An interim report on

Assessment of a unique conflict between gaur (B*os gaurus*) and humans in the northern Western Ghats, India

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Research Team

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Contents

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1. Introduction

Human-wildlife conflict is among the serious issues of concern for conservationists, local communities, local authorities and policy makers worldwide(Hill 2004). Human-wildlife conflict occurs more often when the needs and behaviour of wildlife impacts human goals negatively or when human activity adversely impacts wildlife (Karanth et al. 2002; Dickman 2005).

Some wild animals, especially mammal species that have large body size such as elephants, wild cattle or wild cats require greater absolute amounts of food (Eisenberg 1983). These requirements can be met by traversing bigger home range and/or choosing area of abundant resources (Owen-Smith 1992). The large home range of large mammals dramatically increases the likelihood of human-animal interaction. These animals may come in contact with humans during daily foraging and territorial movements which many times turn into conflict (Karanth & Madhusudan 2002; Madhusudan & Mishra 2003). The highly abundant species such as rats may cause far more crop damage or loss than large mammals; but at the same time the higher conservation value of these large mammals limits the severity of action humans can take to combat the loss. In densely populated countries like India, it is very difficult to remove the human settlements in and around the habitats of large mammal species as a means of reducing conflict. These factors make conflict with large mammals often becomes a serious and complex issue (Madhusudan & Mishra 2003).

The major human-animal conflict issues in India are crop-raiding, livestock depredation, and human-killing (Madhusudan & Mishra 2003). Across the Western Ghats of India, a global biodiversity hotspot (Myers et al. 2000), among large herbivores, conflict with elephants has been reported in many places(Sukumar 1990; Karanth & Madhusudan 2002; Kumar et al. 2004). The northern Western Ghats (popularly known as Sahyadri), an area with few or no wild elephants has been witnessing a fairly unique situation of conflict between gaur (*Bos gaurus*) and humans.

In India, gaur is distributed across the hill forests of Western Ghats, Central highlands and North east India (Menon & Daniel 2003). Across this distribution, there were very few records of conflict between gaur and humans (Choudhury 2002). This may be because of the shy nature of the gaur and preference for forest cover (Prater 1965; Schaller 1967). Based on current information, gaur-human conflict in Sahyadri, India appeared to be unique to the Sahyadri region. Such conflict incidences usually have major impacts on the livelihoods of rural people and leads to the hostility with the wild animals (Newmark et al. 1994; Hoare 1999; Linkie 2007). Therefore, along with ecological perspective, it is also important to examine such human-wildlife conflict issue within the context of social, economic, and cultural lives of people (Karanth & Madhusudan 2002; Hill 2004).

In this context, a study was designed to understand the nature and intensity of conflict in the region, its impact on the socio-economic status of the people and on the perceptions of people regarding wildlife and evaluate various mitigation measures to gaur-human conflict in this region.

Objectives

1. Describe spatio-temporal variation in gaur-human conflict in the Sahyadri Hill of northern Western Ghats and identify its environmental and anthropogenic correlates.

2. Understand local perceptions of gaur-human conflict, assess its socioeconomic impact, and critically evaluate various options of conflict alleviation.

In this report, based on our preliminary analysis, we have tried to address following questions:

1. What are the losses inflicted by gaur and other focal wildlife species?
2. What is the impact of crop losses on households?
3. What crops were preferred by gaur and other focal wildlife species for raiding?

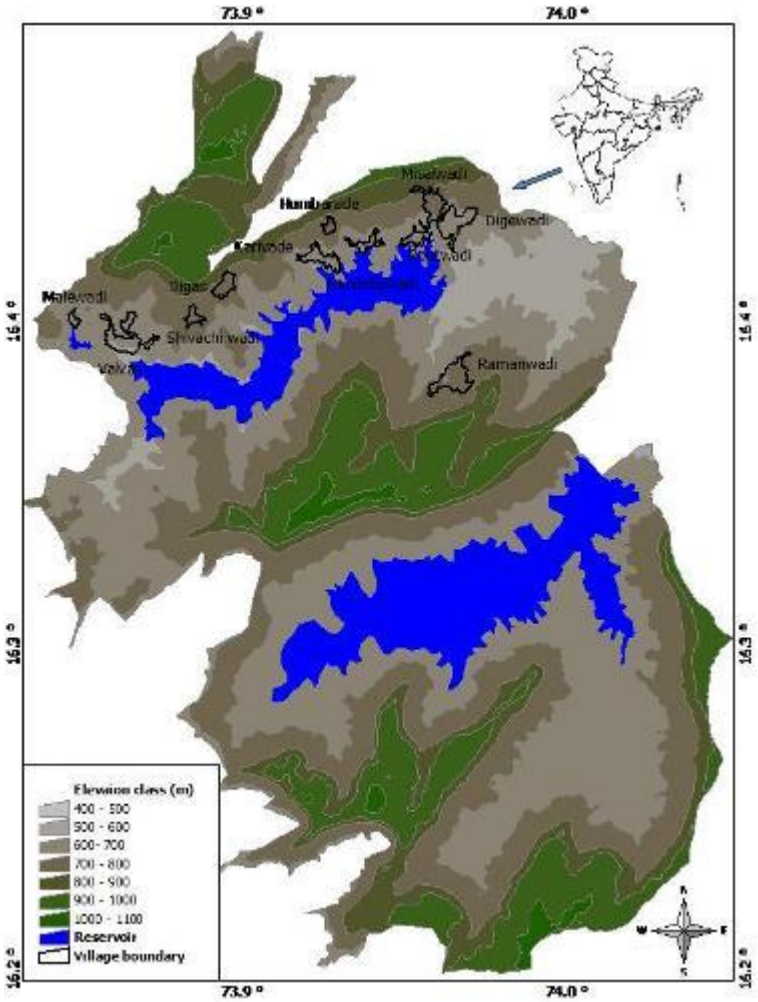
4. What are the perceptions of local communities towards conflict? Did the perceived conflict losses differ from observed conflict losses?

2. Study region

Radhanagari Wildlife Sanctuary (WLS)
Radhanagari WLS (16° 10' N to 16° 30' N, 73° 52' E to 74° 5' E), located in the northern Western Ghats, India is the first wildlife sanctuary of Maharashtra state notified in 1958 (Fig. 7). The part of the sanctuary forms a game reserve maintained by the then Maharaja of Kolhapur Province which was declared as Dajipur Gaur Sanctuary in 1958. It was later declared as Radhanagari Wildlife Sanctuary in September 1985 with the area of 351.16 km^2. The mean annual rainfall is about 2500 mm and maximum being 5000 mm. Two dams have been constructed on rivers *Bhogavati* and *Dudhganga*. The catchments of these two reservoirs *Rajarshi Shahu Sagar* and *Lakshmi Sagar* are included within the sanctuary. These two reservoirs and their surrounding forests constitute prime habitat for the wildlife of this sanctuary. The main forest types are Southern tropical semi-evergreen and west coast semi evergreen forests, Southern tropical moist mixed deciduous forests and West coast tropical evergreen forests (Champion & Seth 1968). Within the sanctuary, 47 species of mammals, 59 species of reptiles, 20 species of amphibians, 264 species of birds and 66 species of butterflies have been reported (Salunke & Sardesai).

At present, there are around 55 villages located in and around the Radhanagari WLS. Few villages, those were inside the Sanctuary area, were rehabilitated by Irrigation Department during the dam construction on Dudhganga. It has been reported that, the upper hill terraces were mainly habituated by a Shepard community called *Gavli dhanagar* till 1985. Their main occupation was livestock rearing. As the area was declared as Wildlife Sanctuary, livestock grazing was prohibited within the area. As a consequence they left this area with their livestock and settled down around Dharwad and Mysore in Karnataka. The major occupations of the communities residing in this area are agriculture and livestock rearing. Much of the young men population has been migrated towards the industrial towns and cities in search of employment. Along with agriculture and livestock rearing, money provided by these individuals, who work away in towns and cities, to their families also forms an important source of livelihood to the people residing in this area.

Figure 7. Map of Radhanagari Wildlife Sanctuary showing monitored villages and the elevation from mean sea level



3. Methods

In the Sahyadri region, the baseline data on conflict was not available as no study has been done on the human wildlife conflict in the region. With the objective to understand the nature of conflict in the region, secondary data in the form of forest department reports and local media reports were used. It was observed that the conflict incidences are more frequent in and around Radhanagari WLS as human settlements are more in comparison with other protected areas in the region. Therefore, area inside and around the Radhanagari WLS was selected to study the human-wildlife conflict.

A key informant survey was carried out in randomly selected 18 villages located in and around Radhanagari WLS to assess the local perceptions on human-wildlife conflict in the area. In each village, information was collected pertaining to the losses incurred on villagers by wildlife and the economic condition of respective village through semi structured interviews with the group of elderly people those have good knowledge about their village. During the interviews, the precautions were taken that there will be minimum three members in a group to be interviewed, the group members belong to the same village and have fair information about their village and surrounding area.

The collected data in the form of questionnaires were compiled and analyzed using Filemaker Pro, Microsoft Excel software, R statistical software and Manifold GIS software.

Along the gradient of perceived losses, five villages were selected for the assessment of spatio-temporal variation in human-wildlife conflict. Each household in these selected villages were monitored for 17 months during July 2008 to November 2009. In addition to these villages, four more villages were monitored from June 2009 to November 2009. The monitoring period was distributed across the all three seasons of the year: monsoon (June to mid October), winter (October to February) and summer (March to May). A local research assistant was appointed for each village and trained to collect data pertaining to losses due to conflict and socio-economic status of each household. The crop field was considered as a unit for recording the conflict incidents. The number of forays by large wild animals within one night could not be differentiated and were considered as one crop raiding incident. The crop area loss and produce loss incurred due to wildlife were recorded after each incident of crop raiding through actual measurement of losses in the field. The information pertaining to socio-economic status of each household was obtained through questionnaire based interviews. The previous year's losses at household level were recorded through the questionnaire based interviews. The perceived losses by households were recorded after each conflict incident through the interaction with the affected household.

In each crop field the potential predictor variables of conflict intensity were recorded. The variables considered were: distance to forest edge, distance to road, distance to water source, distance to human habitation, crop field area and crop species. The data collected by assistants were verified by frequent visits to the study villages and crop fields.

Data on the potential predictor variables of the conflict occurrence and losses were collected through various sources. The proximity variables such as proximity of crop fields to wildlife habitat, human habitation and water body were derived from the field data collected during monitoring and with the help of GIS software – Google Earth, Manifold and Quantum GIS. Kolhapur Wildlife Division of Maharashtra Forest Department and NCF collaboratively conducted a wildlife population monitoring study in Radhanagari WLS during the same period. The estimated relative abundance of selected large mammal species within the Radhanagari WLS was considered as one of the potential predictors of conflict. The Rainfall during the monitoring period was taken from the Block Development Office of Radhanagari Tehsil of Maharashtra State, India. The data pertaining to geographical variables such as Elevation, Slope and Vegetation were derived from the satellite imageries. Anthropogenic variables such as Population, crop area, crop protection measures, crop species cultivated, were recorded from the field surveys and household level surveys whereas, livestock grazing, forest produce collection, human trails boundary, and forest fires within Sanctuary area were recorded from wildlife population monitoring study.

4. Analysis

The perceived loss of each crop species was calculated on the basis of raiding incidents per month, relative perceived damage and proportion of area. The local market price of each crop and the productivity of each crop per unit area were taken into account to estimate the loss due to crop damage. Perceived loss for each village was calculated by summing up of the perceived loss for all crop species in that village. Along the gradient of perceived loss, nine villages were selected and monitored to assess the nature, the impact and the causes of losses incurred due to wildlife.

The losses incurred due to wild animals were calculated in terms of frequency of raiding incidents and monetary losses. The frequency was calculated as number of raiding incidents per unit area. The monetary losses were calculated from the produce losses measured in the field by multiplying them by local market price of that produce. The analyses were carried out using software: Microsoft Excel and R.

5. Results and discussion

Overview

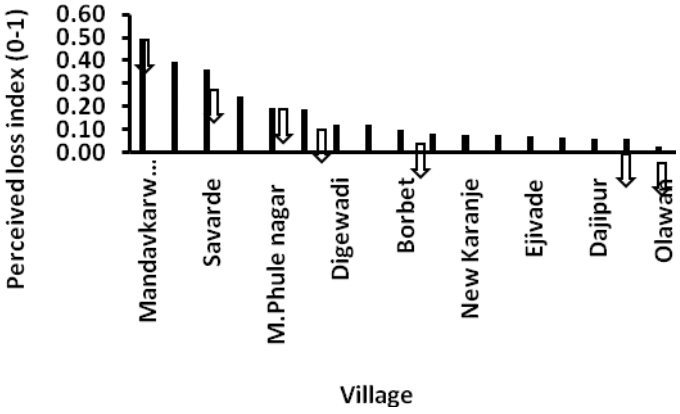
Around 55 villages were located within and around three km proximity of the Radhanagari WLS. The key informant survey across 18 villages revealed that these villages comprised 1079 families with the human population of 6855. These villages mainly had resident population of Maratha community (78%) and traditionally subsisted on agriculture. The other communities were scheduled caste and shepherd. They were observed as minority communities in this region with the 14% and 7% of the total population respectively.

Agriculture, livestock rearing and labour work were three major livelihood sources observed in this region. Monsoon agriculture was being practiced by largest portion of families (88% of total monitored families), followed by livestock rearing (75%) and labour work [dry season (71%) and monsoon (52%)] in these villages. The labour work was mainly done by young men (age ranging from 20 to 55 years) and mostly either in nearby industrial towns such as Kolhapur and Ichalkaranji or in big cities, Mumbai and Pune. Around 32% of the households had access to the irrigation during dry season and they cultivate the crops throughout the year.

Three forms of conflict were identified across the study villages: crop raiding, livestock depredation and attack on humans. People perceived that crop raiding by wildlife species is the major problem due to wildlife in this region as compared to humans and livestock depredation. Across the study villages, 42% of the households were perceived as affected by crop raiding with the loss of 20% of the total crop area in this region whereas there were two incidents of livestock depredation and three incidents of attacks on humans in 2008.

Based on the perceived losses, five villages were selected in such a way that they will represent each loss level. After completion of one annual cycle of seasons, four more villages were monitored for one season along with the other selected villages. The study villages and their corresponding perceived loss indices are shown in following figure. The villages marked with arrow (⬇) are the selected villages for evaluation study of the human-wildlife conflict. These villages were monitored to assess the spatio-temporal variation in conflict and their anthropologic and social correlates.

Figure 8. The perceived losses across the surveyed villages (the arrows show the villages selected for monitoring the conflict)

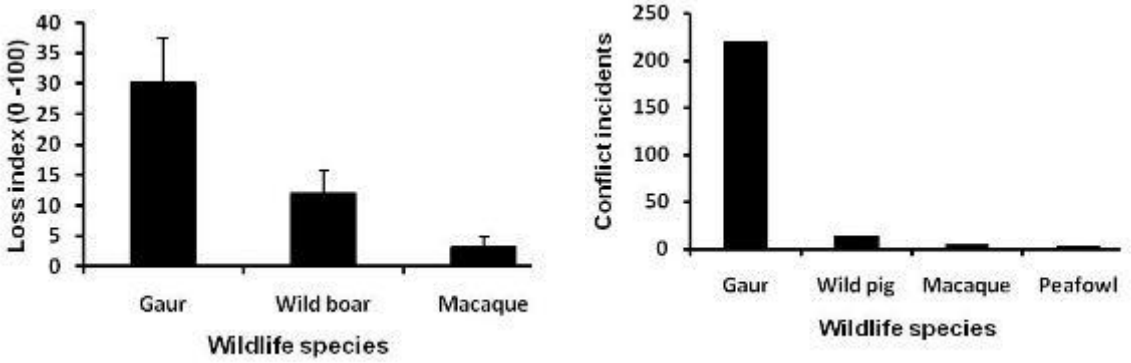


The crop fields of 250 households were monitored across the selected nine villages. During the monitoring period, from June 2008 to November 2009, total of 245 crop raiding incidents by wild animals were recorded. The total area monitored was 287.58 hectares of crop fields; out of which crops over 7.68 hectares of land (2.67 % of monitored land) were destroyed by wild animals. The total loss was worth 2, 51,270 rupees which was 1.58% of the expected total income from the crops cultivated across these villages. These losses were incurred by gaur, wild pig, macaque and peafowl.

Losses across the wildlife species

The gaur was observed as well as perceived as the wild animal, among all large herbivores, inflicting highest losses to the farmers. The assessment of perceived losses across the species showed that gaur inflicted highest crop losses (loss: 30.2%, se: 7.20); followed by wild pig (loss: 11.95%, se: 3.77) and macaque (loss: 3.1%, se: 1.70) (Figure 9). The observed losses showed that gaur inflicted crop losses worth 2, 37,320 rupees whereas losses inflicted by wild pig, macaque and peafowl were 10250, 1300 and 2400 rupees respectively (Figure 9). The losses inflicted by the wildlife species in both studies indicated that the variation in losses were in accordance with their body size i.e. larger the body size of the wild herbivore, greater were the losses.

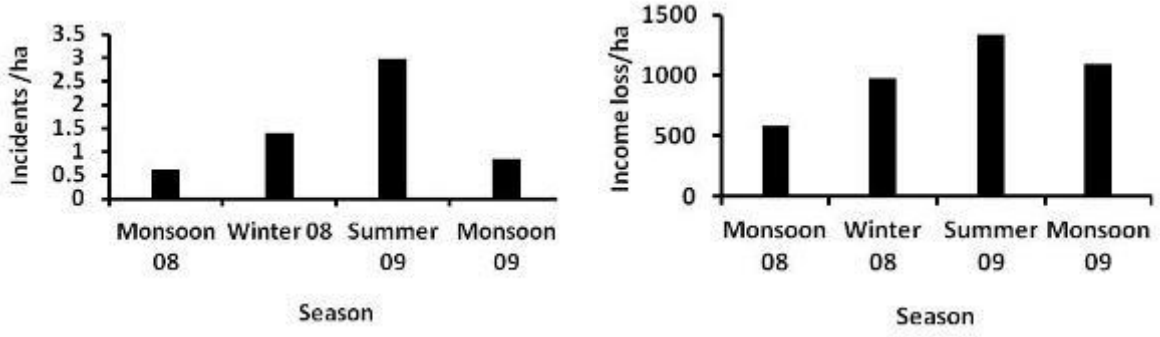
Figure 9. Crop losses across the wildlife species (left chart shows the perceived losses and right chart shows the observed losses across wildlife species)



Losses across and within the seasons

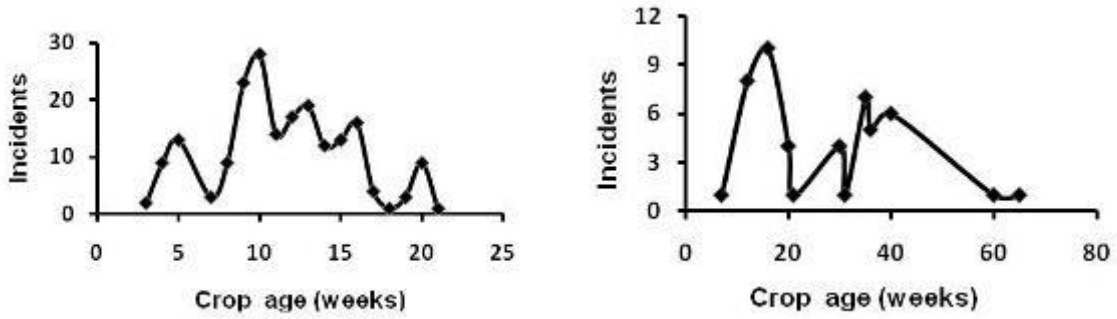
The frequency of crop raiding incidents as well as the income loss due to crop raiding sharply varied across the seasons (Figure 10). In this region, monsoon season is starts from June and ends by mid October; winter (rabi) season covers months of November to February and summer season extends from March to May. The increase in conflict from wet (monsoon) season to dry (summer) season indicated that the relative availability of food and/or water within and outside the Sanctuary area across the seasons may be the important factor influencing the intensity of conflict in the region. It is also important to note that the damage was greater to monsoon crops (Monsoon 2008- 76 incidents, Monsoon 2009-118, Winter 2008-19, Summer 2009-32) and total area under cultivation showed sharp decline from wet to dry season (monsoon- 124 ha, winter-13.5ha and summer-10.7ha) and the crop raiding during the dry seasons was concentrated within relatively small portion of the crop area.

Figure 10. Losses across the seasons



The losses in seasonal crops across their age showed that the frequency of raiding incidents and income losses inflicted by wild animals were greater at mid age, premature, crops whereas the annual crop sugarcane showed no such trend (Figure 11). The average duration of seasonal crops is 25 weeks. These species start flowering after they attain age of approximately 15 weeks and fruiting takes place within the two weeks of flowering. It appears that the wild animals prefer to raid the crops after crops grow tall enough to eat (i.e. after 6-7 weeks) and before they attain the flowering stage. The decline in frequency from the flowering stage of crops indicated that the wild animals preferred to raid the crops at the stage when the crops' nutritive value remains greater.

Figure 11. Losses across the seasonal crops' (left chart, N=196) and the perennial crop, sugarcane's age [right chart, N=49]

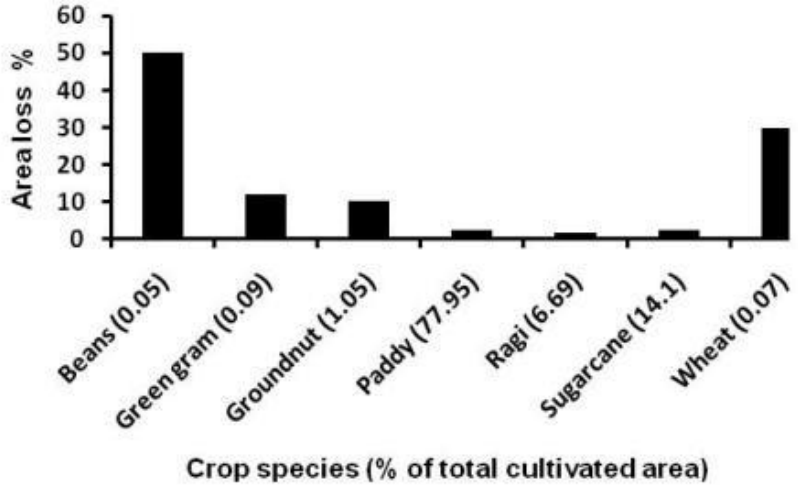


Losses across the crops

Paddy was widely cultivated crop species in the region, followed by sugarcane, ragi and groundnut. Though, beans, wheat and green gram were observed to be cultivated in very

small proportion (<1% of the total cultivated land); they faced greater losses compare to the monsoon crops' losses (Figure 12). Among the monsoon crops, paddy incurred greater losses followed by ragi and sugarcane. People perceived that among the cultivated crops paddy, followed by ragi and sugarcane, faced highest loss. Paddy is widely cultivated in the region (78% of total cultivated area across surveyed villages) and it is a staple food of the people residing in the region. The greater perceived losses of paddy may be attributed to these facts.

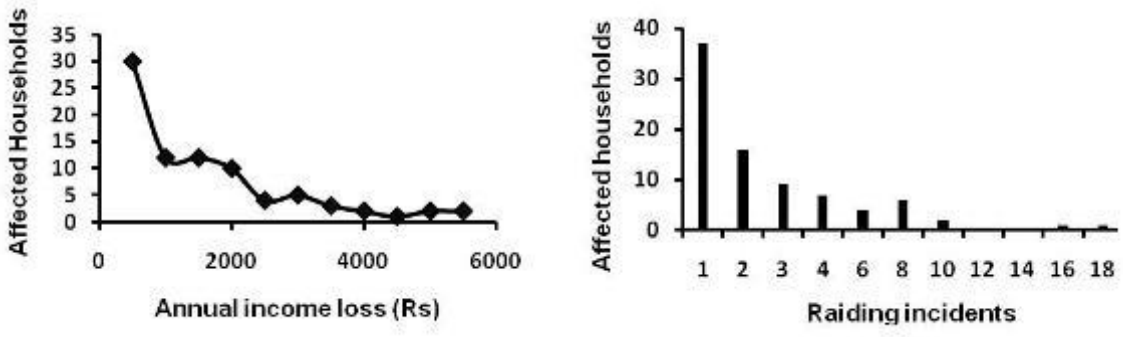
Figure 12. Crop area losses across the cultivated crop species



Impact of loss across the households

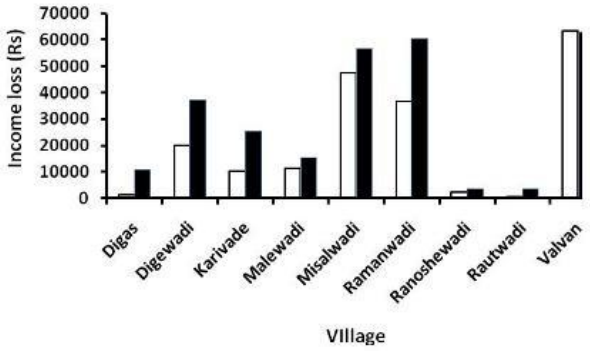
Total 250 households were surveyed and their crop fields were monitored during June 2008 and October 2009. During the monitoring period, the crop fields of 161 households remain unaffected whereas 83 households lost the income varying from 100 to 6000 rupees per annum and had to face raiding events up to 17 (Figure 12). The households monitored had varying landholding and economic status. Therefore, even similar crop losses may impact the households with varied socio-economic status. The impact of crop losses on households was assessed through the assessment of distribution of crop losses across the landholdings and living indices of the households. Between these variables, the landholding of households showed positive correlation with the income loss of households (Adjusted R^2= 0.02, *df*=246, *p*=0.05). This indicated that the losses were, though weakly, distributed in proportion of the landholdings of the households, thereby avoiding unbalanced impact on the affected households.

Figure 13. Annual Income loss and raiding incidents across the affected households (N=83)



Observed Vs Perceived losses

Figure 14. Observed and perceived income losses across the study villages (white columns show the observed losses and black columns show the perceived losses)



The perceived losses were significantly greater than the observed losses across the affected households (t = 5.603, df = 82, p < 0.001) with the mean difference of 997.95 rupees and across the nine villages (t = 3.402, df = 8, p = 0.009) with mean difference of 9203 rupees (Figure 14). The 74.5% of the families across the nine study villages were observed to be solely dependent on agriculture for their livelihood. The significant difference in observed and perceived losses may be attributed to this greater dependency on agricultural crops.

6. Inferences

Based on the results of preliminary analysis, inferences were drawn and are listed below.

- Across the wildlife species, in comparison with other wildlife species, gaur was perceived and observed as the species causing greater losses to crops.
- The gradual increase in raiding incidents and losses from wet to dry seasons indicated that the relative availability of food and/or water inside and outside the Sanctuary may be the important factor influencing the raiding frequency and the losses inflicted by wild animals.
- Much of the crop raiding incidents and losses occur at the middle of harvesting season which may affect the flowering and consequently fruiting of the raided crop species resulting into the greater produce losses.
- Significantly greater perceived losses than the observed losses may be attributed to the greater dependency of the people on the agriculture as a source of livelihood. It also indicated that, the greater perceived losses by local communities may result in to the negative attitudes towards wildlife and its conservation in the region.
- Gaur appears to be selective in raiding crops. Among all cultivated crop species, it preferred leguminous crops which, despite being cultivated in very small area, incurred the heaviest losses.

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