villages within KWS and another 64 villages on the periphery within a radius of 5 km of the sanctuary boundary. 369 households were sampled in 15 villages (2 inside and 13 outside the sanctuary). The pattern of dependence differed for the households sampled outside KWS. Agriculture was the main occupation within and outside KWS. Majority of households agreed that KWS should be given protection. Households outside KWS however had less support for protection to wild animals. Alternatives should be provided to local communities for reducing dependence on KWS. These families should also be involved in conservation oriented employment generating schemes in order to address the issue of unemployment. Extraction of resources should be regulated by creating zones within KWS so as to curtail the impact of biotic dependence on the PA.

Key Words: Resource Dependence; Attitudes; Conservation; Protected Area

## INTRODUCTION

Forests cover about 23% of India's geographic area (FSI, 2011) and are an important source of ecosystem services like protection of environment, clean air, and water and also offer subsistence to people living in and around them. Forests also have a potential to support livelihoods and, in the process, participate in poverty alleviation. Apart from this there are some secondary resources associated with forests like grazing, wastelands, NTFPs and fuel wood collection, etc., which have a potential to afford local economies to some extent. With time, deforestation for cultivation, food, shelter and pasture, diversion for developmental purposes and removal of valuable timber trees have affected the forest resources adversely.

In a developing country such as India, the rural poor who live close to forests largely depend on the forest resources to meet their daily livelihood requirements. These requirements are fulfilled by collecting different types of forest produce for household consumption, as well as providing subsistence income for the family. The high degree of dependence and requirements of the families over period of time has resulted in degrading the forest habitat and loss of wildlife.

The dependence of local communities on protected areas in terms of grazing by their livestock, collection of fodder, timber, fuel wood, Non Timber Forest Produce (NTFP) and encroachment on the Protected Area (PA) for agriculture, creates conflict between long term conservation interests of PAs and local people. The presence of villages and human settlements inside the PA

and adjacent to the PA boundary often lead to severe human-wildlife conflict when wildlife species destroy crops, injure and kill local people and livestock. This often leads to retaliation by local communities resulting in killing of wild animals.

Most PAs in India are also affected by livestock grazing, which varies in intensity from low to severe. While low intensity of grazing may be sustainable, severe grazing leads to degradation of habitat, reducing not only the food availability for wild herbivores but also altering the species composition of ground and shrub layers through weed proliferation and higher regeneration of unpalatable species at the cost of palatable species. Similarly severe lopping can affect the regeneration of tree and shrub species.

Various studies have however shown that sustainable forest resource management designs are helpful in maintaining and enhancing the future flow of economic benefits to the surrounding communities without damaging the natural resource system (Babulo et al. 2008). Thus, the key issue is to investigate forest use and dependence on forest resources among different groups at a local level and its implications for policy (Marshall 2011, Davidar et al. 2010, Mamo et al. 2007). This can only be done through case studies of dependent groups.

Conservation of biodiversity and wildlife can only be successful on long term basis when there is total harmony between the conservation interest of the PA and the interest of local communities. PA managers must therefore evolve strategies which would lead to not only significant reduction in people's dependence on PA resources but also generate greater awareness and support among local communities for the PA.

Eco-development initiatives have been taken up in several PAs in order to reduce the dependence of local communities on PA resources as well as to mitigate human-wildlife conflict. But these initiatives have however, been mostly taken up in tiger reserves. On the other hand, exclusionary approaches which emphasize removal of people from protected areas cannot be viable in India given the large human population and high level of poverty which results in greater dependence on forest resources for sustenance. The state of Uttar Pradesh is one of the most populated states with high level of poverty leading to high biotic dependence on natural resources. Moreover, the state has also witnessed severe reduction in forest cover due to large scale conversion of forest land for agriculture. Consequently, the protected areas in the state have been subjected to increasing biotic pressure due to increasing resource demand. Moreover, growing intervention of market economy and increasing population have led to changes in the basis of subsistence economy and people's aspirations. Although studies have been carried out on socio-economic aspects of people's dependence on forests in various protected areas across India, a comparative study of the Protected Areas in Uttar Pradesh has not been carried out. Thus the present study which was carried out in Katarniaghat Wildlife Sanctuary (KWS) in Bahraich district is significant as there is a need for a better understanding of socio-economic status of the local communities residing in and around protected areas in Uttar Pradesh and the factors responsible for their dependence on these forests, human wildlife conflicts and their attitudes towards conservation.

## STUDY AREA

The Katarniaghat Wildlife Sanctuary (KWS) located in Terai area of Uttar Pradesh is an important area for conservation of Terai forest and grassland ecosystems. It is located in the Nanpara Tehsil of district Bahraich. The northern boundary of KWS lies along Indo-Nepal border. KWS covers an area of 400.09 sq. km and is situated between 28°06' N and 28°24' N latitudes and 81°02' E and 81°19' E longitudes. The forest was declared a Wildlife Sanctuary vide Govt. of U.P. notification no. 388/14-3-32/1976 dated May 31, 1976. The Sanctuary together with adjoining 150.02 sq. km of Reserve Forests, which serve as buffer, constitutes a single ecological unit.

It is one of the few remnants of the rich and diverse Terai ecosystems, having connectivity with Royal Bardia National Park in Nepal which lies to the north and Dudhwa National Park, which lies to the west of the Sanctuary. KWS is one of the most significant representatives of highly rich, diverse and fragile Terai ecosystems (Kumar et al. 2011).

### Biotic Pressure on KWS

KWS faces immense biotic pressure from the resource dependent human populations residing both inside the PA as well as on its periphery. There are 10 villages within the boundary of KWS and another 64 villages outside the PA, within 5 km of the sanctuary boundary. There are about 5,000 people and 60,000 livestock residing in these villages. This results in various types of

biotic pressures viz. grazing, poaching, wood cutting and encroachment on forest land. At times the local people set fires resulting in a lot of damage to the PA. The local rural economy primarily depends on agriculture which is supplemented by animal husbandry. Eco-development program is being implemented by the forest department in the dependent villages. The program seeks to minimize the level of resource dependence of surrounding population upon the resources of the Sanctuary by helping them to adopt ecologically sustainable alternatives.

KWS is also under enormous grazing and biotic pressure exerted by more than fifty villages of Nepal located on the northern periphery of the PA. The population of these villages depends on KWS for fuel wood to meet their domestic energy needs. They often indulge in illicit felling of trees and poaching of wild animals in the PA. The PA management however, has no control over these villagers and moreover, there is no mechanism for dealing with the problem.

**Physiographic Characteristics and Climate of KWS**

KWS located in the Gangetic plain, has three main types of soils viz., a) the low alluvium extending across large areas in the north and along the eastern boundary of the Sanctuary; b) the middle alluvium in the south of the Sanctuary; and c) the high alluvium in rest of the Sanctuary. KWS is very rich in terms of water sources. The main rivers are Girwa, Kauriala, Ghagra and Saryu. The rivers Kauriala and Girwa which enter the PA from Nepal branch before entering India and recombine at Girija barrage into river Karnali. According to the Management Plan of Katarniaghat Wildlife Sanctuary (2000) KWS experiences climatic variations typical of the plains of northern India with extremes of heat and cold. Winter nights are very cold and foggy and heavy dew falls regularly, with the result that vegetation remains damp for most of the day. The days in winter are cool and bright. Frost occurs generally in January. The nights remain cool and dew falls until late spring. The hot weather commences in April and lasts until the rains start towards the end of June. Heavy monsoon rains fall from June until October.

**Flora and fauna of KWS**

KWS represents the Terai-Bhabhar bio-geographic division of Upper Gangetic Plains. As per Champion and Seth (1968) classification the three forest types are (i) Sal forest (ii) Miscellaneous forest and (iii) Grasslands. The Sanctuary is rich in floral diversity with 95 tree species, 57 shrubs, 28 climbers and 23 species of grasses reported from the Sanctuary (Management Plan of Katarniaghat Wildlife Sanctuary, 2000). The main tree species were *Shorea robusta* (Sal), *Terminalia alata* (Asna), *Dalbergia sissoo* (Shisham), *Aegle marmelos* (Bel), *Schleichera oleosa* (Kusum), *Bombax ceiba* (Semal), *Mallotus philippinensis*, *Acacia catechu* and Ficus spp. The dominant shrub species are *Glycosmis pentaphylla, Murraya paniculata, Clerodendron viscosum.* The main grass species occurring in the area are *Saccharum spontaneum* (Kaans) and *Saccharum munja* (Moonj) and *Calamus* sp. (Tripathi and Singh 2009).

Owing to great floral diversity, the Sanctuary has a mosaic of diverse habitat (Jha 2000), and consequently, the faunal diversity is also high. Along with Tiger *(Panthera tigris),* the Sanctuary has five species of deer namely, Chital *(Axis axis),* Hog deer *(Axis porcinus),* Sambhar (*Cervus unicolor),* Barking deer *(Muntiacus muntjak),* and the highly endangered Swamp deer *(Cervus duvaucelii duvaucelii).* Among the antelopes, the Sanctuary still has a small population of Blackbucks (*Antilope cervicapra*).

The Girwa, which is a large snow fed river, supports the faunal diversity of the area. It has a good population of the Gangetic dolphin *(Platanista gangetica),* Gahrial *(Gavialis gangeticus),* Mugger *(Crocodylus palustris)* and Smooth Indian otter *(Lutra perspicillata),* all of which are highly endangered. Moreover, the reservoir of Girwa irrigation barrage attracts thousands of migratory birds in winter (BirdLife International 2012).

METHODOLOGY

Primary as well as secondary data were collected to assess the socio-economic status and dependence of the people on the KWS. Secondary data on the villages were collected from the Revenue and Forest Departments of Uttar Pradesh. Primary data was collected through village surveys, group discussions and household interviews. Questionnaires were used for collecting household data in the villages located within and around the Protected Areas. Qualitative as well as quantitative data were collected using both open- and closed-ended questionnaires. The questionnaire was designed and tested during the reconnaissance and appropriate changes

were made thereafter. The reconnaissance survey for all villages was carried out and GPS (Global positioning system) location of each village was recorded with Magellan eXplorist® handheld GPS. Fixed response questions were also included in data sheet for easy interpretation and analysis. The village survey was used to collect data on the macro aspects of the study, i.e., the general economic status, occupation, broad demographic features of the population and the forest area used by the local people for extracting resources and grazing livestock. The household interview was used to collect detailed information on people's dependence on forest resources. Data was collected on the following aspects:

- Demographic structure, occupation, socio-economic status and income;
- Size of land holding, type of irrigation, crops grown and expenditure and income from agriculture;
- Size of livestock holding, expenditure and income from dairying;
- Following dependence on forest were quantified:

(a) Non-timber forest produce (NTFP)- types of NTFP collected, quantities consumed and sold each year and contribution to the annual income of the family.
(b) Fuelwood and timber- quantity collected, used/sold and income earned through sale.
(c) Grazing of livestock, collection of fodder and grasses and income through sale of dairy products.

Data to assess dependence on the forest were collected using stratified random sampling. Sample villages were selected from each stratum. Secondary information was used to stratify the villages on the basis of distance from the protected area and human and livestock populations. Household interviews were conducted using random sampling method within each sample village.

Data were analyzed to find out the extent of biotic dependence on Katarniaghat. Four community groups were identified in the protected area e.g., scheduled tribes (ST), scheduled casts (SC), other backward classes (OBC) and general (GEN).

**Limitations**

Socio-economic data based on questionnaire surveys depends upon the recall, accuracy, and intentions of respondents and are subject to various biases. Recall periods in the survey normally extended to 12 months, which is accepted for survey based study. However, it is difficult to entirely eliminate every bias, but the effort was to gather baseline information on the factors and extent of anthropogenic dependence.

## RESULTS AND DISCUSSION

There were 10 villages inside KWS and another 64 villages outside within a distance of 5 km from the sanctuary boundary (Table 1). The people living in these villages were dependent on the resources of the Sanctuary. In addition to these villages, more than 50 villages located outside the northern boundary of the PA (within a distance of 5 km) on the Nepal side, were also dependent on KWS for their requirements of fuel wood and fodder. More than two decades ago, the forests on the other side of the border were clear felled consequently, villagers living in adjacent villages in Nepal indulged in illicit felling of trees in KWS. Within KWS there were three major clusters of villages. Cluster one comprised of Amba, Bardia, Bishnapuri, Fakirpuri and Rampurwa villages. Bhawanipur and Bicchia constituted the second cluster. Tedhi and Dhakia formed the third cluster. Bharthapur was separate from these clusters. Bhawanipur, Bichhia, Tedhi and Dhakia were forest villages and therefore under the control of the forest department. These forest villages were established by the forest department for supply of labour to carry out traditional forestry activities. The various communities residing in these villages were Brahmin, Muslim, Yadev, Mushahar, Mallah, Harijan and Tharu. The Tharu is an indigenous tribe, traditionally dependent on forest resource for their subsistence requirements. They constituted a sizeable proportion of the local population. They have extensive knowledge of the indigenous flora and its medicinal use. Some of the major NTFPs collected by the local people in Katarniaghat Wildlife Sanctuary were grasses, fruits, tubers, leaves, etc. The socio-demographic characteristics of the sample households of different communities are given in Table 2. The dominant community was the Backward classes (OBC). Table 3 shows that most of the land holdings in KWS were marginal (up to 1 ha) and small (>1-2 ha).

Landholding pattern across the communities was also assessed. Chi-Square Test showed significant difference ($\chi^2$=2.52, df=9 $p<0.01$) in the mean landholding size across the communities in KWS. The data on livestock ownership (Table 4) shows that the mean livestock holding per family was 9.09±8.89 with >80 percent of the families owning livestock. However, Kruskal-Wallis 1-way ANOVA showed no significant

Table 1. Basic socio-economic information of Katarniaghat Wildlife Sanctuary (KWS).

| Parameters | KWS |
|---|---|
| Number of villages | 64 |
| Types of villages | Revenue / forest |
| Village inside the forest | 10 |
| Village sampled inside the forest | 2 |
| Village sampled outside the forest | 13 |

Source: Revenue and forest departments of KWS

Table 2. Demographic characteristics of sample households of different categories in Katarniaghat Wildlife Sanctuary

| Socio-demographic variables | Number | % |
|---|---|---|
| (A) Number of Households | | |
| General (GEN) | 53 | 14.4) |
| Other Backward Class (OBC) | 151 | 40.9 |
| Schedule Caste (SC) | 98 | 26.6 |
| Schedule Tribe (ST) | 67 | 18.2 |
| Total | 369 | 100.0 |
| (B) Number of individuals according to Education category | | |
| Primary | 332 | 45.1 |
| Junior High School | 264 | 35.9 |
| Above High School | 140 | 19.0 |
| Total (No. of Literate | 736 | 100.0) |

Source: Revenue and forest departments of KWS

Table 3. Land holding pattern in Katarniaghat wildlife Sanctuary.

| Parameter | Number | (%) |
|---|---|---|
| Marginal (upto 1 ha) | 119 | 46.5 |
| Small (>1-2 ha) | 68 | 26.6 |
| Medium (>2-4 ha) | 46 | 18.0 |
| Large (>4 ha) | 23 | 09.0 |
| Total | 256 | 100.0) |

difference in the mean livestock ownership across the communities. The occupational distribution showed that in selected villages of KWS, most of the population was engaged in agriculture which was the major source of livelihood. Other households were busy in various nonfarm activities due to non-availability of land. Low figure was recorded for the people engaged in government services in KWS. Small business and labour were the other sources of income after agriculture in the study area (Figure 1).

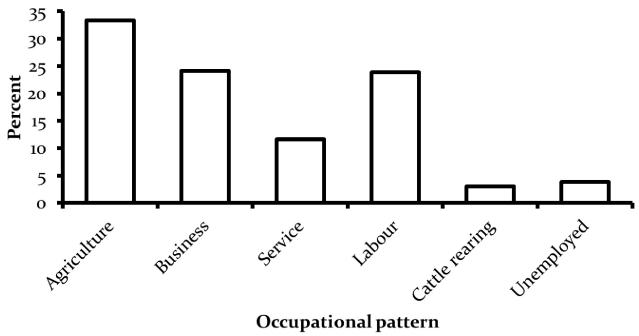


Figure 1. Main occupations of villagers near Katarniaghat Wildlife Sanctuary

**Dependence on Forest Rources**

The villages in the study site were dependent on the forests for their sustenance. Major resources extracted from KWS and RWS were fuel wood, non-timber forest Products (NTFPs) and for grazing of livestock. The average fuel wood collection by different communities in the sample villages is given in Table 5. The fuel wood consumption across communities was highest for Tharu households in KWS. The fuel wood collection by the people was done throughout the year except for 2–3 monsoon months when the area becomes inaccessible due to heavy rainfall. People walked 3 to 4 km inside the forest in the morning for collecting of fuel wood and spent about 2 to 3 hours. Some of the important fuel wood species in the study area were *Schleichera oleasa*, *Trewia nudiflora*, *Acacia catechu*, *Adina cardifolia*, *Tectona grandis*, *Dalbergia sissoo*, *Cymbopogon* etc. In the month of June the fuel wood collection was usually and usually no collection was done during July–August period due to heavy rainfall, but during these months, the wood collected during earlier months was used. The highest consumption of fuel wood took place during late rainy and winter months as the wood was required for heating purposes in addition to cooking. The tree trunk, branch and root components were used as fuel wood. Maximum consumption of trunk and branch components was observed in the study area.

Table 4. Livestock ownership of sampled households across communities in KWS

| Communities | Number | (%) |
|---|---|---|
| General (GEN) | 45 | 15.1 |
| Other Backward Class (OBC) | 120 | 40.3 |
| Schedule Caste (SC) | 81 | 27.2 |
| Schedule Tribe (ST) | 52 | 17.4 |
| Total | 298 | 100.0 |

Table 5. Average fuelwood consumption (kg per capita; mean ±S.E.) in sampled household across communities in KWS

| Communities | Fuelwood Consumed |
|---|---|
| General (GEN) | 765.35 ± 88.72 |
| Other Backward Class (OBC) | 913.40 ± 106.84 |
| Schedule Caste (SC) | 925.79 ± 127.45 |
| Schedule Tribe (ST) | 1263.18 ± 215.82 |

Table 6. Annual collection of non-timber forest produce and income earned from sale by sampled households in KWS. Values are mean ± SE

| Major items | Quantity (kg) | Income earned (Rs) |
|---|---|---|
| Gum and resin | 16.00 ± 7.21 | 640.00 ± 288.44 |
| Fodder for livestock | 259.48 ± 53.10 | - |
| Medicinal Plants | 12.92 ± 2.79 | 2125.00 ± 350.38 |
| Vegetables | 68.00 ± 16.50 | 1266.66 ± 190.90 |
| Thatch grass | 352.48 ± 52.03 | 2900.00 ± 718.79 |
| Honey | 37.20 ± 6.21 | 3225.00 ± 332.60 |
| Shikakai | 22.00 ± 18.00 | 1400.00 ± 200.00 |
| Sal-Saguan leaves | 49.80 ± 6.93 | 360.00 ± 124.89 |
| Fruits | 81.70 ± 11.62 | 4365.71 ± 2231.92 |

Non-timber forest products (NTFPs) are all forest product other than timber. This includes not only fruits and vegetables, honey or resin, and non-timber construction materials like bamboo, and certain grasses, but also fish and other wildlife. Non-timber Forest Products (NTFPs) play an important role in addressing poverty issues for the marginalized, forest-dependent communities, by contributing to livelihoods, including food security, income, health and sustainable human development. Various types of NTFPs were being used by locals for the improvement of their livelihood status. These included leaves, flowers, fruits, branches, gums/ resins, roots etc. Table 6 shows the quantities and income earned from different NTFP items collected by sample households. All the communities were found to be collecting most of the non-timber forest produce. The collection and sale of NTFPs provided income, food and medicine for a large number of the poor in the KWS.

Livestock grazing is a common problem in majority of protected areas in India. Overgrazing by domestic livestock changes the ecosystem function, structure and organization by reducing species richness and diversity. Excessive grazing also accelerates the growth of unpalatable weed species and adversely affects the regeneration of plant species. During the monitoring of entry points at the forest boundaries, it was recorded that majority of the livestock population grazed inside the forest in both the protected areas. Livestock herds entered the PAs through different entry points and grazed 5–8 km deep into the forest and spent about more than 8 hours for grazing. In the household survey, the villagers also accepted that their livestock grazed inside the forest although there was some restriction from the forest department. Percentage of stall-fed livestock was very low (Figure 2). Stall-fed livestock were either milk yielding buffaloes or bulls which were used in agriculture. These animals were never sent for grazing with the herds due to fear of livestock predation by Tiger and Leopard.

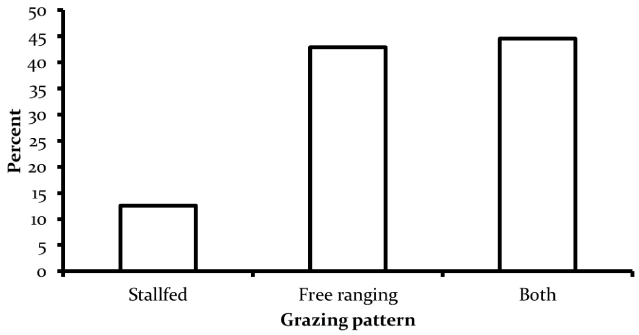


Figure 2. Livestock grazing pattern in Katarniaghat Wildlife Sanctuary

## Human-Wildlife Conflicts and People's Attitudes Towards Conservation

The long-term sustainable management of natural resources depends on local people's support. Assessing

local people's attitudes, taking into account their needs, and respecting their opinions should become a management priority (Macura et al. 2011, Mahanta and Das 2013). Various studies have shown links between attitudes of local people and conservation of nature (Heinen 1993, Newmark et al. 1993, Mehta and Kellert 1998, Walpole and Goodwin 2001, Sah and Heinen 2001, Badola et al. 2012, Mahanta and Das 2013). People were found to have negative attitudes towards conservation in their locality due to costs associated with conservation such as damage to crops and killing of human and livestock by wildlife while the bene ts from conservation such as revenue from tourism and collection of NTFPs and fuel wood have some positive effects. Majority of the PAs in India are located in densely populated agricultural landscapes and this coexistence of Protected Areas with high population densities, leads to conflicted people-park relationships (Nagendra 2008). The people living around the Protected Areas depend upon them for their livelihood in different ways. The extraction of forest products like fuel wood and fodder affects wildlife habitat and the ecosystem of the forest. Increasing demand for forest products, driven by demographic and market pressures, often leads to accelerated extraction of forest resources that in turn drives habitat degradation. There is a need for holistic conservation initiatives, to have a clear description of the region in order to understand various socio-economic factors, forest resource production, use and dependence (Sati and Song 2012, Jaiswal and Bhattacharya 2013).

Crop damage by wildlife species has been studied extensively globally. Studies on crop depredation by larger mammals are also well documented in India. Damage to various crops by different species of wild animals has been recorded in the literature. Tree and shrub mortality caused by Sambhar after a drought in Gujarat was described by Khan et al. (1994). Protected areas (PAs) in India support an array of wildlife that is prone to conflict with people. The main animals involved in crop damage at Katarniaghat Wildlife Sanctuary were Nilgai *(Boselaphus tragocamelus),* Elephant *(Elephas maximus),* Cheetal *(Axis axis),* Sambar *(Cervus unicolor),* Wild boar *(Sus scrofa),* Rhesus monkey *(Macaca mulata),* and Pea fowl *(Pavo cristatus).* Crop raiding occurred in both summer (March-June) and winter (November-February) and consequently crops were affected in both seasons. There was however, relatively more damage to summer crops due to slackness in crop watching due to heavy rains (Figure 3).

Assessing attitudes towards wildlife provides insights to the degree to which people are willing to co-exist with wildlife. Attitudes towards wildlife are seldom uniform across space because factors affecting attitudes, such as interactions with wildlife, are spatially heterogeneous (Sitati et al. 2003, Naughton-Treves and Treves 2005, Carter et al. 2013). Human losses due to wild animals were reported. While the leopard *(Panthera pardus)* was responsible for most attacks, other animals like the Tiger *(Panthera tigris),* Bear *(Melursus ursinus)* and Elephant *(Elephas maximus)* were also involved in human- wildlife conflict (Figure 5).

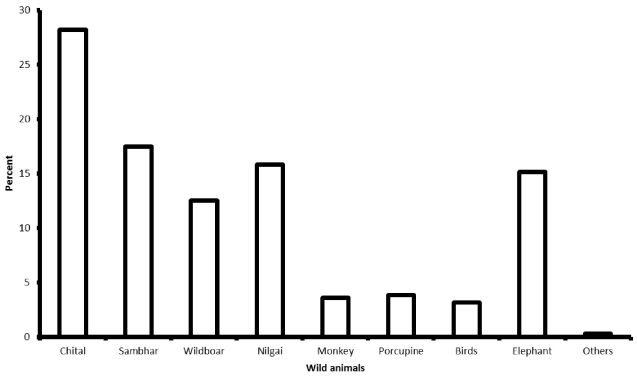


Figure 3. Major wild animals responsible for crop damage in Katarniaghat Wildlife Sanctuary

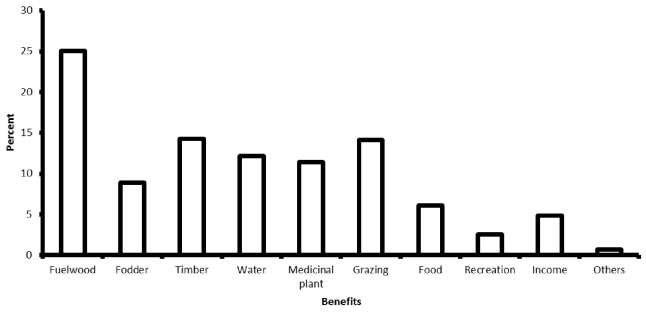


Figure 4. Benefits drawn from the forest by villagers in Katarniaghat Wildlife Sanctuary

Injuries to human beings from wild animals are common to adjoining villages of the protected areas. Residents most often directly bear the costs of living alongside wildlife and may have limited ability to cope with losses (Karanth and Nepal 2012). As growing human populations invade ever further into wildlife habitats, people and wildlife are increasingly competing over living space and food. The resulting conflict not only threatens wildlife population in protected areas, but poses a major problem for communities living in and around wildlife habitat.

Forests provide a wide range of economic and

social benefits to the people. These include contributions to the overall economy through employment, processing, trade of forest products, energy and investments in the forest sector (Figure 5). They also include the protection of landscapes of high cultural, spiritual and recreational value. Maintaining and enhancing these functions is an integral part of sustainable forest management.

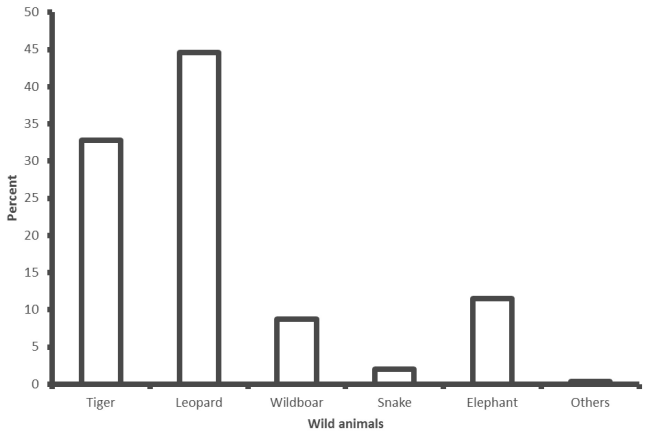


Figure 5. Major wild animals responsible for threats to humans in Katarniaghat Wildlife Sanctuary

Information on the status of and trends in socio-economic benefits is thus essential in evaluating progress towards sustainable forest management, together with the more usual statistics on the predominantly environmental values considered under other themes. Economic benefits are usually measured in monetary terms and may include: income from employment in the sector; the value of the production of goods and services from forests; and the contribution of the sector to the national economy, energy supplies and international trade (FAO, 2010).

People living in these forest periphery villages accepted that they depend upon forest for a variety of goods and services. These include collection of edible fruits, flowers, tubers, roots, leaves for food and medicinal plants; fuel wood for cooking (also sale in the market); materials for agricultural equipment, house construction and fencing; fodder (grass and leave) for livestock and grazing of livestock in forest and collection of a range of profit-making non-timber forest products. Fuel wood was considered as a major resource by 25 % households at KWS. In the absence of alternative energy sources, households were heavily dependent on fuel wood to meet their basic energy needs. Villagers were trying to meet fuel wood demand from all available sources like agriculture field, forests, pasture land, roadside plantations and open fallow land etc. but the major source of fuel wood were forests of both PAs. Dependence on fuel wood from the forests poses a serious problem in the protected area and may cause further deforestation in the areas near the villages. There is an urgent need to create awareness among the villagers who should be encouraged to use biogas, smokeless stoves and LPG to reduce pressure on the forests.

Due to restriction on fuel wood collection from the forest, villagers seemed hesitant to disclose that they collected fuel wood from the forest. The other major benefits drawn from the forest were timber (14 %), medicinal plants (11 %) and cattle grazing (14 %) inside the forest (Figure 4).

The Forest Rights Act (FRA) was enacted in the year 2006 and its implementation started in the year 2008. This act recognizes a range of individual and community rights on forest resources, including ownership of forest land. The act provides "right of ownership, access to collect, use, and dispose of minor forest produce, which has been traditionally collected from the forest. The tribal population of both the protected areas were not getting befits under FRA although the act aims at restoring traditional rights of forest dwellers and maintaining ecological equilibrium to the forest areas. The act also talks about the preservation of sustainable livelihoods of the tribes and other traditional forest dwellers. This new Act can provide people with secure land tenure and legal access to the forest. Benefits gained from the rights given by the Forest Rights Act may thus overcome the costs of living close to reserved forests and positively influence people's attitudes (Carter et al. 2013).

Most of the respondents (88%) expressed a positive attitude toward the forests. Although when asked about animal protection their attitude was relatively lower (58.54 %) due to prevailing human-wildlife conflict in the PA (Table 7). The villagers were willing to participate in wildlife conservation (68.6 %) if initiated by the government. Many Non-governmental organizations (NGOs) such as WWF-India, Katarniaghat Foundation and Katarniaghat Welfare Society were working closely with the villagers who had benefited from these organizations. There was however, negative attitude (54.7%) towards forest department. The attitudes towards the protected area staff and the perceptions of management practices affect people's attitudes. In the study area the negative attitude towards protected areas may be due to conflicts with managers, strict rules on the

Table 7. Attitudes toward conservation in Katarniaghat Wildlife Sanctuary.

| Questions | Response in % | | |
|---|---|---|---|
| | Yes | No | Don't know |
| Do you think forest should be protected? | 88.62 | 8.94 | 2.44 |
| Do you think animal should be protected? | 58.54 | 37.94 | 3.52 |
| Would you like to participate in wildlife conservation programs? | 68.56 | 24.12 | 7.32 |
| Do the forest staffs interact with the villagers? | 33.60 | 54.74 | 11.65 |

use of and access to forest resources, rude behavior, or harassment by park rangers (Macura et al. 2011).

The disadvantaged groups particularly tribes, landless, marginal farmers, women and children are among the first ones to be affected by degradation and loss of forests. They are also people to bear disproportionately large burden of externally-defined conservation measures. Forests have traditionally been the habitats of tribal communities with a variety of lifestyles ranging from nomads, hunters, wild food gatherers to agrarians. The traditional lifestyles of tribes and their recorded rights have been respected and embedded in forest management practices as well as in subsequent policies. A law was enacted in 2006 recognizing the rights of occupation of forests by tribes and forest dwellers and empowering them to manage the forests (used by them) as common property resources. Hence, it has been argued that the social, physical and economic well-being of protected area dependent people should be realized within a holistic conservation effort.

## MANAGEMENT IMPLICATIONS

Forests are a major natural resource and play a vital role in maintaining the ecological and environmental balance. Over utilization of forest resources has resulted in their depletion. The changes in tropical forest cover are a matter of global concern due to its role in carbon cycle. This renewable resource continues to decrease at accelerated rate (Roy et. al., 2002). Long-term survival of wildlife and their habitat depend upon the support of local people sharing natural resources. Therefore, it is important to involve the local population in the management of forests as their traditional knowledge can be used for effective management of natural resources. Involvement of rural communities living close to forests in protection and management of natural resources is enshrined in the National Forest Policy 1988.

Understanding of past and present human usage, its current or future impact, and the means by which sustainable usage can be achieved is required for management of the protected areas. It also has important to place the site within the community context and respond to any potentially threatening development that may take place in the surrounding area. So the understanding of the dependency of villagers on the protected areas is critical in the development of management strategies. Reducing the human pressure on protected areas and conserving valuable genetic resources has been and still is a fundamental policy concern in many countries. In the face of rapidly growing human populations in and around the bio-diverse regions of the tropical forests, sustainable use of forest products, both timber and non-timber forests products is not easy (Lepetu et al. 2010).

Various management issues were identified in this study for the KWS that need to be addressed by the government and the policy makers.

### (1) Human-Wildlife Conflict

Human-wildlife conflict is, one of the most important issues, in the overall conflict between "people and parks" or between human interests and conservation in general. The PA was severely affected by human killing/injury, crop raiding and livestock depredation. To reduce public anger, compensation paid for any damage should be given immediately without delay. Human-wildlife conflicts are currently recognized as a serious impediment to the implementation of international biodiversity conventions, species recovery plans and the management of protected areas. These types of conflicts are the most important aspect in biodiversity conservation (Thomassen et al. 2011). Information about which crops are most frequently consumed and which are ignored has enormous potential for aiding on-the-ground stakeholders (i.e. farmers, wildlife managers, and conser-

vation and agricultural extension practitioners) and developing sustainable wildlife management schemes for ecologically specialized and protected species in anthropogenic habitats (Hockings and McLennan 2012).

**(2) Fuel wood Dependency**

We observed that forest resources in the KWS were important for the day to day sustenance of local households. Majority of sampled households reported collecting fuelwood from the forest area for domestic consumption and/or income generation. To reduce fuel wood dependency, technological initiatives including the fuel-efficient improved chulhas, solar energy and use of biogas should be promoted in the study areas. The Government of India has been running Integrated Rural Energy Programmes (IREP) since 1987. These programs should be more emphasized in such protected areas.

**(3) Forest Fire**

Human carelessness is one of the sources of forest fires in most forests. Another important factor is setting of intentional fires by livestock owners in the belief that this would help bring a flush of grass. The occurrence, intensity and nature of forest fires are scientifically less understood, and the studies are scanty. Timely information on the location can help in preventing, planning and management of forests against fire. Local communities play a significant role in preventing and suppressing fires because they have clear understanding of local condition and circumstances important for successful fire management (Kunwar and Khaling 2006).

**(4) Connectivity Between Adjoining Forests**

Some species, especially large animals like tigers, leopards and elephants, need large areas of natural habitat. There is a lack of connectivity between Katarniaghat Wildlife Sanctuary, Dudhwa National Park and Royal Bardia National Park in Nepal to facilitate the movement of animals. To address this, corridors must be developed between these protected areas to allow species to move from one protected habitat to another. The linking of protected areas to form networks or systems is very important for the survival of many species .

**(5) International Border**

KWS shares a porous international border with Nepal. Over hundred vehicles use the 40-km stretch of the Mihipurwa-Bichia road in the sanctuary every day. In addition, about 13 passenger trains run every day through the dense forest of the sanctuary. The railway lines were laid before independence to transport timber. The trains and buses are used by the people living in the villages adjoining the forest and those from Nepal who come to India through the border post.This route is also used for illegal activities such as wildlife trade, arms and drugs smuggling across the border. People from Nepal enter the forest to smuggle fuelwood and timber. Forest official are unable to take action as they cross the border after committing the crimes. There is urgent need for good coordination at Range level and joint patrolling by forest staff of the two countries along the international border.

**(6) Grazing**

India supports 18% of world's cattle population in 2.5% of geographic land cover. Indian forests suffer from pressure of cattle grazing inside protected areas (Mandal 2003). Grazing by livestock has been an important issue for the management of the national parks and protected areas. It has been observed that heavy grazing has negative impact on the ecological stability of the grazing area, albeit at varying levels.The livestock is a part of rural livelihood, and it forms a part of the fabric that links other elements of socio-economic structure of individual households and communities (Wangchuk 2002). The forests of KWS are also intensively grazed by the livestock. It has been well documented that while grazing has a detrimental effect on communities with little history of grazing, some level of grazing is necessary to maintain communities with a long history of grazing (Naveh and Whittaker 1980, Andren et al. 1997, Mehra and Mathur 2001, Dave and Jhala 2011). The complete removal of cattle may not be a viable option as it will adversely affect the livelihood of these forest communities. A more pragmatic approach of rotational grazing would be fruitful for preservation of protected forest areas in countries like India (Das 2008).

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