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Human wildlife conflict: nature and extent in Katerniaghat wildlife sanctuary, India

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Abstract
The objective of the study was to assess human wildlife conflict in Katerniaghat Wildlife Sanctuary. The sanctuary encompasses an area of 400 sq.km. Situated in Bahraich district of Uttar Pradesh. There are hundred and one villages present at the periphery and six in core area of sanctuary. Primary data was collected from 302 households randomly selected from 28 villages accounting 10% sampling on the basis of highest human and livestock population. Secondary data was collected from forest and revenue department. Human casualty (48.6%) is the most frequent conflict and is primarily of the injuring (76%) instead of killing by the top predators inside the sanctuary. Livestock depredation is on buffalo and goat (33%) in and around the sanctuary. The secondary data showed yearly decline in livestock depredation by the predators inside the sanctuary. Crop raiding is mostly on sugarcane and wheat by the wild herbivores. Nilgai is the primary crop raider damaging the agricultural field around the sanctuary. Cropfield protection is mostly done by planting vegetation and application of fire crackers as a repellent strategy for wild herbivores raiders from damaging the farm. Distance from the sanctuary plays a linear relationship with the crop raiding damage and incidents of livestock depredation. The present study concludes that illegal human activities like forest resource collection and livestock grazing escalate conflict issues inside the sanctuary. Therefore; check on illegal human activities, trenching at the sanctuary boundary, increase in compensation grant, local people participation in wildlife conservation and protected area management is needed.

Keywords: katerniaghat, human habitation, human death, livestock depredation, crop raiding

Introduction

India is rich in variety and variability of the living organism i.e. biological diversity. These are important resources for the human for sustenance and livelihood activities of villagers (Chandra et al. 2008) [5]. A tremendous increase in human population had caused negative impacts on biodiversity in the form of forest fragmentation, habitat degradation, species extinction and invasion of exotic species. Moreover, human wildlife conflict is another serious consequence of human interference in the premises of wildlife habitat. Human wildlife conflict can be defined as, "interaction between humans and wildlife where negative consequences, whether perceived or real, exists for one or both the parties when actions of one has an adverse impact on the other party (Concover, 2001; Decker *et al.* 2002) [9] and spatially common at the peripheries or in buffer zone of protected areas (Gillingham and Lee, 2000; Thapa, 2014) [29]. Human wildlife conflict is a serious conservation issue by which protected area managers, wildlife experts are dealing globally.

Human wildlife conflicts include human death, wildlife poaching, crop-raiding and livestock depredation (Monney *et al.* 2010; Jadhav and Barua, 2012; Karanth *et al.* 2012; Banarjee *et al.* 2013) [22, 12, 14, 16,] Crops and livestock loss, being an economic asset, may affect villager's perception towards wildlife and protected area (Blackburn *et al.* 2016) [3]. Villagers settled around the protected areas are depends upon agriculture, cash crops and forest resources for food security, survival and livelihood activities (Dakwa *et al.* 2016) [8]. The agricultural crops because of their nutritious value are attracted by wild herbivores resulting in raiding adding severe wreckage to the agricultural field. Illegal forest resource extraction creates adverse impact on vegetation community of the protected area escalating wildlife conflict issue. These events hamper the activities related to protected area management and biodiversity conservation because of the negligible or no harmony with the local people and protected area managers. In India, majority of the protected area are experiencing human-wildlife conflict (Madhusudhan, 2003).

Various literature available depicts the cost of loss due to conflict (Mishra, 1997; Madhusudhan, 2003; Lyngdoh *et al.* 2014) [21, 18] suggestive measures (Parker and Osborn, 2006; Monney et al., 2010; Rahayani *et al.* 2014) [25, 22, 27] spatial and temporal variation (Gillingham and Lee, 2000; Onisiomo and Adjorlolo, 2008; Karanth, 2012; Thapa, 2014) in different protected areas all around the world [24, 14, 16, 29].

Katerniaghat Wildlife Sanctuary, a protected area present in Uttar Pradesh is facing human-wildlife conflict problem from more than a decade (Anonymous, 2000) [1]. No scientific documentation is available on the issues of human wildlife conflict from the sanctuary. Therefore, in the present study the nature and extent of human-wildlife conflict was assessed. The purpose of study was to come up with slight recommendations that will help to reduce human wildlife conflict issue promoting sustainable utilization of forest resources and wildlife conservation. The findings of the study will be helpful to policymakers and protected area managers by providing them greater insight into the problem hampering wildlife conservation and protected area management.

Study Area

Katerniaghat Wildlife Sanctuary was designated as a protected area in 1976 by the state government. It is situated in Bahraich district of Uttar Pradesh having an area of 400 sq.km. The whole Katerniaghat wildlife division is 551sq.km. in connectivity with Royal Bardia National Park in the north and Dudhwa National Park to the west of sanctuary. It is located between 28º 06'N & 28 º 24'N latitude and 81º 02É 81º 19'É longitude (Figure 1). The sanctuary is rich in alluvial soils of Gangetic plain. The important rivers are Girwa, Kairiyala, Ghaghra and Saryu. Though, area of sanctuary is small but important link of Terai Arc Landscape significance for the ecological connectivity of biodiversity. The sanctuary supports the tropical moist deciduous type of forest categorized into three major habitats i.e. sal forest, miscellaneous forest and grasslands (Champion's and Seth classification, 1968).Where the sal forest consists of moist bhabhar Sal, moist bhabhar Sal/5B/C1b dry plain Sal. The miscellaneous forest consists of Termialia alata forests, cane brake, eastern seasonal swamp forest, low alluvial mixed Savannah woodland, northern mixed deciduous forest, Aegle marmelos forest and Khair-sissoo forest. The grassland habitat has only low alluvial savannah woodland. The sanctuary is rich in a wide variety of flora and fauna. There are around more than a hundred villages situated at the periphery of the sanctuary. Six villages are present inside the sanctuary. Before the declaration of sanctuary, local people possessed rights over forest land. Soon after the declaration of sanctuary, those rights over forest land and concessions in the form of livestock grazing and fuelwood collection were stopped (Anonymous, 2000) [1].

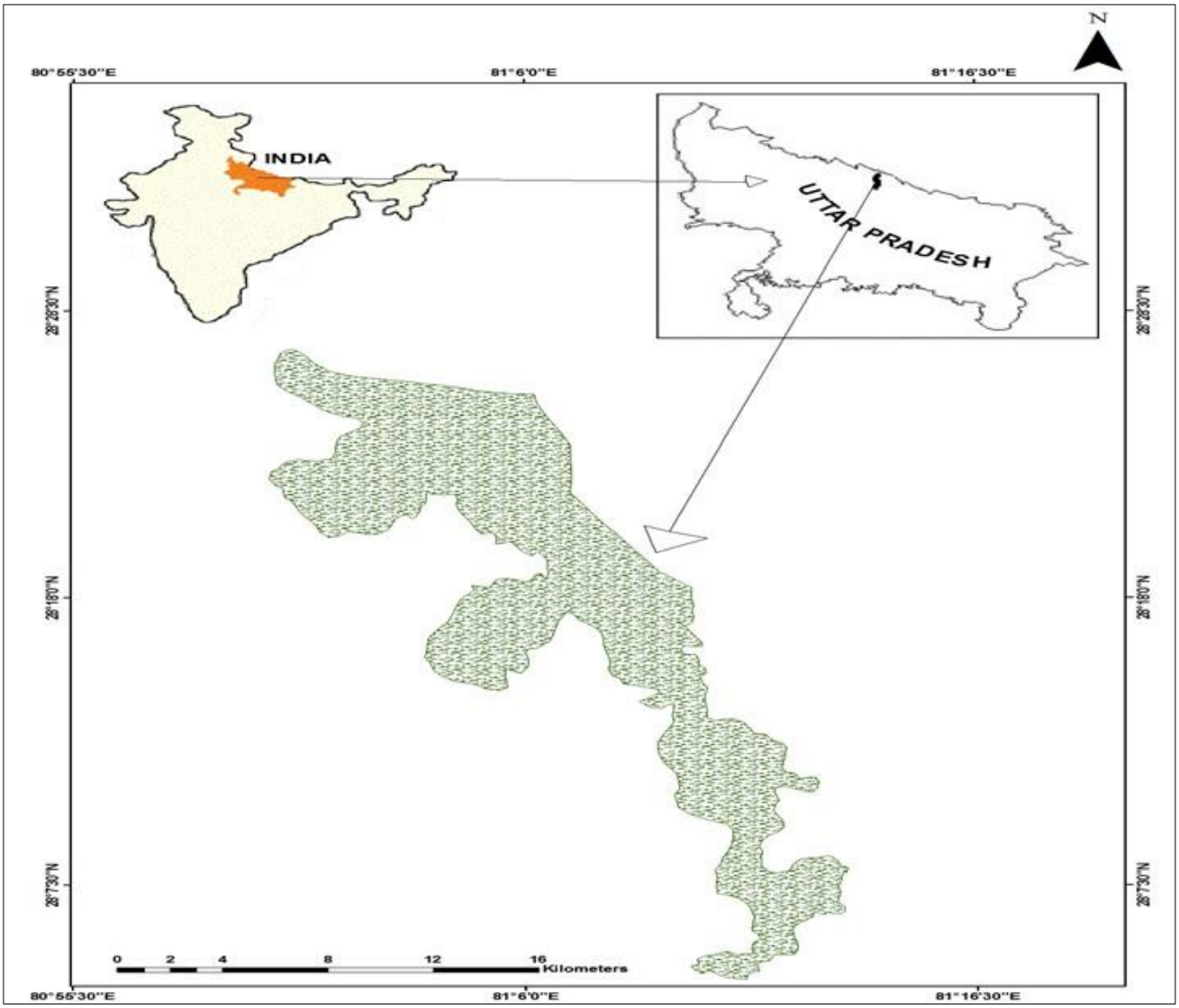

Fig 1: Map showing location of Katerniaghat Wildlife Sanctuary (inset: Uttar Pradesh) (Tahoor, 2019)

Materials and methods

Human settlements are forest resource dependent which are present in the vicinity and inside protected areas (Anonymous, 2000) [1]. Both primary and secondary sources were included in the present study. A buffer zone of 2.5 km was created from the protected area boundary with the help of Arc GIS software for sample site selection. The buffer zone covered 101 villages that are dependent on the forest resources of the protected area. Soon after buffer zone creation, with the help of forest and revenue department, a list was prepared to have information on human

and livestock population of 101 villages. To carry out data collection, those villages having the highest human and livestock population were included in the study. This accounted for a total number of 28 villages from the sanctuary (including villages present inside the sanctuary). From each selected village, 10% household was sampled. Thus, a total number of 302 households were sampled from the Katerniaghat Wildlife Sanctuary. Figure 2 shows the location of sampled villages inside Katerniaghat Wildlife Sanctuary.

After the sample site selection, data collection was started. A questionnaire survey was carried out in the selected village. From each selected village, randomly households were selected. During the survey, whoever is present above the age of 18 was included in the questionnaire survey. The survey was conducted with the help of one assistant who was well versed in local languages. Open and close-ended questions were asked during the household survey. For data analysis and interpretation, various techniques were used in an authentic manner including quantitative and qualitative tools. In quantitative technique, percentage value was calculated to get a general overview of findings. Contradictory, qualitative techniques were applied with the help of tables and graphs.

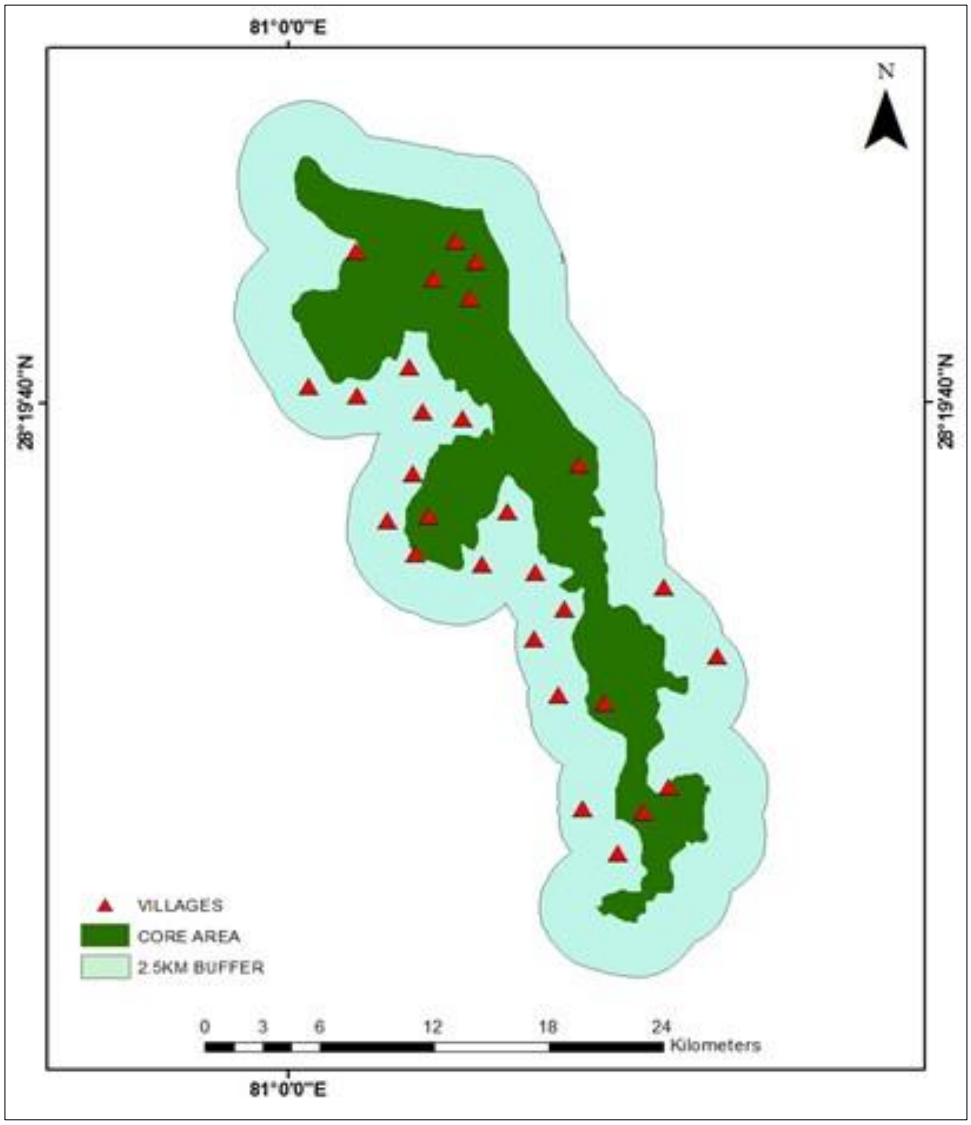

Fig 2: Location of sampled village in and within the buffer zone of the Katerniaghat (Tahoor, 2019)

Results

Human wildlife conflict

The general demographical detail of Katerniaghat Wildlife Sanctuary is given in Table 1. Out of 302 households, 2240 human population was sampled with livestock ownership of 1485 from 28 villages present inside and outside the sanctuary (within buffer zone of 2.5km). The findings of Katerniaghat showed that human kill/injured, livestock depredation and crop-raiding are three categories of conflict occurred in the study area (Table 2). Human kill/injured (48.6%) is the most frequent conflict followed by livestock depredation and crop-raiding.

Table 1: Demographic detail of Katerniaghat WLS

Demographic detail	Number
Village	28
Household	302
Human population	2240
Livestock population	1485

Table 2: Type of conflict occurred in and around the Katerniaghat WLS

Type of conflict	Percentage
Crop-raiding	16.8
Human Kill/injured	48.6
Livestock depredation	19.2
Poaching	0

Human casualty

Figure 3 showed that Katerniaghat range showed maximum incidence of human kill/injured by the predators followed by Nishangarah (49.6% and 39.4% respectively) administratively inside the sanctuary. Whereas, Trans-gerwa range had zero reporting of human kill/injured. Murtiha and Kakraha range had lowest number of human casualties by the predators (2.3% and 11.6% respectively). It is might be due to presence of core and dense habitat of wild predators and illegal human interference which can be fatal to villagers present at the vicinity of the sanctuary. The Trans-gerwa range showed no conflict issues because it is present at northern part of sanctuary adjacent to Indo-Nepal border causing no trespassing across boundary and only one small village called Bharthapur is present in the range causing little or no interference with the wildlife and its habitat. Table 3 showed the gender of human casualties occurred in the sanctuary. Majority of the human casualty is of adult male followed by boys (35.2% and 30.3% respectively). This is so because usually males go inside the forest premises to collect fuelwood, fodder and other consumable products and becomes an easy victim of wild predators. The proportion of adult female and girl for human casualty was below 20% because females are less involved in illegal collection of forest resources from the protected area. Males are usually involved in collection of forest resources from the forest and females are involved in household activities The data obtained from forest department reveals that leopard was the dominant predator species involved in human casualties done in 2002-2012 (Table 4). The temporal variation was observed in human casualties over the twelve years by the predators inside the sanctuary. Tiger was involved in 22% human casualties inside the sanctuary. Leopard was the dominant predator and was involved in 77% casualties faced by human. The twelve-year data showed that 67% casualty was done by tiger in 2005. In 2012, leopard was involved in all the incidents regarding human casualty inside the sanctuary. The twelve year data showed temporal variation in human casualties inside the sanctuary. In a recent study, impact of moon phase was found in relation with the conflict incident in Chitwan National park by Lamicchane *et al.* (2018). According to study, human casualties were found mostly during full moon phase by the carnivores. Though, in the present study, data in relation to moon phase was not collected, therefore, we are not sure that whether there is an impact of full moon or not on the human wildlife conflict incidents. In the future, extensive research is needed to understand the relationship of human wildlife conflict and moon phase.

In the present study, secondary data reveals that nature of human casualty was more of injury (75.9%) as compared to the killing type by the predators (24.1%). Similar result was also reported from other protected areas of India. For example; Chouksey and Singh (2018) [6] found nature of human casualty is injury rather than killing in Bandhavgarh Tiger Reserve.

Table 3: Gender of human casualties occurred in and around the Katerniaghat WLS

Adult male	35.2
Adult female	16.2
Boy	30.3
Girl	18.3

Table 4: Yearly detail of human casualty caused by tiger and leopard in and around Katerniaghat WLS

Year	Tiger (%)	Leopard (%)
2001	50	50
2002	50	50
2003	50	50
2004	0	0
2005	67	33
2006	13	87
2007	40	60
2008	12	88
2009	6	94
2010	24	75
2011	50	50
2012	0	100
Total	21.5	78.5

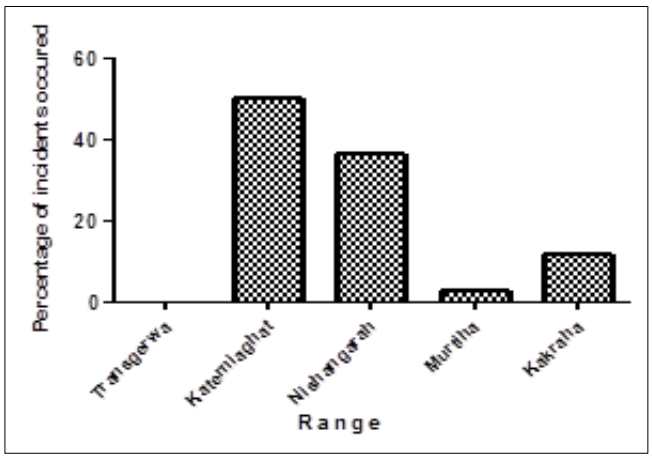

Fig 3: Human casualties occurred in different ranges of Katerniaghat

Livestock depredation

Livestock depredation is the second occurred conflict inside the sanctuary. In the present study; cow, buffalo and goat were equally depredated by the predator (33%) inside the sanctuary (Figure 4). This showed that livestock when illegally graze inside the sanctuary becomes the easiest prey items for the wild predators irrespective of their body size. On the contrary, Patterson *et al.* (2004) [26] argued that predators on the basis of body size differed in their prey/livestock selection. Generally, tiger preferred large bodied prey whereas leopard prefers to prey upon sheep and goat. Figure 5 showed graphical presentation of incidents of livestock depredation and distance from the protected area. The primary data showed that on moving away from the sanctuary, livestock depredation was reduced from 80% to 15%. The distance from protected area plays a major role in livestock depredation in the present study. A slight decline in incidents of livestock depredation by predators was observed in the sanctuary probably due to fine prey abundance. The prey availability inside the sanctuary might reduce the livestock depredation. Usually

situation gets worse when livestock graze illegally inside the protected area becomes easy prey items for wild carnivores. Similar results were also reported by Mwaktobe *et al.* (2014) [23] concluding increase in distance from the protected area causes a decline in incidents of livestock depredation. In some of the protected area, livestock lifting from the surrounding villages by the wild predators is also reported. Similarly, Mishra (1997) [21] conclude that livestock depredation in the surrounding village is due to high livestock density and easily available attracting wild predators from the forest. Karanth and Ranganathan (2018) [15] conclude that livestock depredation takes place due to illegal livestock grazing inside the Mudumulai Tiger Reserve.

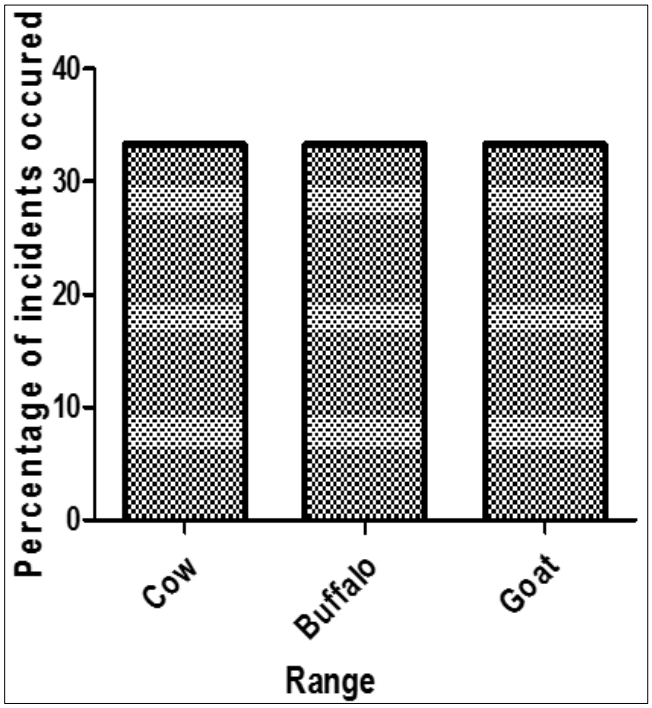

Fig 4: Livestock depredation by predators in and around Katerniaghat (primary data)

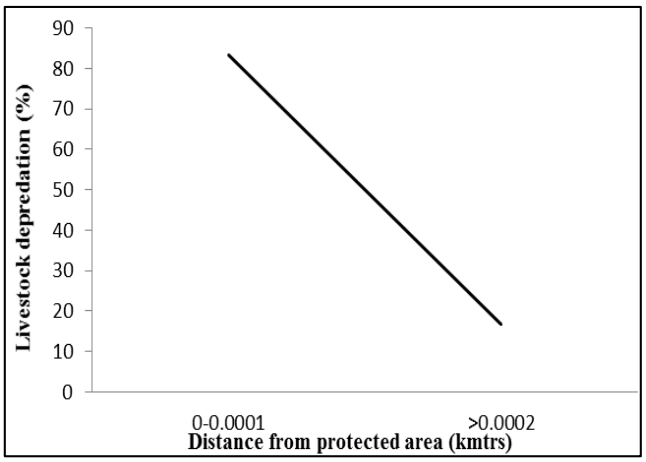

Fig 5: Relationship between livestock depredation and distance from the Katerniaghat

Crop raiding

Crop raiding is the least occurred conflict in the study area. Figure 6 showed rice and sugarcane are mostly raided by wild herbivores (39% and 37% respectively). Table 7 showed that nilgai is the common crop-raider (35.2%) in the present study. Whereas, wildboar and elephant equally involved in crop-raiding incident (23.5%) in the sanctuary. Deer and primates are least involved in crop-raiding incidents. Table 6 showed details of villager's perception regarding crop raiding done by wild herbivores. Around, 36% villagers agreed that the rate of recurrence of crop damaging is frequent. Usually, crop-raiding is done when the crops are mature enough and giving no time to the villagers to cultivate again. More than 30% villagers agreed that usually wild herbivore comes in group of more than 10 individuals. Only 21% villagers responded that group size ranging from 1-10 of crop raiders visits the cropfield. A three-year secondary data showed that in 2009 and 2010 the average cropfield damage near the sanctuary was around 11 ha. In 2011, cropfield damage was 0.4 ha reported from the sanctuary. In the current study, extent of crop damage was found to be low with increase in distance from the protected area (Figure 7). The present study agreed with the previous findings of Hill (2000) [11] and Karanth (2012) [14, 16] concluding crop-fields present near the protected area are most attracted by the wild herbivores. Hill (2000) [11] found cropfield at the periphery of the sanctuary are more prone to crop-raiding incidents. Karanth (2012) [14, 16] found distance and cropping pattern plays a major role in crop-raiding incidents done by wild herbivores.

Table 6 showed that 50.3% respondents use five types of measures for the protection of crop-field. These are planting of cactus, dry branches, shrubs, trees and scare crows. The major crop-field protection measure is tree plantation followed by cactus and dry branches (26%, 7.6% and 7.3% respectively). Villagers used various measures to deter wild herbivores from raiding the agricultural field. These are drum beating (5.9%), torch lights (13.2%), shouting in groups (5.6%) and using fire crackers (25.1%). Among all, usage of fire crackers as a repellent strategy for the crop raider is quite dangerous for the villagers as well as to the wildlife. Therefore, Parker and Osborn (2006) [25] documented that use of chilli is an ensured deterrent for the crop-raiders in Zimbabwe. Monney *et al.* (2010) [22] documented that chilli fences acts as an important deterrent for wild elephants in Ghana. Rahayani *et al.* (2014) [27] recommended radio-frequency devices for preventing crop-raiding incidents from elephant.

Table 5: Percentage of wild herbivores involved in crop-raiding in and around Katerniaghat

Elephant	**23.5**
Wildboar	23.5
Bluebull	35.2
Deers	11.7
Primates	5.8

Table 6: Villager's perception (%) regarding crop-raiders (wild herbivores) in and around Katerniaghat

1. When wild species raids your crop-field	
frequently	36.1
occasionally	17.2
rarely	1.6
2. The number of wild species raids your crop-field	
single	0.33
less than 10	21.2
above 10	34.437
3. What is the phenology of your crop-field?	

sowing	7.61
immature	12.25
standing (mature)	35.7
4. Do you use apply any measure to protect crop-field?	50.3
5. What methods you used to protect your crop-field	
planting Cactus	7.6
planting dry shrubs	7.3
planting scrubby vegetation	5.63
planting tree species	26.5
presence of scare crows	2.31
6. Did you do something to repel wild species from your crop-field?	
light	13.2
drum-beating	5.9
shouting	5.63
fire crackers	25.16

Conclusion

In Katerniaghat, human wildlife conflict incident will create negative impact on villagers because of the economic loss they suffered due to livestock depredation and crop-raiding. Moreover, relationship of villagers with the forest department will also be affected and eventually creates impact on wildlife conservation initiatives and hampers the protected area management activities. Therefore, local people's participation in wildlife conservation programmes and protected area management is advisable. Government should increase the compensation grant so that it should meet the loss of villagers which they economically suffer due to conflict with wildlife. For suggestive measures, trenching at the boundary of protected area is necessary and will help in reducing the frequency of conflict issues by reducing the tress passing of human and wildlife across the protected area boundary. Villagers should encourage in stall-feeding instead of illegal livestock grazing this will helps in reduce anthropogenic pressure inside the sanctuary and incidents of livestock depredation. Fire cracker is mostly used by villagers to deter wild animals from damaging their crop field. It is quite harmful to human kind therefore, it is advisable to apply other strategies like chilli fences, radio frequency devices, bee hives to deter wild animals from raiding agricultural field. Education and awareness among the villagers is necessary about the importance of forest and wildlife conservation this will help in reduce the illegal human activities inside the sanctuary and will eventually reduce conflict issues.

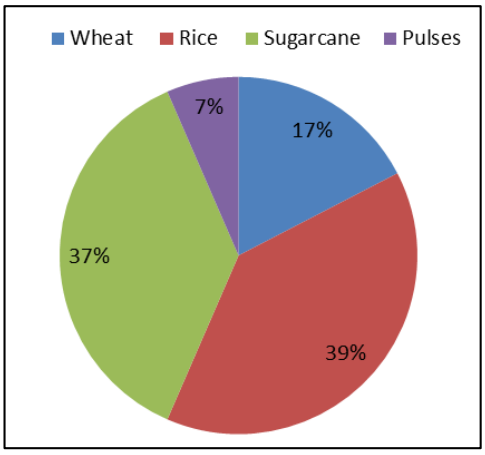

Fig 6: Types of crops damaged by wild herbivores in and around the Katerniaghat (primary data)

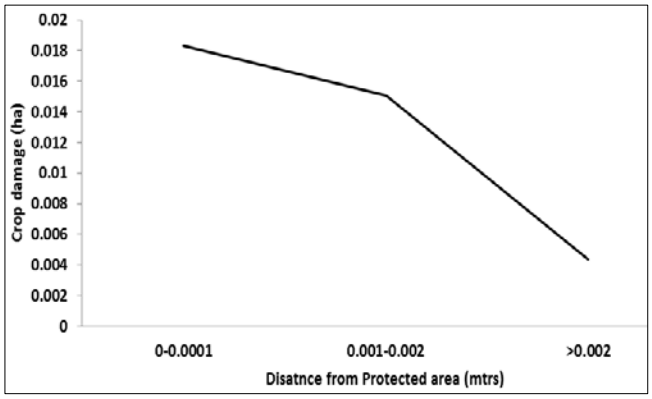

Fig 7: Relationship between area of crop damage and distance from Katerniaghat

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