HUMAN-WILDLIFE CONFLICT IN SHUKLAPHANTA WILDLIFE RESERVE, KANCHANPUR, NEPAL

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DECLARATION

I hereby declare that the work presented in this thesis entitled **"Human-Wildlife Conflict in Shuklaphanta Wildlife Reserve, Kanchanpur, Nepal"** has been done by myself, and has not been submitted elsewhere for the award of any other degree. All the sources of the information have been specifically acknowledged by references to the author(s) or institution(s).

Date: May 26, 2014 ……..

Maniram Banjade

RECOMMENDATIONS

This is to recommend that the thesis entitled **"Human-Wildlife Conflict in Shuklaphanta Wildlife Reserve, Kanchanpur, Nepal"** has been carried out by Mr. Maniram Banjade for the partial fulfillment of the requirements for the Degree of Master of Science in Zoology with special paper 'Ecology and Environment'. This is his original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions. I recommend that the thesis be accepted for the Degree of Master of Science in Zoology (Ecology and Environment), Tribhuvan University, Kirtipur, Kathmandu, Nepal.

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LETTER OF APPROVAL

On the recommendation of the supervisor Prof. Dr. Khadga Basnet, this thesis submitted by Mr. Maniram Banjade entitled **"Human-Wildlife Conflict in Shuklaphanta Wildlife Reserve, Kanchanpur, Nepal"** is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for the Degree of Master of Science in Zoology (Ecology and Environment).

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CERTIFICATE OF ACCEPTANCE

This thesis submitted by Mr. Maniram Banjade entitled **"Human-Wildlife Conflict in Shuklaphanta Wildlife Reserve, Kanchanpur, Nepal"** has been approved as a partial fulfillment of the requirements for the Degree of Master of Science in Zoology (Ecology and Environment).

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ABSTRACT

The thesis entitled "**Human Wildlife Conflict in Shuklaphanta Wildlife Reserve Kanchanpur, Nepal**" assessed various aspects of human- wildlife conflict in the buffer zone of Shuklaphanta Wildlife Reserve. Specific objectives were to document distribution, types, intensity of damage, identification of wildlife pests, principal cause of conflict and value of damage. Three buffer zone committees like Shuklaphanta, Kalikich and Bageshwori buffer zone user committees from the northern and southern sites of the reserve were selected and ten plots of 10 x 10 m^2 were established (5 inside and 5 outside the reserve). Questionnaire surveys and interviews were conducted and data were collected during January 2012-November 2012. Data were analyzed using Ms Excel 2007, R-software and SPSS.

Majhgaun and Jhilmila of Shuklaphanta and Kalikich respectively were the areas with higher wildlife damage. Crop raiding by wildlife was higher as compared to physical property damage, livestock killing, and human injuries. Frequency of chital (*Axis axis*) and porcupine (*Hystrix indica*) visiting to cropland was significantly different in northern and southern sites. Number of dungs and livestock did not differ significantly accordingly to sites and seasons. Altogether there were eight pest species including chital, wildboar (*Sus scrofa*), elephant (*Elephas maximus*), rhino (*Rhinoceros unicornis*), monkey (*Macaca mulatta*), porcupine, peacock (*Pavo cristatus*), nilgai (*Boselaphus tragocamelus*) and three livestock predators including tiger (*Panthera tigris*), leopard (*Panthera pardus*) and jackal (*Canis aureus*). Among the pest species chital, wild boar and elephant were the most frequent crop raiders in each buffer community. Food deficiency, lack of fencing, increase in wildlife populations and deforestation were the major causes of conflict. The survey of 233 households showed that there was a total economic loss of Rs.11,92,335 in Shuklaphanta, Rs 7,02,510 in Kalikich and Rs.4,41,310 in Bageshwori. Wheat damage accounted the highest among the crops. Crop loss within sites was not significantly different. Human-wildlife conflict still exists but types, intensity, wildlife species and crops vary spatially.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

LIST OF ABBRIVIATIONS

HWC	Human Wildlife Conflict
WWF	World Wide Fund for nature
IUCN	International Union for Conservation of Nature and Natural Resources
BZUC	Buffer Zone User Committee
DNPWC	Department of National Parks and Wildlife Conservation
NTNC	National Trust for Nature Conservation
SCP	Shuklaphanta Conservation Program
CNP	Chitwan National Park
SWR	Shuklaphanta Wildlife Reserve
VDC	Village Development Committee
SBZUC	Shuklaphanta Buffer Zone User Committee
KBZUC	Kalikich Buffer Zone User Committee
BBZUC	Bageshwori Buffer Zone User Committee
KCA	Kanchenjunga Conservation Area
Hh	Households
PWR	Parsa Wildlife Reserve
KTWR	Koshi Tappu Wildlife Reserve
BNP	Bardia National Park

1. INTRODUCTION

1.1 Background

Human-Wildlife Conflict (HWC) or negative interaction between the people and wildlife has become the fundamental aspect of wildlife management as it represents the most widespread and complex challenge currently faced by conservationists all over the world (WWF 2007). The conflict usually starts when wild animals consume resources meant for human consumption: crop by herbivore and livestock by carnivores (Kissui 2008). The IUCN (World Conservation Union) defines HWC as "when wildlife requirements encroach on those of human populations, with costs both to residents and wild animals" (IUCN 2005). When wildlife loses their natural habitats and reduced their natural food sources, they eat agricultural crops, kill/injure livestock and people, and destroy property (WWF 2008). As the natural habitat gets fragmented, the interface between human and wildlife increases while the animal populations become compressed. Consequently, it leads to greater contact and conflict with human as wild animals seeks to fulfill their nutritional, ecological and behavioral needs (Sukumar 1990). The human-wildlife conflict is particularly due to the conversion of forest into large scale monoculture plantations, shifting cultivation, overgrazing, forest cutting and encroachment in the home range which reduce the availability of natural food to the wild animals (Bajracharya 2009). This results the carnivore shifting their diets to livestock that are easier to capture with limited escape ability (Mishra et al. 2003).

An increase in human population from hill migrant and gradual forest encroachment for agricultural land have made the situation worse in the lowland and the illegal extraction of forest resources make further escalation for park people conflict (Sharma 1991). The local people, who once were enjoying free access to areas henceforth covered by parks and were able to meet their needs from "inside" resources, now no longer, have legal access (Nepal and Weber 1993) which also leads people to bear cost not only indirectly through loss of resources such as firewood, fodder and non- timber forest products, but often by direct losses from crop and livestock raiding by wild animals dispersing from protected areas (Kumar

2012). Conflicts often arise when conservation regulations are imposed roughly to avoid natural resources usage, such as grazing land, firewood collection, fodder, medicinal plants and land for hunting without alternatives being provided (McNeely 1995, Lewis 1997) which become a serious problem for land managers and conservationist because such actions lead to negative human attitude towards wildlife, with potentially negative effects for conservation too (Pittigoli 2008).

Now-a-days, HWC exists globally in one form or the other. For instance, in North America, white-tailed deer (*Odocoileus virginianus*) and wolf (*Canis lupus*) are the most conflicting species (Musiani et al. 2003). In Europe, several wildlife species such as red deer (*Cervus elaphus*), wood pigeon (*Columba palumbus*), bears (*Ursus arctos*), wolf (*Canis lupus*) etc. are responsible for causing substantial damage to crop and livestock (Lamarque et al. 2009). Similarly in Australia, kangaroo (*Macropus rufus*) and wild rabbits (*Oryctolagus cuniculus*) are considered as pests because they damage crops and compete with sheep for forage (Therin 2001). In Africa, several large herbivores as elephant (*Loxodonta africana*), hippopotamus (*Hippopotamus amphibious*) etc, and large mammalian carnivores like lions (*Panthera leo*), leopards (*Panthera pardus*), spotted hyaenas (*Crocuta crocuta*) and crocodiles *(Crocodilus niloticus*) are considered as threat to human and responsible for majority of the human-wildlife conflict (Lamarque et al. 2009) whereas in Asia, large feline predators as tigers (*Panthera tigris*), leopards (*Panthera pardus*), lion (*Panthera leo persica*) and snow leopard (*Uncia uncia*) and elephant (*Elephas maximus*) are the principle sources of conflicts (Lamarque et al. 2009). In Chitwan National Park, rhinoceros (*Rhinoceros unicornis*), Elephant (*Elephas maximus*), wildboar (*Sus scrofa*) and chital (*Axis axis*) cause greater troublesome (Lamsal 2012) while elephant, chital, wildboar and blue bull (*Boselaphus tragocamelus*) are troublesome to the villagers of Shuklaphanta Wildlife Reserve (Bhandari 2011).

The existence of these sorts of conditions results in the unhealthy relationship between the wildlife, particularly the predator and the local people and people may undertake retaliatory killing in response to the economic loss incurred by livestock depredation resulting the reduction in the population of wildlife (Dhami 2011).

The Physical loss by wild animals in each Buffer Zone User Committee (Buffer Zone is an area adjacent to the protected area in which the land use is partially restricted to give a additional layer of protection to the protected area while providing valuable benefits to neighboring rural community) (Mac Kinnon et al. 1986) is greater each year in Shuklaphanta Wildlife Reserve (SWR) with a total compensation of Rs. 13,300, Rs. 27,800 and Rs. 7,100 was given to Kalikich, Bageshwori and Shuklaphanta Buffer Zone User Committee respectively and a total of Rs. 6,000 was given to the person injured by wild animals in Sagarmatha Buffer Zone User Committee in the year 066/067 (DNPWC 2011). A study conducted in ward nos. 13-15,18,19 of Mahendranagar Municipality reveals a total of 82,230.53 kg of crop being damaged; (> 70%) 58288.72 kg of paddy followed by wheat 15,062.07 Kg (18.31%) and maize 8,881.77 kg (10.08%) (Gautam 1999).

1.2 Objectives

The main objective of this research was to examine the human-wildlife conflict in Shuklaphanta Wildlife Reserve.

Specific objectives were to:

- document distribution, types and intensity of damage due to wildlife
- determine the major problematic animals
- identify major causes of conflicts
- assess the value of damage

1.3 Rationale

Only limited research has been done to explore the conflict related to wildlife in Shuklaphanta Wildlife Reserve. Despite a long history of human-wildlife conflict in buffer zone of this reserve, there is no comparative study in the buffer zone. This study was carried out to assess comparative human wildlife conflict in three different buffer zones of Shuklaphanta Wildlife Reserve and develop basic information required to minimize the issue of conflict.

2. LITERATURE REVIEW

2.1 Crop depredation

Crop loss by wildlife is common in the adjoining areas of parks and reserves which are considered as one of the main reasons of park people conflict. Due to limited grassland areas within park boundaries and highly nutritious supplement of food in the crop grown in the adjacent agricultural areas made possible that the wild animals may be forced to expand their defense on the peripheral agricultural land of the park (Sukumar 1990). Not all the individual of particular species raid the agricultural field. Only those animals with home range that encompasses cropland can do so (Jackson 1990).

Study of crop damage in the buffer zone of SWR revealed that highest economic loss; (74.28%) was estimated to be paddy (*Oryza sativa*), followed by wheat (*Triticum aestivum*) (17.08%) and maize (*Zea mays*) (8.62%) (Gautam 1999). Among the wild animals, highest economic loss (43.29%) was estimated by wild elephant, (28.67%) by wildboar, (24.09%) by chital and (3.92%) by blue bull with the loss of 61.62 kg to 126.33 kg per households (Gautam 1999).

In Chitwan National Park, Jnawali (1989) showed highest economic loss (27.6%) occurred in the rice crops, followed by mustard (21.9%), lentils (18.4%), maize (16.8%) and kitchen garden plants (12.5%) by rhinoceros. During wheat growing season, chital caused the greater damage, whereas during the season of maize and potato, wildboar caused greater troublesome to the villagers (Milton and Binney 1980).

Study in midhill areas (then Shivapuri National Park) revealed that rhesus monkey, wildboar, porcupine, rat and birds were the most destructive pest (a competitor of humanity) causing higher quantity loss for Maize followed by millet (*Paspalum scrobiculatum*), wheat, paddy, potato (*Solanum tuberosum*) and sweet potato (*Ipomoea batatas*). The total loss estimated for crop damage was NRs. 3, 51,618.74 and the total quantity was 19,011.4 kg per annum (Purkait and Chalise 2010).

Crop depredation by wildlife has also been reported from many protected areas of the world. In Nanda Devi Biosphere Reserve (India), loss of crop near to forest had contributed more than half of the destruction. Similarly Potato alone represents 43.6% loss and the highest lost was on Kidney beans and the least for amarantha. Concerning about crop damage, wildboar and monkey were responsible for 50-60% of the total crop depredation, however, porcupine and musk deer also did harm in food grains and horticultural crops (Rao et al. 2002). But in Sariska Tiger Reserve (Rajasthan), Nilgai and Wild Boar contributed for at least half of the total damage to the major crops (Nagoth 1998).

In Jigme Singye Wangchuk National Park (Bhutan), major financial loses annually was due to crop damage by Wildpigs, Barking Deers, Macaques and Sambars. Among them, the highest rate of damage was caused by Wild Pigs (97%) whereas the damage by Macaque increased only after the establishment of the park in 1993 (Wang et al. 2006).

On the other hand, it has been said that due to construction of Kariba Dam and Kariba Town in Africa, reduced the space originally occupied by wild animals which enhanced human wildlife conflict. Elephants, buffalos, lions, tigers, jackles and wild pigs invaded to residential areas causing great troublesome by destroying vegetable garden and fences, some preyed upon livestock while baboon entered houses, broke windows and asbestos roof sheets and tipped beans (Svotwa et al. 2007).

Similarly, 11 species of wildlife were identified as problematic in Luangwa Valley of East-Zambia among which african elephant caused the most damage (67.82%) and (98.41%) of total wet and dry farming crop incident respectively. Maize and Cotton were the most affected crops (Nyirenda et al. 2011). On the other hand, in Kaibeli National Park (Uganda), crop raiding by primate and elephant is more common due to the landscape fragmentation, decrease in size and number of wetland and forests (Hartler et al. 2010).

2.2 Livestock depredation

When livestock production constitutes a major part of local livelihood, a high level of conflict can occur between livestock owners and wildlife carnivores due to predation

(Jackson 1990). Tiger and leopard were identified as livestock depredators in Chitwan National Park (CNP) (Mishra and Margaret 1991, Sharma 1991) and Bardia National Park (Jnawali 2002). Jackal, Indian fox, common mongoose and jungle cat have been reported as livestock lifter around the CNP (Uprety 1995). Similarly Leopard, Jackal, Wild dog and Grey wolf were identified as livestock depredators in Makalu-Barun Conservation Area (Jackson 1990).

The study in three villages around Kibber Wildlife Sanctuary in India showed 189 livestock death over a period of 18 months by wild predators such as leopard and wolf, where the loss per household was found equivalent to half the average annual per capita income (Mishra 1997).

In Samburu Heartland of Africa, mostly lion, leopard and hyaena are responsible for killing of livestock (Ogada and Ogada 2004) while in Lake Mburo National Park of Uganda leopard was the most common livestock predator followed by hyaena and African rock python (Tweheyo et al. 2011).

One study in Pendjari Biosphere Reserve of Northern Benin reported that within seven years period (2000-2007), a total of 725 Livestock loses that included sheeps, goats, pigs and cattles by spotted hyaena, baboon and lion (Sogbohossou et al. 2011).

2.3 Conflict with Human

The main reason that arise conflicts between the local people and the park authorities is that government laws restrict access to the park resources in an attempt to halt natural resource utilization (Sharma and Shaw 1993). However, the park has become a very good source for villagers to fulfill their resources needs through veneering into illegal poaching, logging and hunting which directly conflict with the park objectives (Milton and Binney 1980).
12 people were killed and four were injured in tiger attacks between 1994 and 2007 and four tigers were killed due to the human tiger conflict in between 1989 to April 2009 in Bardia National Park, Nepal (Bhattarai 2009).

Within eight years (1990 to 1998), 72 % lion attack and 59 % leopard attack case took place in the farmlands in Talala sub-district on the periphery of Gir National Park (Vijayan and Pati 2002) whereas in India about 150 - 200 people were killed every year by elephants during 1980 –2000 (Sukumar 2003).

Siddiqi and Chaudhary (1987) analyzed the forest department data and found 554 human casualties in Sundarbans, Bangladesh for a period of 28 years between 1956 and 1983.

Within the period of 27 months (July 2006 - Sep 2008) a total of 265 people were killed mostly by major conflicting species such as hippopotamus and crocodiles in Mozambique. Among those, 67 % kill cases were found in the Northern Mozambique including the cases of minor conflicting species such as buffalo, hyaena and leopard (Dunham et al. 2010).

In Kalimanjaro Heartland, Muruthi et al. (2000) reported that 15 elephants had been killed within the time of one year in conflict situation with local people, representing three quarters of the local population mortality.

3. MATERIALS AND METHODS

3.1. Study area

3.1.1 Location and boundary

Shuklaphanta Wildlife Reserve (28°42’ 29”- 29°03' 27” North latitude and 80° 0' 08”- 80°25' 53” East longitude) lies in the extreme south-western part of Nepal. Initially the reserve covered an area of 155 km² and later in 1994 it was extended to 305 km² (DNPWC 2011). The reserve is bounded in the east and north by protected forest of Kanchanpur district, Lagga Bagga, a national forest of India in the south and Mahakali River in the west (Aryal and Yadav 2010). A small part of a reserve extended to the north of East-West highway creates a corridor for seasonal migration of wildlife up to the crest of Churiya Hills (DNPWC 2001). The reserve and its surrounding area comprise of flood plains of various river systems (Mahakali, Bahuni, Chaudhar, etc.) and alluvial sandy soils with altitudinal ranges between 174-1386 m above sea level (DNPWC 2001).

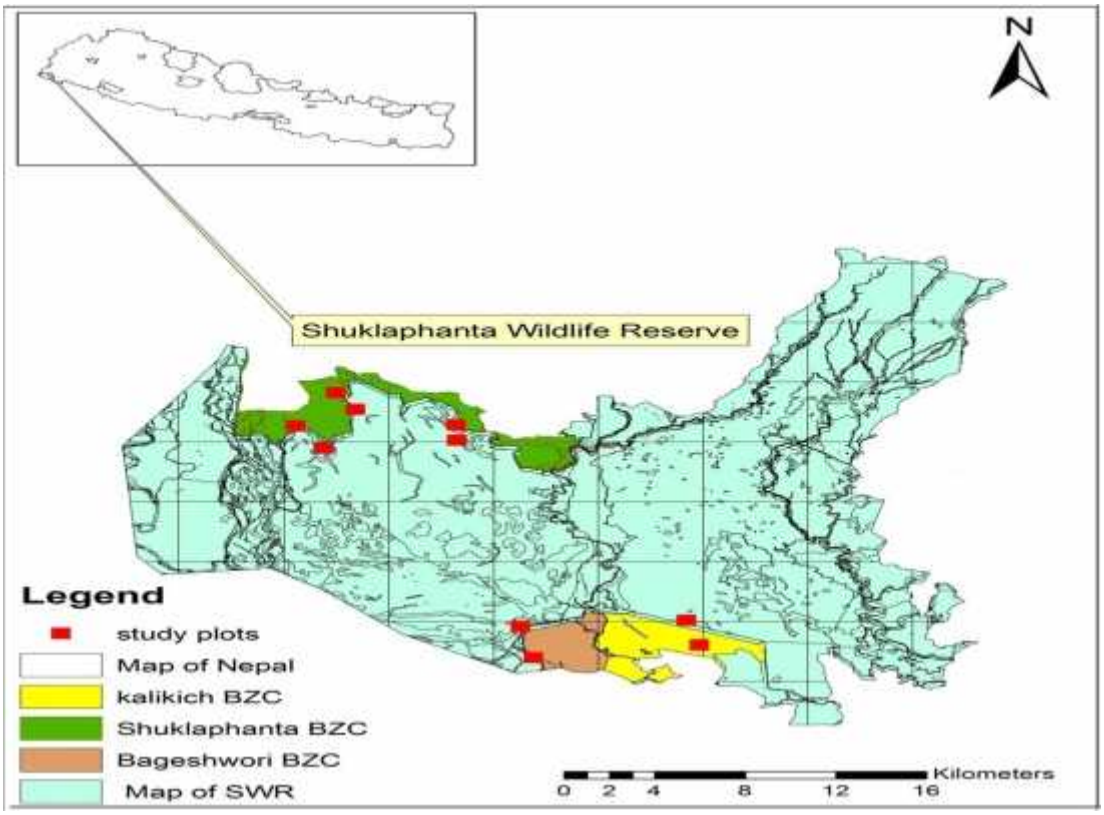

Figure 1. Map showing intensive sampling area with study plots.

3.1.2 Climate

The climate is sub-tropical with three distinct seasons. Hot and dry summer season starts from the third week of February and lasts up to June. June is the hottest month of the year with mean maximum temperature of 36.17 ºC. After monsoon season cold winter season starts and temperature reduces continuously. January is the coldest month of the year with average minimum temperature of 7.31 ºC recorded from 2000 to 2010. Monsoon (Rainy) season starts from mid June to last week of September. Maximum rainfall was recorded in August. The mean annual rainfall of the season from 2000 to 2011 was 1356.7 mm which was 78 % of the total average rainfall of the year. Relative humidity remains high throughout the year except April to June. Average minimum and maximum relative humidity recorded from 2000 to 2010 were 64.05 in April and 95.29 in January respectively.

3.1.3 Flora

Shuklaphanta is important both nationally and internationally for its extensive grasslands or phantas that constitute almost half the reserve's vegetation and a much greater area than grasslands in the rest of lowland Nepal (Baral and Inskipp 2009). The aquatic and terrestrial habitats of SWR contains more than 665 plant species belonging to 438 genera and 118 families, which is the highest, reported for any given protected area in Tarai (IUCN 2010). Out of the 665 plant species, 109 (16%) species are trees, 70 (11%) shrubs, 432 (65%) herbs, 41 (6%) climbers, 4 (01%) epiphytes and 9 others (IUCN 2010). A total of 8 species falling into different IUCN threatened categories were found in SWR. Out of these species only 2 were vulnerable, 1 rare and 1 insufficiently known (Yadav 2007). Among these wild flora, Sal (*Shorea robusta)* (52.5%) is the dominant and other flora include (2.5%) Mixed Forest, (6.5%) Riverine Forest, and (30.5%) Grassland (DNPWC 2011).

3.1.4 Fauna

More than 52 species of mammals are found in this reserve (DNPWC 2011) which is the prime habitat for Swamp deer (*Cervus duvauceli)*. The other mammalian fauna includes Hog

deer (*Axis porcinus*), Barking deer (*Muntiacus vaginalis*), Spotted deer (*Axis axis*), Blue bull (*Boselaphus tragocamelus),* Wild Boar (*Sus scrofa*) and endangered species such a Tiger (*Panthera tigris),* Elephant (*Elephas maximus),* Rhino (*Rhinoceros unicornis*) and Hispid Hare (*Caprolagus hispidus*) (Aryal and Yadav 2010).

The Reserve supports 424 species of birds such as endangered Bengal Florican (*Eupodotis bengalensis),* Swamp Francolin (*Francolinus gularis*), Grass Owl (*Tyto capensis*), and Large grass Warbler (*Graminicola bengalensis).* Other birds which inhabit Shuklaphanta are Sarus Crane (*Grus antigone*), Lesser Adjutant (*Leptoptilos javanicus*), Oriental Pied Hornbill (*Anthracocerus coronatus),* Giant Hornbill (*Buceros bicornis)* and Common Pea Fowl (*Pavo cristatus)* (DNPWC 2011). Other faunal diversity includes more than 2 species of Reptiles, 20 species of Amphibians, 21 species of Fishes and 35 species of Butterflies (Yadav 2007).

Densities of ungulates in SWR are found to be 108.32 animals/km^2, with Spotted deer (55.58 animals/km^2) followed by Swamp deer (37.03 animals/km^2), Hog deer (6.50 animals/km^2), Wild pig (5.54 animals/km^2), Barking deer (3.48 animals/km^2) and Blue bull (0.19 animals/Km^2) (Yadav 2007).

The population of greater one-horned Rhinoceros (*Rhinoceros unicornis*) was 7 (male 2, female 2, unknown adult 2 and unknown young 1) in 2011 (DNPWC 2011). It is said that 3-5 elephants permanently reside in shuklaphanta wildlife reserve while other migrate seasonally from the border districts of Indian state (Uttar Pradesh) (Rangarajan et al. 2010).

3.1.5 Socio-economic aspects

The oldest and original inhabitants of this region are Tharu communities who have been living in the area even before the establishment of SWR (Bhattrai et al. 2008). In the past, they lived in enclaves of dense forests, kept different types of livestock and practiced shifting agriculture but this practice does not exist today due to shrinkage of forest cover (Bista 1987). After the eradication of malaria in 1950s hill people migrated to the Tarai where Tharu become the minor community (Sharma 1991). Nowadays, these Tharu communities are facing complex problems and threats to their livelihood. Regarding caste/ethnicity

composition of household in the buffer zone, about 62 percent of households belonged to Brahmin/Chhetri/ Thakuri castes, followed by Kami/ Damai/ Sarki (18%) and Tharu (19.35%), and others (7%) respectively (Yadav 2007).

Traditionally, local people depend upon the forest products (timber and non timber) for their subsistence economy. Agriculture is the major economic enterprise and people here cultivate paddy, maize, wheat, mustard, peas and other lentils. In addition to this, they also raise multiple species of livestock such as cow, buffalo, ox, goat and sheep for their livelihood (WWF 2007).

3.2 Intensive sampling area

The intensive sampling was done in the VDCs adjacent to three buffer zone areas of SWR such as Kalikich Buffer Zone User Committee (KBZUC), Bageshwori Buffer Zone User Committee (BBZUC) and Shuklaphanta Buffer Zone User Committee (SBZUC). Kalikich and Bageshwori buffer zones lie in the southern section of the park whereas Shuklaphanta buffer zone lies in the northern section.

Table 1. BZUC, VDCs, wards, population and household of the study area

Buffer Zone User Committee (BZUC)	**Village Development Community (VDC)**	**Wards**	**Total households**	**Population**
Shuklaphanta	Bhimdutta Municipility	13,14,15,16, 17,18	3288	20847
Kalikich	Beldandi	7,8,9	2311	14739
	Rampur Bilaspur	8,9		
Bageshwori	Beldandi	1,2,5,6	1638	8926
	Rauteli Bichuwa	7,8,9		

(Source: NTNC-SCP 2065)

3.3 Reconnaissance survey

The reconnaissance survey was conducted in January 2012 to have the background knowledge of the study sites and its design. Shuklaphanta, Kalikich and Bageshwori Buffer Zone User Committee areas were selected. Information about the main pest species, damage area, cause of conflict were gained from personnel involved in conservation sectors and local peoples.

3.4 Research design

Plots were established both in the northern and southern site of the reserve. In each site at least two plots/quadrate (10X10 m^2) were established randomly (one inside and one outside the reserve). The plots inside the reserve were established to estimate the frequency of livestock while the plots outside the reserve were established to estimate the frequency of wildlife. The northern site (SBZUC) with its large adjoining area with reserve has six plots (3 inside and 3 outside) while the southern site (KBZUC and BBZUC) had four plots (2 outside and 2 inside). These plots were observed for three seasons to explore data on conflicting species, frequency of their visit and intensity of damage (Table 2).

Table 2. Research design

SITES		**SEASONS**		
		WINTER	**SUMMER**	**AUTUMN**
Northern site	Inside	3 Plots	3 Plots	3 Plots
	Outside	3 Plots	3 Plots	3 Plots
Southern site	Inside	2 Plots	2 Plots	2 Plots
	Outside	2 Plots	2 Plots	2 Plots

3.5 Field visits and observation

Observation is the basic tool for the collection of qualitative data in the fieldwork. Observations were done following Hygnstrom et al. (1994) and Tweheyo et al. (2010) to explore animal signs and marks for identifying the types of vertebrate pest species feeding on particular crops in three different seasons. Winter season field observations and data collections were done during February 2012 and that of summer during June, 2012 and of autumn during October 2012.

3.5.1 Frequency estimation

Frequency of the livestock and wildlife visits inside and outside the reserve were estimated by using the plots. Foot marks of wildlife and dung of livestock were identified by following the method of Hygnstrom et al. (1994). This helps to identify the distribution and intensity of damage.

3.5.2 Questionnaire survey

Two sets of questionnaire were prepared, one for local people (Annex I) and the other for park officials (Annex II). These questionnaires contained both close and open ended questions. Altogether, 233 Households (HHs) (10 % of total households) were interviewed using systematic random sampling method in February 2012 in Shuklaphant (113 HHs), Kalikich (68 HHs) and Bageshwori (52 HHs). Respondents were interviewed to ascertain the distribution and type of damage, major problematic pest species, causes of conflict, and the protective measures adopted against the pests species.

3.5.3 Crop Loss estimation

The information obtained from the questionnaire was introduced into the statistical tool to assess the crop loss. The following formula was used.

Total Crop Loss (kg) = Expected yield before crop loss – Actual yield after crop loss

$$\text{Crop Loss per Household (kg)} = \frac{\text{Total crop loss (kg)}}{\text{Total no. of Households Cultivating that crop}}$$

Total Economic Loss (Rs.) = Price of crop (Rs.) × Total Crop Loss (kg).

The losses of crops were estimated in local scale "Bori" which was converted into kilogram. Rate of different crops were obtained from the department of agriculture.

3.6 Data analysis

The collected data were analyzed qualitatively as well as quantitatively. Questionnaire responses were edited, coded and analyzed using Ms-Excel 2007 to generate crop loss, mitigation measures and time of wildlife conflict. Similarly, R-software 2.37.1 version was used to compare data of crop loss according to study sites.

Wilcox test through SPSS 16.0 version was used to find the significant difference in frequency of wildlife and livestock between northern (Shuklaphanta) and southern sites (Kalikich and Bageshwori) of the reserve. It is a non-parametric student's t-test, used when data are not normally distributed. Similarly, Kruskal-Wallis Rank Sum Test was adopted to find out the difference in frequency of visits of wildlife and livestock in each plot in various seasons. It is a non- parametric test which is alternative to ANOVA when the data are not normal. The use of T-test and ANOVA was used to test the following null hypotheses:

H0: There was no significant difference in crop loss and frequency of wildlife and livestock between two sections of the reserve.

H0: There was no significant difference in frequency of wildlife and livestock conflict in different seasons.

4. RESULTS

4.1 Distribution, Type and Intensity of damage by wildlife

4.1.1 Distribution of damage

Mostly the damage was caused outside the reserve in the buffer zone communities by wildlife (human injury, livestock depredation and damage of physical structures) and to some extent by human inside the reserve (livestock grazing, firewood collection and wildlife killing). Majhgaun and Pipariya of Shuklaphanta BZUC were most frequently affected by the activity of wild elephants. Other types of conflicts occurred mostly in Jhilmila and Beldandi areas. Bageshwori BZUC was also the victim of such types of damage (Annex III).

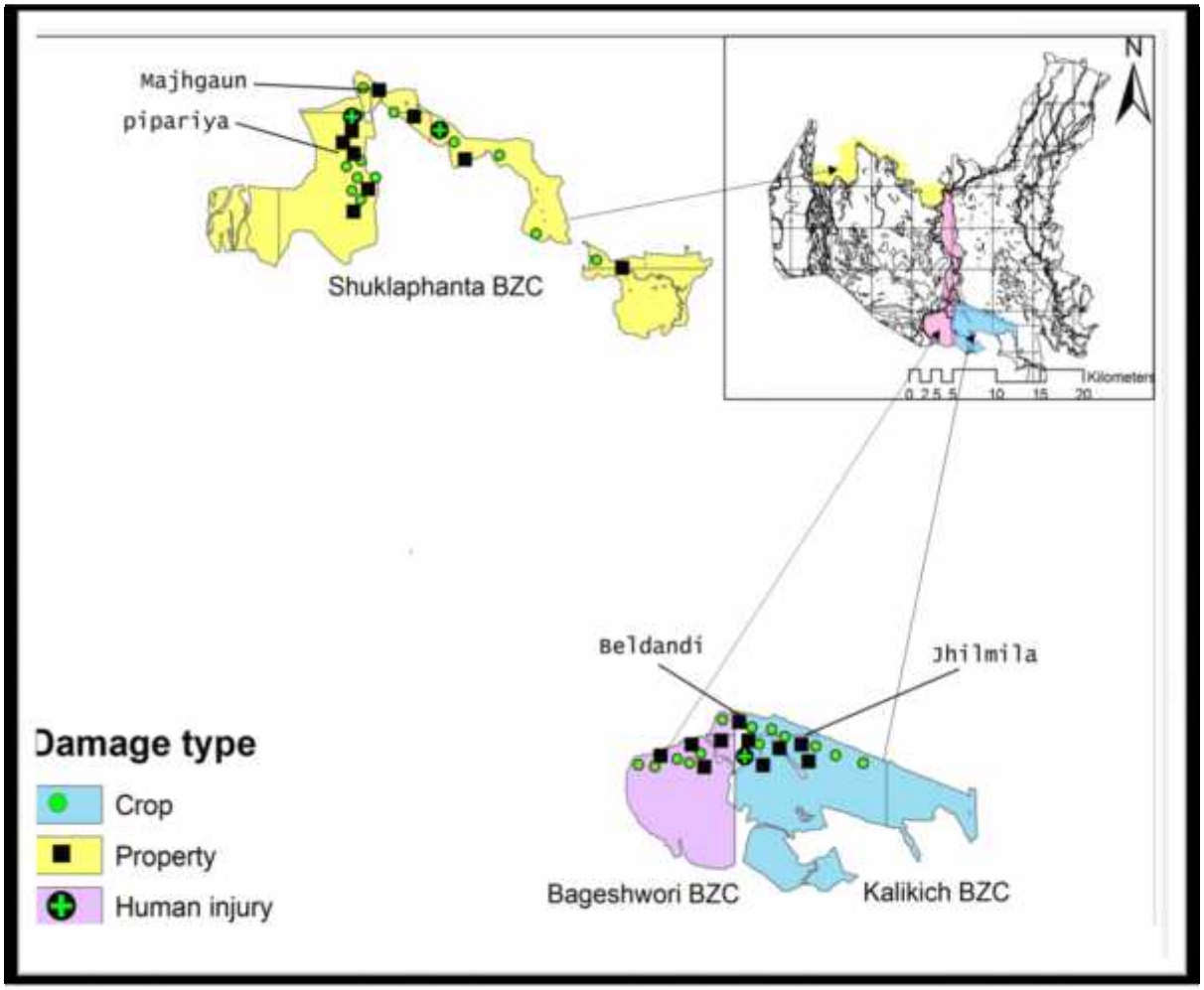

Figure 2. Distribution of damage by wildlife in each Buffer Zone User Committee

4.1.2 Types of damage

The questionnaire survey with households and data provided by buffer zone management committee revealed that crop loss, property/physical structure damage (house/shed/toilet etc.), livestock depredation and human injury were most common in the buffer zones. Approximately 70 % of the respondents had experienced only crop loss, 24% and 4% of the respondents had experienced property and livestock loss respectively. Human injuries by the wildlife in the study area were low (2%) as compared to other damage.

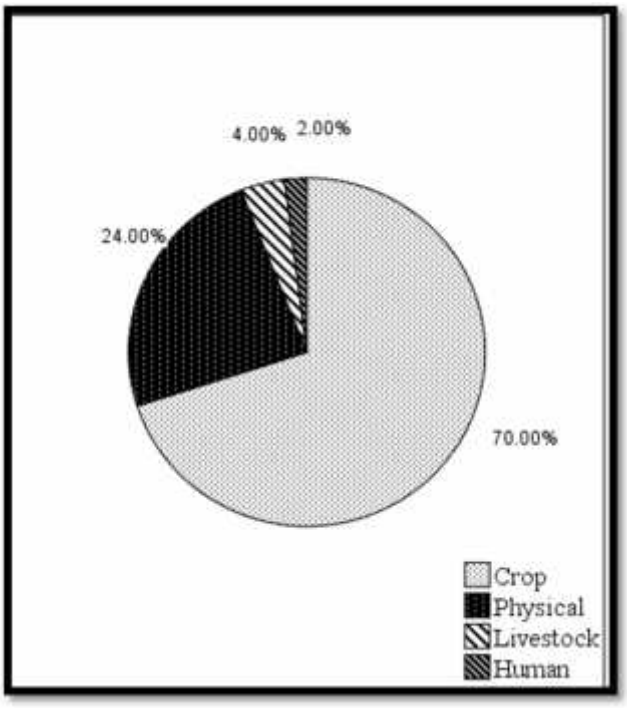

Figure 3. Total property damage in percentage

4.1.2.1 Crop damage by wildlife

Most of the people in SWR are engaged in agriculture. The major crops grown are wheat, rice, mustard, maize, pulses and vegetables. In Shuklaphanta Buffer Zone User Committee, wheat was planted in 1556.5 kattha (N=113 respondents), mustard in 152 kattha (N=63), paddy in 1566 kattha (N=113), maize in 1215 kattha (N=53), pulses in 122.2 kattha (N=113) and vegetable in 96.1 kattha (N=106). There was a total crop loss of 75925 kg by weight and a total economic loss of Rs.1192335 per annum and loss of Rs.10935.14 per household. Wheat damage accounted for 29.37 % of loss by weight, paddy (20.43%), mustard (18.11%), maize (10.72%), pulses (25.23%) and vegetable (15.75%).

Table 3. Quantity of crop and economic loss due to wildlife in Shuklaphanta BZUC

Name of crop	Land cover (Kattha)	Total loss (Kg)	Total Loss (Rs)	Loss Per HH (Kg)	Loss per HH (Rs)
Wheat	1556.5	33960	543360	300.53	4808.48
Mustard	152	676	40560	10.73	643.8
Paddy	1566	37835	529690	334.84	4687.76
Maize	121.5	532	7980	10.03	150.45
Pulses	122.2	769	38450	6.80	340
Vegetables	96.1	2153	32295	20.31	304.65
Total	**3614.3**	**75925**	**1192335**	**683.24**	**10935.14**

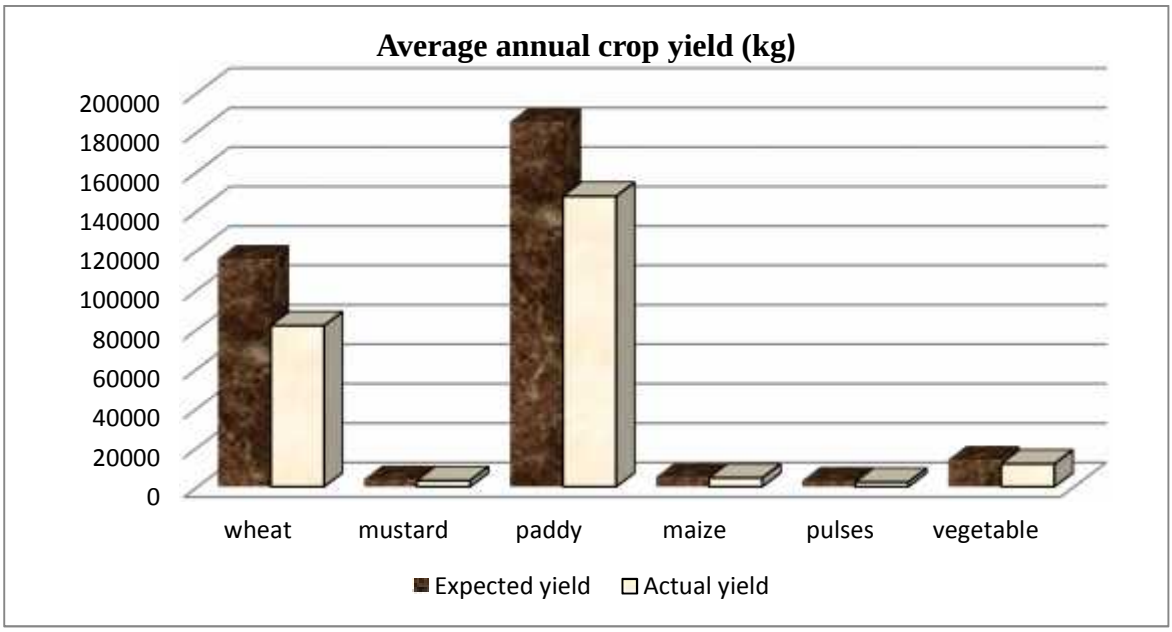

Figure 4. Average annual yield of crop in Shuklaphanta BZUC.

In Kalikich Buffer Zone User Committee, wheat was planted in 771.5 kattha (N=68 respondents), mustard in 85.5 kattha (N=49), paddy in 667.5kattha (N=68), maize in 46.5 kattha (N=37), pulses in 60.4 kattha (N=68) and vegetable in 56.5 kattha (N=68).

There was a total crop loss of 38273.5 kg in weight and total economic loss of Rs.702510 per annum and loss of Rs.8742.57 per household. Wheat damage accounted for about 37.84 % of loss in weight, paddy (27.78%), mustard (6.31%), maize (14.88%), pulses (17.95%) and vegetable (11.10%).

Table 4. Quantity of crop and economic loss due to wildlife in Kalikich BZUC

Name of crop	Land cover (Kattha)	Total loss (Kg)	Total Loss (Rs)	Loss Per HH (Kg)	Loss per HH (Rs)
Wheat	771.5	18780	30040	267.17	4274.72
Mustard	85.5	344	20640	7.02	421.2
Paddy	677.5	18130	253820	266.6	3732.4
Maize	46.5	209	3135	5.64	84.6
Pulses	60.4	231.5	115750	2.04	102
Vegetables	56.5	579	8685	8.51	127.65
Total	**1697.9**	**38273.5**	**702510**	**556.98**	**8742.57**

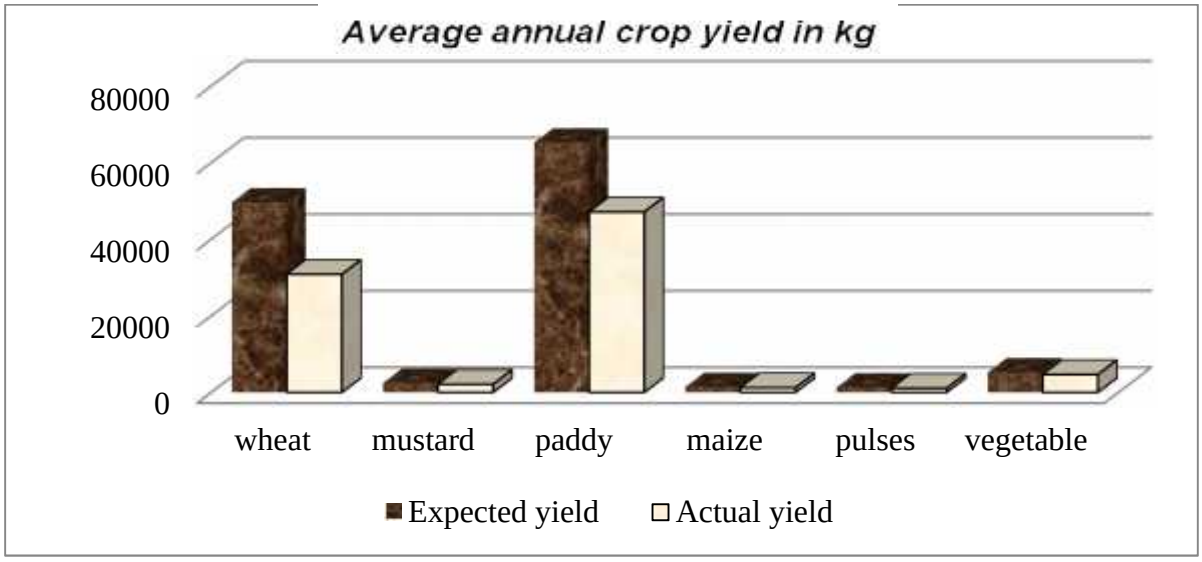

Figure 5. Average annual crop yield in Kalikich BZUC.

In Bageshwori Buffer Zone User Committee wheat was planted in 940 kattha (N=52 respondents), mustard in 42.5 kattha (N=41), paddy in 897kattha (N=52), maize in 60 kattha (N=32), pulses in 53.5 kattha (N=52) and vegetable in 53 kattha (N=52). There was a total crop loss of 28937 kg in weight and total economic loss of Rs.441310 per annum and loss of Rs.8613.65 per household. Wheat damage accounts for about 23.66 % of loss in weight, paddy (20.98%), mustard (14.47%), maize (15.19%), pulses (15.25%) and vegetable (2.08%).

Table 5. Quantity of crop and economic loss due to wildlife in Bageshwori BZUC

S.No.	Name of crop	Land cover (Kattha)	Total loss(Kg)	Total Loss(Rs)	Loss Per HH (Kg)	Loss per HH (Rs)
1	Wheat	940	10380	166080	199.6	3193.6
2	Mustard	42.5	188	11280	4.85	291
3	Paddy	897	17255	241570	331.8	4645.2
4	Maize	60	299	4485	9.34	140.1
5	Pulses	53.5	162	8100	3.11	155.5
6	Vegetables	53	653	9795	12.55	188.25
Total		**2046**	**28937**	**441310**	**561.25**	**8613.65**

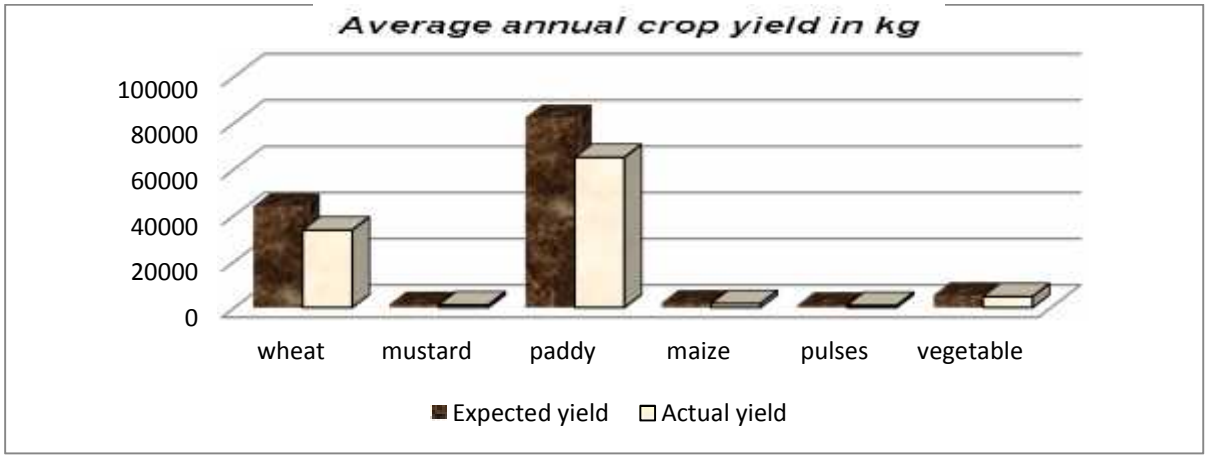

Figure 6. Average annual yield of crop in Bageshwori BZUC

Wilcox test (non parametric t- test) for mean crop loss per kattha in Shuklaphanta BZUC (northern section) and Kalikich BZUC (southern section) revealed that there was no significant difference (P value = 1) whereas Shuklaphanta (northern section) and Bageshwori (southern section) also did not show the significant difference in mean crop loss per kattha (P value = 0.093). Kalikich and Bageshwori also did not show significant difference in mean crop loss per kattha (P=0.56).

4.1.2.2 *Property damage, livestock predation and human injuries by wildlife*

Threats by wildlife to physical property and livestock were higher while the human casualties were low (Figure 3). Mostly tiger, elephant, leopard and jackal were the problematic wildlife species causing human injury, physical damage and livestock killings with an estimated loss of worth Rs. 531000 between years 2061-69. But the SWR paid a compensation of only Rs. 268795 (Annex III).

4.1.3 Intensity of damage

4.1.3.1 Through direct field observation

The direct observation revealed that all three BZUC had high intensity of damage during winter seasons while it was moderate during summer. In autumn, SBZUC and BBZUC had moderate intensity of damage whereas as KBZUC had low intensity of damage.

Table 6. Intensity of damage in three BZUCs observed through direct observation.

	Seasons		
Buffer Zone User Committee	**Winter**	**Summer**	**Autumn**
Shuklaphanta BZUC	High	Moderate	Moderate
Kalikich BZUC	High	Moderate	Low
Bageshwori BZUC	High	Moderate	Moderate

High (>60%), Moderate (30-60%), Low (<30%)

4.1.3.2 Frequency of wildlife visits through Foot marks

Frequency of wildlife through Foot marks within the highly affected areas was high. Wilcox test according to sites (northern and southern sites) revealed that chital and porcupine showed a significant difference while other wildlife did not show the significant difference. Kruskal Wallis test (non parametric ANOVA test) revealed that chital and monkey showed significant difference in Foot marks while the other wildlife did not show the significant difference in foot marks according to seasons at 95% confidence interval (Table 7).

Table 7. Frequency of wildlife through foot marks according to sites (northern and southern) and seasons.

According to sites (Wilcox test)			**According to seasons (Kruskal Wallis test)**	
Animals	**P-value**	**Accepted hypothesis**	**P-value**	**Accepted hypothesis**
Chital	**0.018**	Alternative-hypothesis	**0.007**	Alternative-hypothesis
Wild boar	0.156	Null-hypothesis	0.274	Null-hypothesis
Elephant	0.845	Null-hypothesis	0.070	Null-hypothesis
Rhino	0.915	Null-hypothesis	0.468	Null-hypothesis
Monkey	0.156	Null-hypothesis	**0.013**	Alternative-hypothesis
Peacock	0.308	Null-hypothesis	0.419	Null-hypothesis
Porcupine	**0.026**	Alternative-hypothesis	0.192	Null-hypothesis
Nilgai	0.514	Null-hypothesis	0.700	Null-hypothesis

Frequency of livestock inside the reserve as indicated by the presence of dung and their active presence did not show the significant difference between the northern and southern section of the reserve (T value = -0.414 and 0.687 respectively). Similarly there is no significant difference in frequency of dung and livestock according to seasons (F value = 0.372 and 0.194 respectively) (Table 8).

Table 8. Frequency of dung and livestock inside the reserve according to sites and seasons.

Categories	**P- value**		**Remarks (Accepted hypothesis)**
	Sites	**Seasons**	
Dung	0.686	0.697	Null-hypothesis
Livestock	0.504	0.827	Null-hypothesis

4.2 Major problematic animals

Eight species including Chital, Wild Boar, Elephant, Rhino, Nilgai, Peacock, Porcupine and Monkey were the problem animals in the study area. Among them Chital, Wild boar, Elephant and Nilgai were the most common wildlife species that conflicted with people. In Shuklaphanta Buffer Zone User Committee, 92% of the respondents claimed chital as the most problematic wildlife pest followed by wild boar (86%) and elephant (77%). More than 85% of the respondents in Kalikich Buffer Zone User Committee claimed wildboar the most conflicting species followed by Nilgai (80%) and Elephant (74%). In Bageshwori Buffer Zone User Committee 90% of the respondent found elephant the highest conflicting species followed by Chital (85%) and Wild boar (77%) (Figure 7).

Tiger and leopard were also the conflicting species for livestock predation and human casualties. Foot marks of various species and their indirect signs also indicated their active presence in the area.

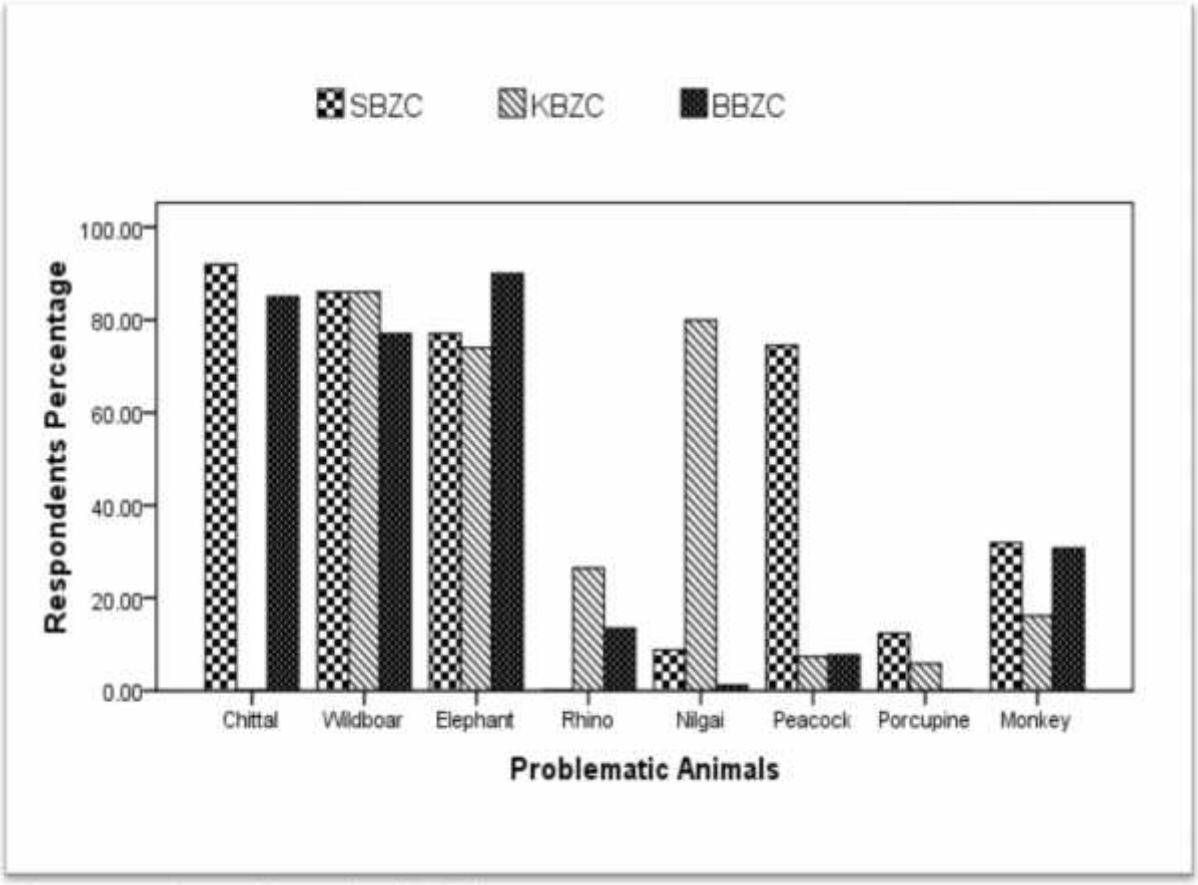

Figure 7. Major problematic animals in SBZUC, KBZUC, BBZUC

4.3 Major causes of conflicts

There were several causes of conflict in the study area. Most of the respondents (>35%) believed that food deficiency inside the reserve was the main cause for the wild animals to visit crop land. Furthermore, absence of fences in the boundary areas, increase in the number of wild animals, deforestation and animals search for palatable food and water are other causes of conflict in the study area (Figure 8).

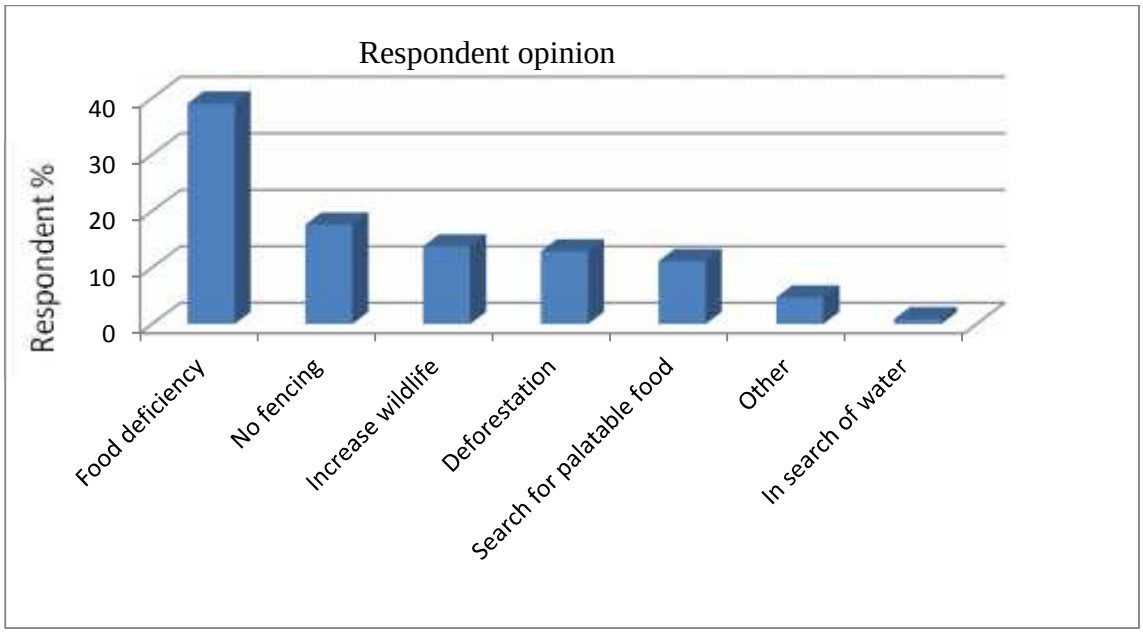

Figure 8. Causes of conflict in Shuklaphanta Wildlife Reserve.

4.4 Valuation of damage

Crop loss was high in every BZUC as compared to property damage. Shuklaphanta Buffer Zone User Committee had the highest loss (Rs 11,92,335) followed by Kalikich (Rs 7,02,510) and Bageshwori (Rs 4,41,310) (Table 9). In each VDC, the loss value in monetary terms was the highest for wheat followed by paddy and mustard.

Table 9. Total damage of crops in each Buffer Zone User Committee.

	Shuklaphanta BZUC	**Kalikich BZUC**	**Bageshwori BZUC**
Name of crops	Total Loss (Rs)	Total Loss (Rs)	Total Loss(Rs)
Wheat	543360	30040	166080
Mustard	40560	20640	11280
Paddy	529690	253820	241570
Maize	7980	3135	4485
Pulses	38450	115750	8100
Vegetables	32295	8685	9795
Total	**11,92,335**	**7,02,510**	**4,41,310**

A total compensation of Rs.268795 has been given for the damage but it was much less as compared to the total property damage. The affected people estimated about Rs 531000 for their loss (Table 10).

Table 10. Total compensation provided by SWR for damage and their expected amount.

Buffer Zone User Committee				
	Shuklaphanta	**Kalikich**	**Bageshwori**	**Total**
Total compensation	107595	41800	119400	268795
Expected amount	140000	136000	255000	531000

Domestic cattle and human beings had also caused higher value of damage towards the reserve. Cattle grazing and forest resources use by humans caused a total loss of Rs. 1,10,70,000 (Annex V).

Questionnaire survey showed that most of the respondents encountered with the wild animals several times. Wild boar was the most encountered wildlife followed by Elephant, Chital and Nilgai. Most of the people (66%) encountered with the wild animals during nights, some (23%) during day time and other (11%) did not specify the time of encounter.

People in the buffer zone used a number of protective measures against raiding vertebrates. Some commonly used methods were noise making tools as clapper and drum, scaring device, chasing with fire and stones, guarding during nights, release of dogs, etc.

5. DISCUSSION

The degree and extent of human-wildlife conflict is determined by multiple factors, which may be influenced either by human or wildlife or both. Migration of people from different areas for the better agricultural products, demand for firewood, fodder and constructing materials causes pressure on the forest. Whereas, killing of livestock, raiding of crops and damage to the physical structures by wildlife determine the extent and nature of conflict in that area (Ayadi 2010).

Distribution of Damage

All nine buffer zone communities in SWR experienced some form of human-wildlife conflict. Among the three buffer zones of my research area, Majhgaun of SBZUC and Jhilmila of KBZUC were highly affected by the damage. Higher damage might be due to the agricultural and residential areas close to the reserve (Figure 2). Bhandari (2011) and Khatiwada (2008) also found low crop damage where the cultivated land was far from the forest in SWR and Kanchenjunga Conservation Area (KCA) respectively. Tamang (2012) in Bhaktapur district found the moderate positive corelation between lengths of the corridor from nearby community forest. The extent of crop damage varied with the distance of agricultural field from the park boundary and location of field corp. Bagmara, Laukhane, Jankauli and Harnaria areas received damage during all cropping seasons due to their location close to the park forest in Chitwan (Jnawali 1989). Nepal and Weber (1993) found out that the intensity and magnitude of conflict were higher in the settlements located near to the park.

Types of Damage

In the study area crop damage, physical property damage, livestock killing and human injuries were the four major types of damages. In all the study buffer zones of SWR, damage

to wheat was the highest among other crops. Average damage each HH per year of wheat was 300.53 kg in SBZUC, 267.17 kg and 199.6 kg in KBZUC and BBZUC respectively. The higher damage of wheat was probably due to more palatability and protein richness than the food plants inside the reserve during late wet season (Sukumar 1989). At Bardia National Park maize damage was in higher ratio followed by wheat (Ayadi 2010) but in Koshi Tappu Wildlife Reserve (KTWR) most of the damage was caused to wheat by wildlife in young to adult milky stage (Limbu and Karki 2003) which was similar to my finding in SWR.

Property damage by wild animals is the second major problem. Among those study areas, SBZUC had the highest number of incidents. This might be due to the fact that SBZUC has larger area with highly dense human population adjacent to the reserve. Wild male elephant is responsible for higher damage followed by leopard, rhino and jackal. The elephant cause higher damage at the time in search of estrous female (WWF 2007), although this case did not happen during this study period. Bhandari (2011) reported that the wild elephant was the major contributor for higher monetary loss in three buffer zones of SWR. Gautam (1999) reported that two persons were killed by male elephant during her field study.

Very few cases of human-carnivore conflict were recorded. This might be due to the presence of higher number of prey species in their habitat. Karki (2011) compared overall density of prey species of SWR with overall densities of other protected areas of Nepal, reveals that SWR has highest density of ungulates followed by CNP and PWR (Parsa Wildlife Reserve).

Intensity of Damage within sites and seasons

Winter seasons had higher intensity of damage than any other seasons. Frequency of most wildlife and livestock through Foot marks and faces did not show the significant difference among sites and seasons. There was a significant difference in frequency of visit of chital and porcupine within sites (northern and southern) while the other wildlife did not show significant difference (Table 6). The significance difference between chital and porcupine might be due to the forest area on one site and the grassland area on the other (DNPWC

2011). The reason beside this might be the distance of agricultural field from the boundary area of the reserve.

Foot marks of chital and monkey showed a significance seasonal difference (Table 6). Chital preferred mostly rice during monsoon seasons (June- July) when immature stage of rice is ready, whereas monkeys prefer maize during summer (June- August) when it becomes fully mature.

Frequency of livestock through dung and their active presence inside the reserve did not show significant difference according to sites and seasons. This is due to presence of higher number of livestock in both the side of reserve on which they fully depend upon for grazing. Other reason beside this might be due to lack of fence at the point of entry.

Ranking of conflicting species

In my study, 92% respondents of SBZUC claimed chital as the most conflicting pest species followed by wild boar (86%) and elephant (77%). This might be due to the fact that this BZUC constitutes higher grassland nearby the agricultural land. These species are nocturnal and group raiders which make the villagers difficult to detect for chasing them from their agricultural field (Ayadi 2010). Gautam (1999) ranked chital as the first major pest species in five wards of Mahendranagar Municipality (SBZUC) which was similar to my result. In KBZUC (86%) of the respondents found wildboar the most conflicting species, followed by blue bull (80%) and elephant (74%). Gurung (2002) identified wild boar (major) and bear, monkey, porcupine, rat and birds (minor) crop raider in then Shivapuri National Park. In BBZUC (90%) of respondents believed that wild elephant were the major conflicting species followed by chital (85%) and wildboar (77%) which was almost similar to Baral (1999) who reported wild elephant, wild boar and chital as the first, second and third major pest species respectively in then RBNP.

Causes of conflicts

Local people believed that natural food deficiency was the major cause of conflict in the reserve. Lack of fence, increase in number of wildlife, deforestation, search of palatable food and water were the main reasons for the attraction of wildlife towards the agricultural field. During the field study it was observed that the cattle reached up to 4km (approx.) inside the reserve boundary for grazing. Grazing larger number of livestock in the forest area reduce the quality and quantity of forests, which influence the conflict in the area. Food deficiency, increase in number of wildlife, search of palatable food and water were the causes of conflict in Banke National Park (Ayadi 2011) which was similar to my finding in SWR. Limbu and Karki (2003) also observed lack of sufficient food in the reserve, palatability of field crops and lack of fences in the boundary of the reserve were the causes of conflict in KTWR.

Valuation of damage

In SBZUC, a total crop loss was estimated to be Rs. 11, 92,335 (Table 2) whereas loss of Rs.7, 02,510 (Table 3) and Rs. 4, 41,310 (Table 4) were reported in KBZUC and BBZUC respectively. Gautam (1999) estimated the total loss of 82,230.53 kg in ward numbers 13,14,15,18 and 19 of SBZUC. Her estimation was higher than the present estimation of 75,925 kg. This was probably due to the inclusion of ward number 19 which is more affected by wildlife in Gautam's study. Wild elephant alone caused a loss of Rs. 3391.76 per household in SWR (WWF 2007). The present study included eight wildlife species, hence the loss was found higher than the report of WWF (2007). In Kalikich and Bageshwori BZUCs, Dhami (2011) found the total loss of Rs. 281400 per year which was far less than my finding of Rs.1143820. He estimated the loss of only four crops (paddy, wheat, sugarcane and lentils) by single pest species elephant but I have estimated the loss of six crops by eight species. Similar result was also seen in Bardia National Park. Baral (1999) estimated a total loss of Rs. 20, 95,336 in then RBNP but it was different from then RCNP (Sharma 1991).

Damage to property by wildlife differs according to time, seasons and number of wild animals. In SWR the compensation of Rs. 2, 68,795 were provided (from the year 2061-

2069). Only a few respondents received compensation for their losses and they were not satisfied with the amount of compensation they received because it did not fully cover their losses.

Local people believed that the wildlife has increased in the reserve because they regularly encounter with them during night time. Wild boar was the most encountered species because it is found in almost all forested habitats including highly degraded and fragmented one (Sukumar 1994). HWC is managed through variety of preventive and protective approaches which include application of noise making instruments (drums, tins), use of scaring devices, chasing, throwing stones and release of dogs. But the effectiveness of these techniques was decreasing as wildlife became habituated. Behavioral flexibility of wildlife thereby enabling them to quickly modify their foraging strategies in response to the protective measures was believed to be one of the major reasons for conflict (WWF 2007). Guarding over night in Machan (guarding hut) was found to be effective but they did not prefer it due to the difficulty in guarding whole day and night. Use of local technology in combination with some new self sustaining techniques has proved effective. Application of electric fencing along with Wildlife Damage Relief Fund (WDRF) became more effective technique in BNP, SWR and CNP to reduce the HWC (WTLCP 2010).

6. CONCLUSION AND RECOMMENDATIONS

This study conducted during January 2012-November 2012 showed that the distribution of damage caused by wildlife was high in areas near the reserve. Majhgaun and Jhilmila were the areas with higher damage. Crop damage, property/physical damage, livestock depredation and human injuries were the major types of damage. Damage to crop and physical property was higher in SBZUC by wild elephant. Tiger, leopard and jackal were the major livestock predators. Frequency of chital and porcupine visiting to cropland was remarkably different in different sites (northern and southern) whereas chital and monkey were significantly different in different seasons.

There were eight major problematic species including chital, wild boar, elephant, rhino, monkey, porcupine, peacock and nilgai while chital, wild boar and elephant were the major crop raiders.

Increased damage by wildlife was due to food deficiency in the habitat, increase number of wildlife, lack of physical barrier and structure to control wildlife movement into the private property.

Crop damage and physical/property damage was the major problem faced by the people in the study area. An estimated total economic loss was of Rs. 11, 92,335, Rs.7, 02,510 and Rs.4, 41,310 per annum for crop loss in SBZUC, KBZUC and BBZUC respectively. Property damage was of higher value as compared to the compensation of Rs. 2, 68,795.

The trend of human wildlife conflict was increasing due to which people kill wildlife by trapping or chasing them. The use of traditional preventive measures such as making noise, drumming, fencing guarding by both people and dog were partially successful to chase wild animals.

Based on the research, following recommendations have been derived:

- Good and effective physical barriers (e.g., strong wall with wire fencing on it) should be constructed in Majhgaun and Jhilmila areas to prevent wildlife entering into the human habitat.
- Behavioral study of the most conflicting species should be done in order to confine them within the boundary of reserve by protecting their habitat, live food and creating water sources, which are lacking inside the reserve.
- Proper compensation for all types of losses/damages should be provided to help people in making the positive attitude towards the conservation of wildlife.
- Local villagers should be encouraged to introduce better breeds of livestock which reduce open grazing so that the reserve will have sufficient food for the wildlife.

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Annex I

Questionnaire survey for households

(Banjade, M.R. 2011/12 survey)

Name…….. Religion……

Ward no……. Occupation……

Household no…… VDC……..

1. How many members are there in your family?

   1-4 ( ) 5-8 ( ) >8 ( )

2. How much land do you have?

   Kattha -

   < 1 ( ) 1-10 ( ) 10-20 ( ) >20 ( )

3. How many Crops do you grow in a year?

Rice Wheat Maize Mustard pulses Vegetable

4. Which Crop do you grow in how much land?

	Bigha	Kattha
Paddy		
Wheat		

Maize

Pulses

Mustard

Other

5. Have you seen any wild animals in your field? If yes then which?

Chital ( ) Wild boar ( ) Elephant ( ) Peacock ( ) others ( )

6. Which is the most frequently occurring species?

Chital ( ) Wild boar ( ) Elephant ( ) Peacock ( ) other ( )

7. Do they come in single or group?

1 ( ) 1-5 ( ) 5-10 ( ) >10 ( )

8. How often do they come?

Every day ( ) Two times a week ( ) Once a week ( ) occasionally ( )

9. When does it enter in the field?

Day ( ) Night ( )

10. Which crop do they prefer the most?

Rice Wheat Maize Mustard pulses Vegetable

10. What was the total loss of crop?

Paddy –

Wheat –

Maize –

Mustard_

Pulses –

Vegetable –

11. If there was no damage what would have been the total production?

Paddy –

Wheat –

Maize –

Mustard-

Pulses –

Vegetable –

12. Have you applied any protective measure to stop the damage?

Yes ( ) No ( )

13. Then what is the measure?

- ( ) Chasing them away by throwing stones.
- ( ) Shout and make noise.
- ( ) Guarding over night.
- ( ) Scare crow.

14. Do you think the damage problem is growing every year?

Yes ( ) No ( )

15. What are the types of conflict beside crop?
    - ( ) Damaging house
    - ( ) Injured human
    - ( ) Kill livestock
    - ( ) Others

16. What are the causes of conflict?
    - ( ) more wildlife
    - ( ) no fencing
    - ( ) deforestation
    - ( ) food shortage
    - ( ) other

17. What do you suggest to this problem?

18. Have you ever got any compensation for your damage?

Yes ( ) No ( )

If yes then how much 1-1000 ( ) 1000-2000 ( ) >2000 ( )

19 Despite damage do these animals need protection? Why.

Yes-……

No-……..

Annex II

Questionnaire to the reserve authority

(Banjade, M.R. 2011/12 survey)

Name…….. Designation……

Institution……... Add of institute……..

1) How long have you been working in this field?

2) Do people affect in the management of SWR?

3) Who are causing effect here?

a) Local b) Other than local

4) What is the effect of the people who live near by the reserve?

a) Cutting grass b) Stole firewood c) Livestock grazing d) Killing Livestock
e) Breaking Fences f) Medicinal Herbs collection

5) Why do people do illegal activity inside the park?

a) Poor economy b) Illiterate c) Occupation d) Unemployment

6) What types of illegal activities did you find inside the Reserve?

7) Why the people enter in the park?

a) Grass and firewood collection b) Tree cutting c) Research work
d) Enjoyment e) Livestock Grazing

8) What type of punishments are given for illegal work?

a) Arresting and seizing b) Punishment c) Convincing

d) Other

9) What types of activities are conducted by the arms personnel against the illegal work?

a) Insulting b) Convincing c) Beating d) Taking to the warden office e)…….

10) Why is there a conflict between the local people and Reserve?

11) What should be done for the good relationship between the reserve and locals?

Annex III

Compensation provided for Property, livestock damage and human injuries by wildlife in SWR

Year	BZUC	Problem types	Problematic wildlife	Compensation rate Rs.	Expected rate
2061	Kalikich	Human death	Tiger	-	
2063/64	Shuklaphanta	Human injury and Physical damage	Elephant	29995	65000
2063/64	Bageshwori	Physical damage	Elephant	4000	20000
2064/65	Shuklaphanta	Physical damage	Elephant	49600	10000
2064/65	Bageshwori	Physical damage	Elephant	4000	45000
2065/66	Shuklaphanta	Human attack	Elephant	2000	20000
2065/66	Bageshwori	Physical damage	Elephant	33500	40000
2065/66	Kalikich	Physical damage	Elephant	26500	60000
2065	Shuklaphanta	an Ox killed	Leopard	-	10000
2066/67	Shuklaphanta	Physical damage	Elephant	18000	20000
2066/67	Bageshwori	Physical damage	Elephant	36800	60000
2066/67	Kalikich	Physical damage	Rhino	2000	5000
2067/68	Shuklaphanta	3 Goats killed	Leopard	2000	5000
2067/68	Bageshwori	Physical damage	Elephant	27800	65000
2067/68	Kalikich	Human injury and Physical damage	Elephant	13300	70000
2067	Kalikich	Kill chicken	Jackal	-	1000
2068/69	Shuklaphant	Physical damage	Elephant	6000	10000
2068/69	Bageshwori	Physical damage	Elephant	13300	25000
		Total		**268795**	**531000**

Source: SWR annual report 2067/68

Annex IV

Quantity of crop loss in each buffer zone of SWR

Quantity of crop and economic loss due to wildlife in Shuklaphanta BZUC

S.N.	Name of crop	Land cover (Kattha)	Expected yield(Kg)	Actual yield(Kg)	Total loss(Kg)	Total Loss(Rs)	Loss Per HH (Kg)	Loss per HH (Rs)
1	Wheat	1556.5	115620	81660	33960	543360	300.53	4808.48
2	Mustard	152	3732	3056	676	40560	10.73	643.8
3	Paddy	1566	185115	147280	37835	529690	334.84	4687.76
4	Maize	1215	4960	4428	532	7980	10.03	150.45
5	Pulses	122.2	3047	2278	769	38450	6.80	340
6	Vegetables	96.1	13665	11512	2153	32295	20.31	304.65
Total			**326139**	**250214**	**75925**	**1192335**	**683.24**	**10935.14**

Quantity of crop and economic loss due to wildlife in Kalikich BZUC

S.N.	Name of crop	Land cover (Kattha)	Expected yield(Kg)	Actual yield(Kg)	Total loss(Kg)	Total Loss(Rs)	Loss Per HH (Kg)	Loss per HH (Rs)
1	Wheat	771.5	49620	30840	18780	300480	267.17	4274.72
2	Mustard	85.5	2447	2103	344	20640	7.02	421.2
3	Paddy	677.5	65240	47110	18130	253820	266.6	3732.4
4	Maize	46.5	1404	1195	209	3135	5.64	84.6
5	Pulses	60.4	1289	1057.5	231.5	115750	2.04	102
6	Vegetables	56.5	5214	4635	579	8685	8.51	127.65
Total			**125214**	**86940.5**	**38273.5**	**702510**	**556.98**	**8742.57**

Quantity of crop and economic loss due to wildlife in Bageshwori BZUC

S.N.	Name of crop	Land cover	Expected yield(Kg)	Actual yield(Kg)	Total loss(Kg)	Total Loss(Rs)	Loss Per	Loss per

		(Kattha)					HH (Kg)	HH (Rs)
1	Wheat	940	43860	33480	10380	166080	199.6	3193.6
2	Mustard	42.5	1299	1111	188	11280	4.85	291
3	Paddy	897	82215	64960	17255	241570	331.8	4645.2
4	Maize	60	1968	1669	299	4485	9.34	140.1
5	Pulses	53.5	1062	900	162	8100	3.11	155.5
6	Vegetables	53	5358	4705	653	9795	12.55	188.25

ANNEX V

Damage caused by human and cattle per year in SWR

Activities	**Estimated damage in Rs.**
Livestock grazing	70000
Grass (1 lakh bhari per year)	4000000
Firewood (1 lakh bhari per year)	5000000
Logs (1 thousand bhari per year)	2000000
Total	**11070000**

Source: SWR records

ANNEX VI

Analysis of crop loss through R:

Normality test **(if p value is > 0.05 then data is normal)**

> mani=read.table("clipboard",header=T)

> attach(mani)

> names (mani)

[1] "NOC" "Shu" "Kal" "Bag"

> View(mani)

> **shapiro.test(Shu)** *## not normal*

Shapiro-Wilk normality test

Data: Shu

W = 0.7656, p-value = 0.02817

> **shapiro.test(Kal)** *## not normal*

Shapiro-Wilk normality test

Data: Kal

W = 0.7847, p-value = 0.04261

> **shapiro.test(Bag)** *## normal*

Shapiro-Wilk normality test

Data: Bag

W = 0.9014, p-value = 0.3824

Wilcox test (non- paramertric t-test)

> **wilcox.test(Shu,Kal, paired=T)**

Wilcoxon signed rank test

Data: Shu and Kal

V = 11, **p-value = 1**

Alternative hypothesis: true location shift is not equal to 0

> **wilcox.test(Shu,Bag, paired=T)**

Wilcoxon signed rank test

Data: Shu and Bag

V = 19**, p-value = 0.09375**

Alternative hypothesis: true location shift is not equal to 0

> **wilcox.test(Kal,Bag, paired=T)**

Wilcoxon signed rank test

Data: Kal and Bag

V = 14, **p-value = 0.5625**

Alternative hypothesis: true location shift is not equal to 0

Annex VII

Estimation of frequency of wildlife through SPSS

Frequency of wildlife according to sites in SWR

Test Statisticsb				
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
chittal	52	223	-2.372	**0.018**
wildboar	74.5	245.5	-1.419	0.156
elephant	103.5	274.5	-0.196	0.845
rhino	105.5	276.5	-0.107	0.915
monkey	74.5	152.5	-1.419	0.156
Peacock	84	162	-1.018	0.308
Porcupine	55.5	133.5	-2.226	**0.026**
Nilgai	96	267	-0.653	0.514
total_pubmark	93	264	-0.635	0.525

Seasonal variation in frequency of wildlife in SWR

Test Statistics[a,b]									
	chittal	Wildboar	elephant	rhino	monkey	peacock	porcupine	nilgai	total_pubmark
Chi-Square	9.908	2.586	5.319	1.519	8.732	1.756	3.300	.713	13.876
Df	2	2	2	2	2	2	2	2	2
Asymp. Sig.	**.007**	.274	.070	.468	**.013**	.416	.192	.700	**.001**

Estimation of frequency of livestock through SPSS

Frequency of livestock according to sites in SWR

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
No. of Dung	-.414	13	.686	-.83333	2.01225
No. of Livestocks	.687	13	.504	.61111	.88982

Seasonal variation in frequency of livestock in SWR

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
dung_no	Between Groups	11.200	2	5.600	.372	.697
	Within Groups	180.800	12	15.067		
	Total	192.000	14			
Livestock_no	Between Groups	1.200	2	.600	.194	.827
	Within Groups	37.200	12	3.100		
	Total	38.400	14			

Annex VIII

GPS location of my study plots (10x10 m^2) in SWR

S.N.	Longitude (X-axis)	Latitude (Y-axis)
1	80˚56’4.68”	28˚7’30.86”
2	80˚57’3.25”	28˚8’44.92”
3	80˚55’42.15”	28˚11’37.28”
4	80˚54’58.03”	28˚8’34.05”
5	80˚56’21.43”	28˚9’13.36”
6	80˚54’32.08”	28˚11’48.62”
7	80˚47’23.25”	28˚13’45.58”
8	80˚45’58.36”	28˚13’28.05”
9	80˚48’39.36”	28˚9’37.32”
10	80˚47’36.21”	28˚8’19.37”

Annex IX

Unit conversion

Wheat 1 Bori =120kg

Paddy 1 Bori =70kg

1 Bigha = 20 kattha

1 kattha = 20 Dhur

Annex X

Local rate of different crops

Crops	Market Rate per Kg. (Rs.)
Wheat	16
Mustard	60
Paddy	14
Maize	15
Pulse	50
Vegetable	15

Photoplates

Conflicting species

Peacock in wheat field

Langur monkey near agricultural field

Taking out the firewood

Livestock grazing inside the reserve

Measures undertaken to mitigate conflict

	
Machan to guard wildlife	Scaring device
	
Trench and wire	Green vegetation in the corridor

Measuring conflict

	
House damaged by wild elephant	Grazed agricultural field measurement
	
Questionnaire with the respondents	Identifying Foot marks of wildlife species