

Community Attitude and Religious Bonding in Human-Wildlife Conflict Mitigation: A Case Study of Kilpura-Khatima-Surai Corridor, Terai Arc Landscape, India

Abstract

Religious and cultural beliefs among the communities residing on the edge of forests areas are important in developing human-wildlife conflict mitigation measures and conservation of various endangered species. Kilpura-Khatima-Surai wildlife corridor is an important linkage between national and trans-boundary wildlife habitats. The present study was conducted to understand the people attitude toward wildlife conservation through structured questionnaire survey of households in Terai Arc Landscape. Our finding reveals that though the wildlife corridor has been severely altered due to various anthropogenic activities, however, the mythological understanding of the inhabiting community has a major role in driving the attitude toward wildlife conservation. These profound beliefs constitute flexible behaviour towards a particular wild animal even if they are facing conflicts with them. Such understanding would be important to implement community based conservation and management inputs, as well as in achieving the desired conservation goals.

Keywords: *Community Based Conservation, Devipura-Majhgaon, Terai Arc Landscape, Wildlife Corridor*

1. INTRODUCTION

1.1 Human wildlife conflict

Human-Wildlife Conflict (HWC) is a critical threat to the long term survival of various endangered species of wild fauna. It has also been one of the major threats to the survival of local human population and their livelihood in the vicinity of wildlife habitat [1]. HWC issues are illustrated as ever increasing global problem [2-4] and not restricted to particular bio-geographical and climatic regions. Moreover, the issue is similar in all areas with the co-existence of human and wildlife for sharing of habitat resources [5]. As a consequence the surviving wild population of various endangered as well as other wild species has dramatically declined during the last few decades [6-9]. Major reasons behind declining wild population of various key species and increasing conflicts are recognized globally [10-11]. Among these reasons, degradation, fragmentation and reduction of natural habitat [7, 12-13] increasing encroachment, over exploitation of resources and changing agricultural practices are important [13-15].

The conversion of forest land for settlement and agricultural purposes is characterized by huge population pressure and poverty in wildlife habitats [16]. Human dependency on forest resources for

36 food, fodder, fuel wood, grazing by livestock and ever increasing demand of shelter and crop
37 production has shrunken and degraded natural habitat [10, 17]. The HWC situations consist of many
38 parallel causes and effects [10] as well as trends and challenges [11, 18-20] and a variety of
39 inferences can be made from these situations. A number of mitigation measures are in practice to
40 mitigate the impacts of HWC [11, 21] however, permanent solutions are still lacking.

41 **1.2 Wildlife corridors**

42 Wildlife corridors are important for movement of wildlife species from one habitat to another. These
43 are crucial part of habitat of mega-fauna such as long ranging elephants and dispersing tigers, and
44 their functionality defines the quality of a particular ecosystem [22-24]. Corridor provides cover to the
45 animals during movement from one place to another and helps wildlife species in extending their
46 habitat range. Corridors build resilience to some of the adverse effects of habitat fragmentation, as
47 these facilitate dispersal species between substantive habitat patches, allowing constant gene flow
48 [25-26]. However, many of these important habitat linkages have shrunk over the years and their
49 functionality has diminished [24-26]. Conserving such landscape linkages in order to restore the
50 habitat functionality, always helpful in conserving the core habitats [22, 27-29]. These conservation
51 efforts are vital in minimizing the isolation effects [28] and maintaining population, demography,
52 survival and birth of a particular species.

53 **1.3 Religious belief and conservation**

54 Indigenous communities hold a direct relationship with nature and natural resources due to
55 inheritance of their religious and cultural values. Many wildlife species such as elephant, tiger, bear,
56 monkey and langur are considered as sacred or spiritual identity and are worshiped [30] in some
57 religions. Such beliefs usually encourage people in neglecting a species as nuisance animal and
58 illustrate a degree of empathy [31-32] toward these animals. These mythological driven values, play a
59 significant role in developing management strategies for the conservation of species and their habitat.
60 Moreover, these conservation values are also crucial to supporting appropriate HWC mitigation
61 strategies [30, 33-34] and the success of any conservation inputs undertaken by management
62 agencies [21, 35]. Generally, such values build community's tolerance up to an extent with respect to
63 particular HWC incident, which ensure willingness to support conservation inputs [10, 20]. However,
64 willingness to support conservation depends on how religious understanding is put into the practices.

65 **1.4 Terai Arc Landscape and conservation challenges**

66 Terai Arc Landscape (TAL) is spread over three state of India namely Uttarakhand, Uttar Pradesh and
67 Bihar which provides suitable habitat to a number of wildlife species of mammals, birds, reptiles and
68 other fauna [36]. These habitats include Protected Areas (PAs) and other reserve forest divisions,
69 connected through important wildlife corridors throughout the landscape [37]. In recent years
70 increasing forest encroachment has threatened these wildlife habitats including wildlife corridors and
71 paced the rate habitat fragmentation with alteration of ecological services [38]. Increasing human

interference in TAL has affected the resource availability for wildlife and impels them to approach human habitation and agricultural land [24, 29, 39]. As a consequence of increasing human-wildlife interaction huge economic loss has been observed among the local communities in the region [29]. Human-wildlife conflict has been one of the major conservation issues throughout the landscape and conflict with elephant, leopard and tiger are widely reported [40].

The landscape has recently witnessed recovery in tiger population [41] but increase in loss of wildlife corridors functionality also observed as a result of anthropogenic activities [36]. In this scenario Human-wildlife conflict are supposed to increase in the landscape. In the present study information were gathered on wildlife movement, HWC issues in an encroached human settlement of Kilpura-Khatima-Surai (KKS) corridor and attempts were made to understand community response to conservation of wildlife species with an objective to understand the challenges in corridor restoration.

2. METHODS AND MATERIALS

2.1 Study Area

KKS corridor is critical in terms of wildlife movement between Nandhaur Wildlife Sanctuary of Uttarakhand and Pilibhit Tiger Reserve of Uttar Pradesh state (figure 1). This corridor is also important for the trans-boundary wildlife movement of wildlife between India and Nepal [36]. A number of faunal species including tiger *Panthera tigris*, leopard *Panthera pardus*, elephant *Elephas maximus*, jungle cat *Felis chaus*, sloth bear *Melursus ursinus*, wild boar *Sus sacrofa*, nilgai *Boselaphus tragocamelus*, chital *Axis axis*, civets *Paradoxurus spp.*, etc, are important wildlife species using the corridor [42].

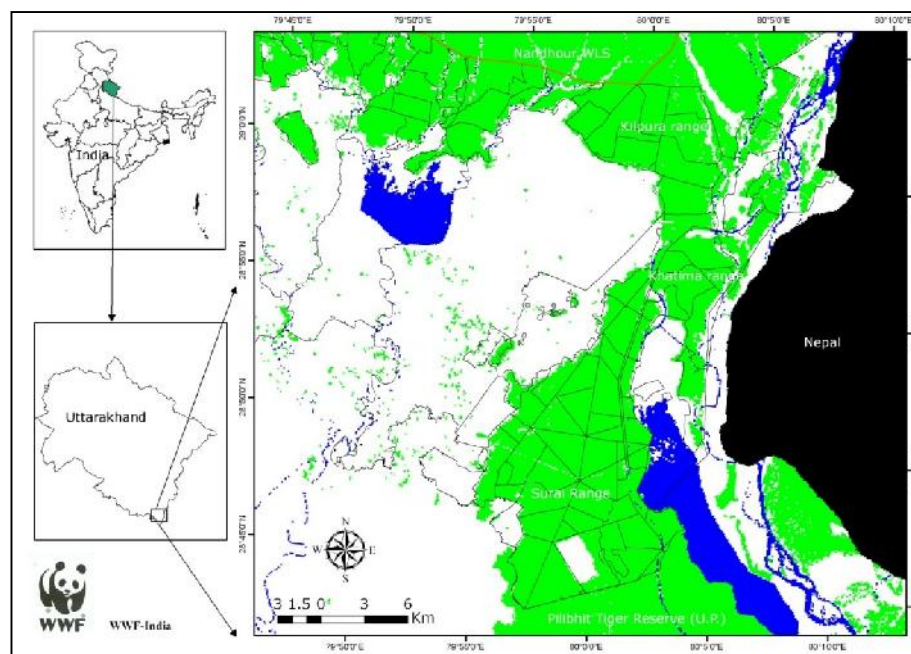


Figure 1: Map depicting the connectivity of KKS corridor with Pilibhit Tiger Reserve and Nepal

In KKS corridor, Devipura village panchayat is an important habitation having more than 350 households. In this village panchayat two villages namely Devipura, which is on the revenue land and Devipura-Majhgaon on encroached land [43] are situated. It is situated between $28^{\circ}55'52.77''\text{N}$ and $80^{\circ}03'06.51''\text{E}$ with an elevation range 220-250m asl under the Khatima range of Terai-East Forest Division, in the Uttarakhand state of India (figure 2). East to West, this encroached settlement lies between Jagbura River and Sonia Nullah. Sharda canal restricts its boundary in the North while Southern boundary is covered by Sal *Shorea robusta* mixed forest and Teak *Tectona grandis* plantations. The KKS corridor is severely altered and destroyed by anthropogenic disturbances such as encroachment, linear infrastructure development, human settlement and agriculture expansion and deforestation.

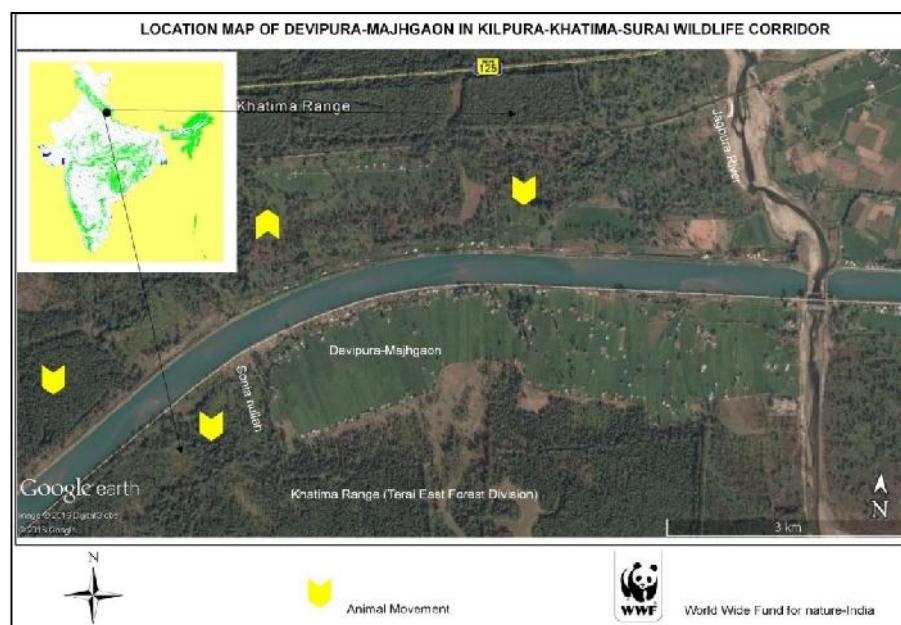


Figure 2: Map depicting location of Devipura-Majhgaon village and other linear infrastructure

2.2 Methodology

To understand the land holding pattern and human wildlife conflict within the encroached habitation of Devipura-Majgaon, a Focused Group Discussion (FGD) was conducted and information was collected on land holding and issues of HWC. The FGD was followed by a semi-structured questionnaire survey in April-May, 2016, to understand the average landholding of households, crops grown and productivity, extent damage to crops in each season, loss of property, livestock depredation, and human injury or mortality among the households. The information was also collected on community's responses to particular wild animal as well as strategies to mitigate the HWC. A total of 105 key informants or respondents, among all households residing along with the periphery (except the households along with the canal side) were considered for the questionnaire survey. However, the

selected respondents were mostly the head of family or person of older age, having some understanding on wildlife movement in the region.

3. RESULTS

3.1 History of encroachment and characteristics of respondents

A total of 105 household were interviewed and considered for the study in Devipura-Majhgaon village. Among the interviewed households, 11% were residing for last ten years while more than 65% household were residing for 10-20 years and 18% for last 20-30 years. Only 6% of households were residing in the village for more than 30 years (figure 3). The household residing history reflected that the expansion of settlement and encroachment has been paced during last twenty years in the area.

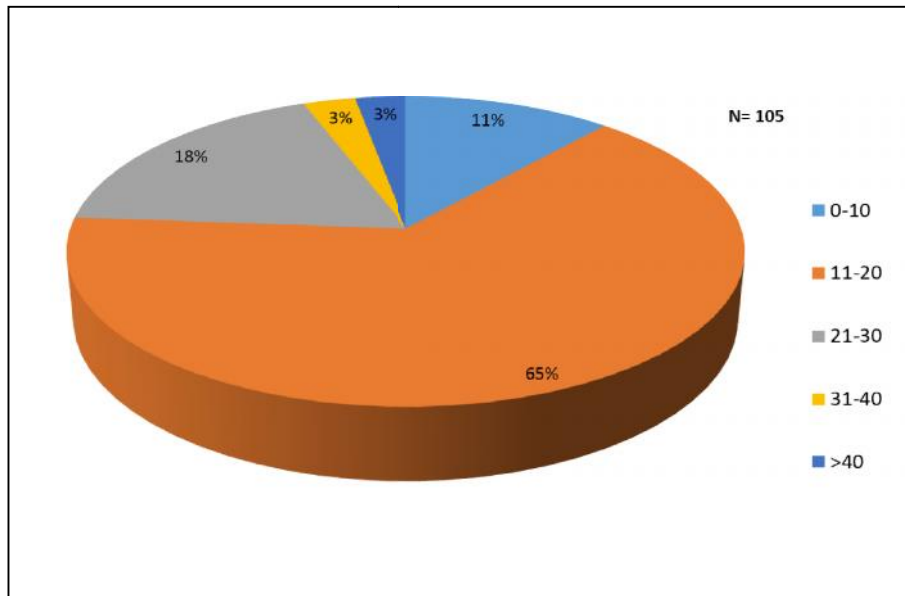
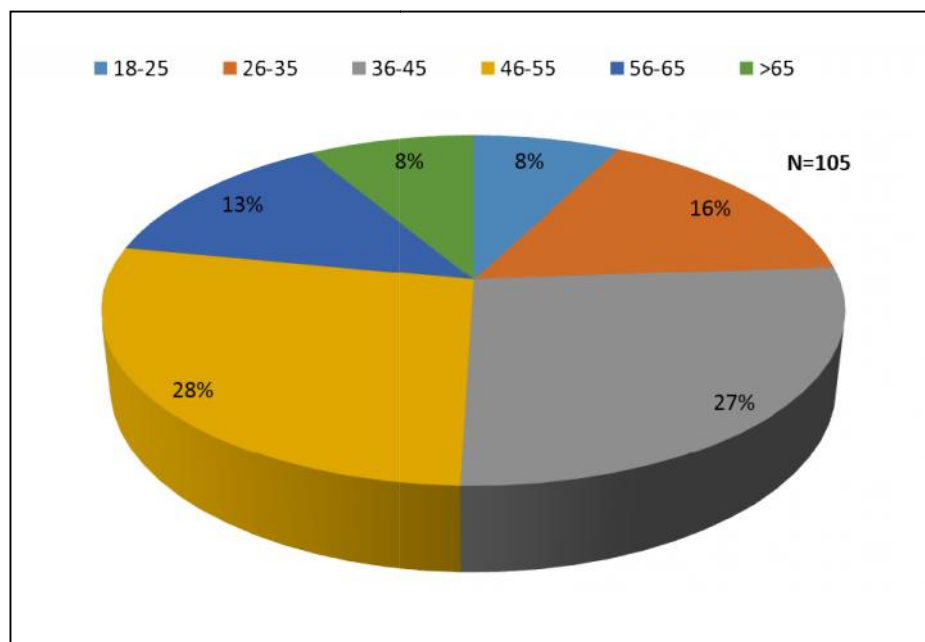


Figure 3: Categorical representation of households based on year of encroachment on the forest land

Among the surveyed respondents (N=105), 13% were between 18-25 age groups, 16% were between 26-35, 27% were between 36-45, 28% between 46-55 and 8% respondents between 56-65 years while 8% of more than 65 years of age category (figure 4). The survey considered more than 70% respondents of more than 35 years age to understand the wildlife movement within last 25-30 year in the area. However, respondents below 35 years were also important as the settlement is newly established.

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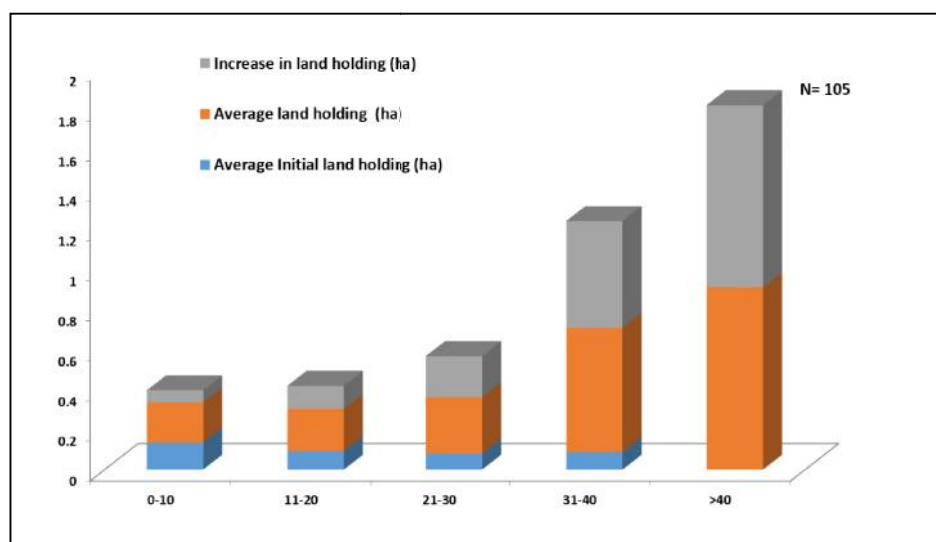
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138 *Figure 4: Percentage of age category of respondents*

139 3.1.1 Land Holding pattern

140 The residing history of the households in the village also reflects from the landholding pattern of each
 141 category and increase in average landholding (figure 5). The average landholding pattern varies as
 142 per the household residing history. Households residing for last 0-10 years have increased their
 143 average landholding about 30.87%, while 55.24% increase has been observed among the household
 144 residing since 11-20 years. Increase in landholding has also been observed among the households
 145 residing over last 21-30 years (71.6%), 31-40 years (85.74%) and 100% with more than 40 years.



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Figure 5: Increase in landholding over the years among the households

The households residing within last 20 years have purchased some part (average 0.116 ha/household) of their present landholding from other households residing for more than 20 years and which has been increased more than 43% to an average of 0.204 ha/household. The increase in average land holding shows an increasing trend with household residing history and has been led by increase in encroachment in Devipura-Majhgaon (figure 6).

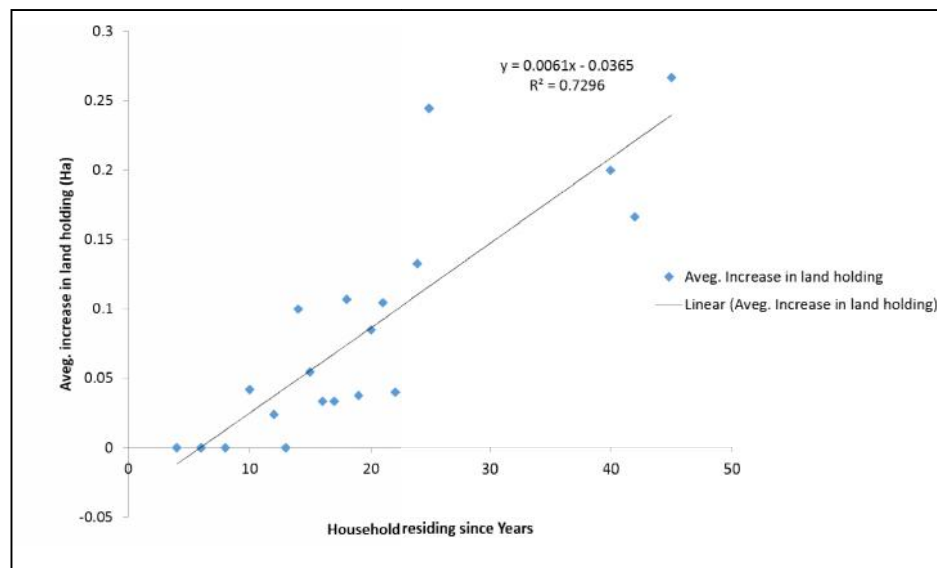


Figure 6: Trends of increase in average land holding through encroachment

3.2 Livelihood and resource utilization pattern

The households in the village are agriculture dominant and grow major crops of grains (wheat *Triticum spp.* and rice *Oryza spp.*) and pulses. They also grows seasonal vegetables like brinjal *Solanum melongena*, tomato *Solanum lycopersicum*, beans *Phaseolus vulgaris*, butter guard *Momordica charantia*, ladyfinger *Abelmoschus esculentus*, onion *Allium cepa*, garlic *Allium sativum*, piper *Pipper spp.*, and capsicum *Capsicum spp.*, for substantial use. However, some families sell their excessive production within the village or nearby local market. All of the interviewed households were involved in agricultural and animal husbandry practices, while 92.38% households among them are involved in grazing on forest land. Only 7.62% practiced stall feeding to their cattle and livestock while rests of the 93.33% were involved in fodder collection from forest (figure 7). Fodder collection is largely practiced by women members of household by covering a distance of 4-5 km in the nearby forests of Khatima range of Terai East FD. Fodder crops like Barseem *Trifolium alexandrinum*, Sorghum *Sorghum bicolor*, Maize *Zea Mays*, are also grown in agriculture field mostly by the households practicing stall feeding.

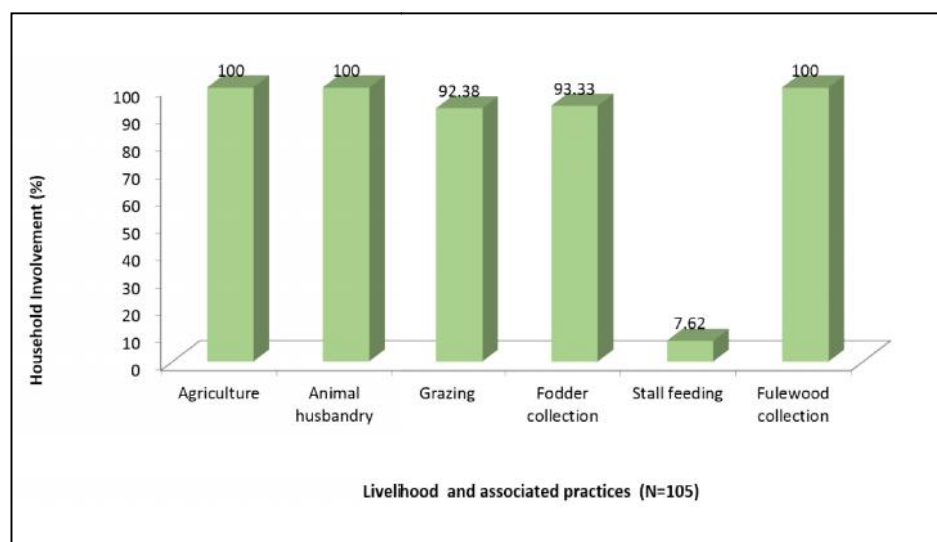


Figure 7: Households involved in livelihood related practices

All households are involved in fuelwood collection (7-8days/month) from nearby forest for cooking purposes, by covering a distance of 3-5 km in to the forest. The woods are stored for cooking in monsoon and winter as well as space heating in winter. Communities residing in the area also used wooden logs and branches for making barrier to protect their crops from wild animals.

3.3 Wildlife movement related information

Most of the respondents provided information on movement or occurrence of wildlife species in the area. Species like elephant), tiger, leopard, nilgai wild pig, chital, monkey *Macaca mulatta*, porcupine *Hystrix indica*, hare *Lepus spp*, and jackal *Canis aureus* are reported to be sighted within the forest and nearby the village. The crocodile *Crocodylus palustris* were reported to be sighted from last 2-3 years in Sharda canal. A total of 17.37% of respondents informed that wildlife species such as elephant, tiger and leopard use Jagbura river for their East-West movement toward forest up to Sharda river and vice-versa. Out of these respondent, only 5.71% (6 individuals) indicated elephant movement through the area up to Nepal, as news of crop raiding by elephants in Chandani, Kanchanpur and Mahender Nagar of Nepal are common immediate after crop raiding in and around of their village. The movement of elephant has also been recorded through camera traps deployed for monitoring of KKS corridor (figure 8).



Figure 8: Elephant movement record through camera traps in KKS corridor

3.4 Human-wildlife conflict and mitigation measures

The local communities often encountered animals in the areas where human co-share resources within wildlife habitat. In Devipura-Majhgaon, respondents have also accepted that during resource exploitation from forest area interaction with wildlife is common but human injury and mortality has not been occurred since last five years. However, people faced livestock depredation, crop raiding incidences and partial damage to property because of wildlife movement. It is estimated that within last five years a total of 74 livestock depredation incidents by leopard and tiger, including cattle (20%), buffalo (17%), goat 45%) and dog (18%) have occurred in the village (figure9).

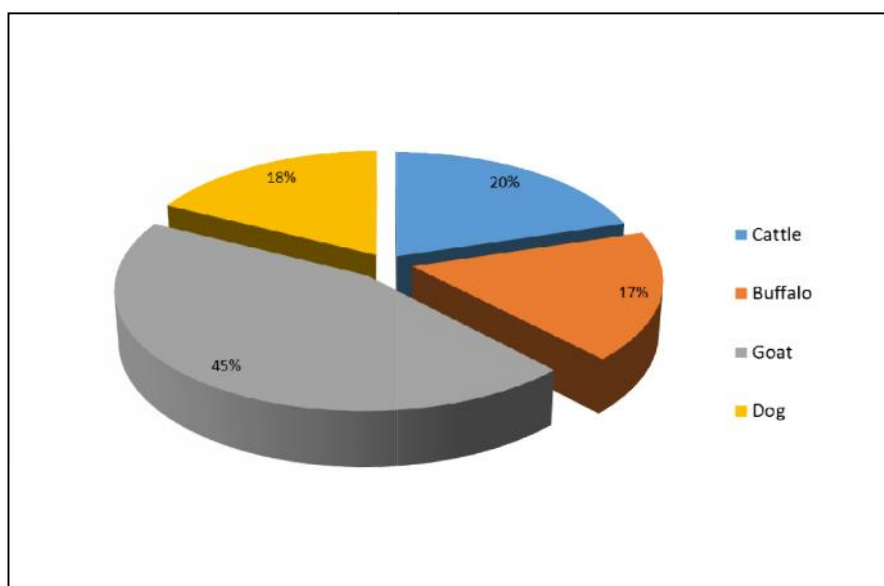


Figure 9: Livestock depredation in Devipura-majhgaon

Out of these livestock depredation incidents, 48.65% incidents occurred within the forest (mostly cattle, buffalo and goats), while 51.35% cases (mostly killing of dogs) occurred within the human habitation. The respondents indicated that tiger and leopard were among the carnivores involved in livestock depredation in the village, however most of the time the predator could not be ascertained.

In terms of crop raiding incidents, species like elephant, nilgai and wild pig are among the major crop raiders. A total of 98% surveyed households among the total 105 households, residing or having landholding along with the periphery (from where crop raiders enter in the village) were affected with crop raiding events in the village and faced huge economic loss. Elephants usually raided crops 8-10 times during each cropping season while nilgai and wild pigs are common crop raider with a herd size of 5-6 individuals (figure 10). On an average approximately 23.5% (0.06 ha/household) of total cropping land (0.25ha/household) is damaged in a single season, however, the extent of damage vary with number of raiding incidents and time. It has a direct impact on reduction in crop production of two major crop wheat (1.424Qntl/household) and rice (1.753Qntl/household) each year.



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220 *Figure 10: Crop raiding by elephant in Devipura-Majhgaon*

221 The people in the Devipura-Majhgaon used various HWC mitigation measures among which making
222 noise, using burning *Masals* (a wooden log covered with cloth and dipped in Kerosene and burn when
223 wild animal enter in the village), beating drums and chasing the wild animals using dogs and making
224 groups are prevalent to scare away the animal. In case of crop raiding by elephant herds, prayers are
225 performed with blowing *Sankh* (Conch shell used in Hindu rituals) by farmers and request are made to
226 leave their crop field after taking his share.

227 **3.5 Perception on wildlife conflict and conservation attitude**

228 Community holds different attitude in terms of conservation of a particular species and generally like
229 the nuisance species outside their crop field and village, until the damage takes place. Most of the
230 respondent (88.57%) favored conservation of all species, however, aggressiveness has been
231 observed towards tiger, leopard, nilgai and wild pig due to more incidences of conflicts in their villages
232 and crop fields. The reason of aggressiveness was described as that of the presence of these
233 animals in the surrounding having a risk of life threats to people. Other animals are generally
234 neglected, as damage caused by them is very little. The community respect elephant even it damage
235 a large fraction of their crop during both *Rabi* and *Kharif* cropping season. The respect toward the
236 animal is much interesting among the households in the village that people used the word “Ganesh Ji”
237 (Lord Ganesha of Hindu mythology), instead of elephant, in response to each question regarding to it.
238 Moreover, the community believes that elephant only takes his share from the crop which they should
239 dedicate to the god. Such belief driven attitude toward conservation of this endangered species and
240 therefore securing its corridor is important and also for developing conservation strategies.

241 The perceptions were recorded to rank the particular wild animal as per extent of damage caused by
242 these animals. Elephant, nilgai and wild pig are major crop raiders in the village, however, elephant
243 was described the most damaging animal by 50.47% of respondents while nilgai as second most

harming animal by 49.52% of respondents. Wild pig, chital, monkey, porcupine, mongoose and hare were among the other crop raiders in the village but caused very less damage in comparison to elephant and nilgai.

4. DISCUSSION

Human-wildlife conflict is a growing issue among the communities residing adjoining to protected and other wildlife habitat [44]. Restoring landscape connectivity is vital for conservation of several large carnivores [45] including herbivores. Maintaining corridor functionality is among the major conservation challenges in Terai Arc Landscape [43]. The KKS corridor has been recognized one of the important linkage or wildlife movement route between national as well as international protected areas network [37, 40, 43, 46] in TAL. However, increasing encroachment and infrastructure development in newly settled villages, have deteriorated this corridor over past few decades [36-37, 40, 43]. The present study also revealed that the encroachment is continued in the area and resource extraction for livelihood deteriorating the habitat quality. HWC incidents like crop raiding by herbivores, livestock kills by large carnivores and news of crop raiding in the villages of Nepal indicate the presence and functionality of the corridor. Despite, the human-wildlife conflict issues are prevalent in the area, however, community response was found towards conservation oriented. These responses are observed to influence with religious belief to species like elephant (despite causing most of the crop raiding incidents) and empathy towards other animals.

Scientific community has recommended restoration of KKS corridor, as it will enable wildlife movement within their historical range using adjoining associated forested habitats [40, 42, 44]. In order to achieve the restoration goal, community attitude toward conservation of key species and their habitat is important [48-49]. In the present case mythological belief based attitude could play crucial role in restoration KKS corridor in TAL. However, providing alternative livelihood options to the communities residing in the vicinity of the corridor is important to reduce pressure on corridor resources. It will enable corridor functionality for healthy movement of large mammalian species and connectivity with adjoining PAs would be important to gene flow and also mitigating human wildlife conflict. However, in order to restore, maintain and sustain the functionality of corridors, appropriate policy intervention and to consider them as protected areas or provide them status of protected area is the need of the time. This would be significant to wildlife conservation and mitigating conflicts in adjoining human habitations and overall ecological functionality.

5. MANAGEMENT IMPLICATION IN KKS CORRIDOR

The encroachment has been a severe problem to ensure the functionality of corridor in KKS area and its increasing trends are depriving conservation inputs. Devipura-Majhgaon has been identified for restoration and to make it functional for wildlife movement. As HWC issues are prevalent in the area and communities faced severe economic loss which is sometime compensated by forest department. To mitigate the HWC issues as a result of wildlife movement through the area and preventing encroachment integrated measures like restoration of corridor through involving local community and

providing livelihood alternatives to them are necessary. WWF-India has identified solar power fencing as an effective measure to mitigate the HWC impacts and demarcation of boundary to limit further encroachment on forest land with involving community for its maintenance and management. Alternative livelihood opportunities such as alternate energy option, promoting fodder cultivation and stall feeding are also planned to be implemented in adjoining habitations of the corridor. Such management and conservation inputs would be crucial for long term conservation support and outcome.

6. CONCLUSION

It is important to monitor human habitations on a critical wildlife corridor to minimize its further expansion and degradation of core habitat. KKS corridor is vital for the movement of endangered species between Protected Areas (PAs) network of India as well trans-boundary protected area in Nepal. Over the time various barriers including ever increasing settlements, linear infrastructure development, degradation of water bodies and deforestation have resulted into increase in conflicts with human. Increasing HWC issues within the corridor are important in terms of both species and human survival. Understanding the trends in HWC issues and implementing appropriate mitigation measure are important to sustain the functionality of the corridor. Corridors restoration measures are crucial for genetic flow maintenance of a species between habitats and reduction in risks as a result of habitat fragmentation. In order to develop of management and conservation strategies, local community perceptions are important to be considered for desired conservation outcome. Moreover, promoting religious and cultural values among the local people, linking these with species conservation plan and benefit sharing are keys to achieve desired conservation goal.

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