Norwegian University of Life Sciences

Wildlife Damages, Mitigation Measures and Livelihoods Issues Around Chitwan National Park

By Saroj Upadhyay

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saroj.upadhyay@student.umb.no

Noragric
Department of International Environment and Development Studies
P.O. Box 5003
N-1432 Ås
Norway
Tel.: +47 64 96 52 00
Fax: +47 64 96 52 01
Internet: http://www.umb.no/noragric

Declaration

I, Saroj Upadhyay, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Date 15th December 2013.

Signature……..

Dedicated To,

My Father and Niece

(Forever in our heart and mind)

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Abstract

Human-wildlife conflict is closely associated with the economics and social well being of the local people. It occurs worldwide and its frequency and severity have been rising annually, especially in Chitwan National Park. Crop damage and loss of livestock by wildlife from park are some of the major causes of park-people conflict in Chitwan National Park. In response to these damages, local people employ different defensive measures to alleviate the losses or reduce the risk of wildlife damages. Such measures often represent a significant investment in terms of money and time. Since these damages and mitigation measures can have a substantial impact on the local people, it becomes important to study what effect they have on the livelihood and wellbeing of the people living in the vicinity of the park. A questionnaire survey of 140 households was conducted in Meghauli and Bachhauli VDCs in buffer zone of Chitwan National Park. Sustainable livelihood framework provided by DFID was used to analyze how wildlife damage and mitigation costs affect income and livelihood of the local people with emphasis on equality and justice issues. Also, the factors affecting attitude of people towards the park, wildlife damages and mitigation measures were studied.

Diversified livelihood income, access to loan or credit facilities, services and infrastructures and high level of participation in buffer zone programs were some of the positive strategies or capitals that helped the households in achieving a sustainable livelihood. High inequality in income and wealth distribution and a lack of education and training especially among women and lower caste groups implied vulnerability in achieving both sustainable livelihood and mitigating wildlife damages. Wildlife damages were found to be responsible for creating a greater economic inequality. This was because people with less income and wealth faced more wildlife damages resulting in reduced food security and options for cash generation. The poorest face compounding vulnerability due to lost resources on wildlife damages and need to invest in mitigative measures further fostering poverty. Benefits as tourism and access to electricity is reaching only a certain fraction of communities while other groups of people are experiencing most of the costs associated with wildlife damages which is contributing to injustice. Tangible benefits as yearly grass cutting, park related income, tourism was found to be more influential in shaping peoples attitude towards the park than demographic and socio-economic factors. Hence, it is recommended that future policies should be adopted so that all get equal access to services and those policies should supplement livelihood strategies of the local people in dealing with wildlife damages especially the excluded groups and women.

Keywords: Human-wildlife conflict, mitigation measures, livelihood, inequality, injustice

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Abbreviations

BNP=	Bardia National park
BZ =	Buffer zone
BZUC=	Buffer Zone Users Committee
CAs=	Conservation Areas
CNP=	Chitwan National Park
DFID =	United Kingdom Department for International Development
DNPWC=	Department of national park and wildlife conservation
Exp. (B) =	Exponential of coefficient B
Exptd =	Expected frequency
HHs=	Households
HWC=	Human Wildlife conflicts
ICDP=	Integrated conservation and development program
IUCN=	International Union for Conservation of Nature
LSU=	Livestock unit
NRs=	Nepalese Rupees
Obsvd=	Observed frequency
PAs=	Protected areas
PCLG=	Poverty and conservation learning group
RAMSAR =	the convention of Wetland
SD=	Standard deviation
SE=	Standard error
Sig=	Significance
SLF=	Sustainable livelihood framework
SPSS=	Statistical Package for Social Survey
TC=	Transaction cost
UNDP=	United Nations Development Program
UNESCO=	United Nations Educational, Scientific and Cultural Organization
VDC=	Village development committee
WWF=	Worldwide fund for nature

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1. Introduction:

Since the establishment of Yellowstone National Park as the first protected area in 1872, the establishment of national parks and other forms of protected areas (PAs) has been a key component of the conservation strategies of many countries (Studsrød and Wegge, 1995). According to IUCN, a protected area is "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008). Protected areas provide a number of direct and indirect benefits such as recreation/tourism, ecological processes, biodiversity, education and research, and other consumptive and non-consumptive values (Dixon and Sherman, 1991) and thus remain a cornerstone of biodiversity conservation and an integral part of sustainable development strategies (Ervin et al., 2010; Butchart et al., 2012). As of 2012, over 150,000 PAs have been established covering somewhere between 12.7%-12.9% of the earth's terrestrial surface (Butchart et al., 2012; Bertzky et al., 2012). Protected areas have come a long way since the early days of their establishment when they were set aside to provide for the public's enjoyment and sightseeing. Present-day management of nature in the parks differs substantially from that in the early decades of national park history (Sellars, 1997) with an expansion from strict biodiversity conservation towards incorporating human welfare issues and local resource use (Naughton-Treves et al., 2005).

Protected areas in developing countries are generally characterized by high levels of biodiversity and have experienced tremendous growth in the past 25 years. These protected areas, particularly in Asia, were established beginning in the second quarter of this century (Mishra, 1982). The earlier establishments were largely copied from western ideas and philosophy (Hough, 1988), ill-suited to the needs of the developing countries where the socioeconomic and political conditions are very different (Nepal and Weber, 1995). People were evicted from their traditional land and various rules and regulations were imposed to restrict utilization of natural resources, resulting in negative consequences and serious conflicts between local people and the park authorities (Mishra, 1984; Shrestha, 1996). Even after its establishment, the management of these protected areas continues to face a number of challenges including widespread poverty, particularly among people living adjacent to these parks, rapid population growth, and political instability (Naughton-Treves et al., 2005).

1.1 Human-wildlife conflict

As human population expands, the demand for land and resources will lead to escalating conflicts between wildlife and humans competing for the same space and resources. The IUCN World Parks Congress (WPC, 2004) defines human-wildlife conflict as occurring "when the needs and behavior of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife". The direct impacts such as crop raids and loss of livestock and human lives caused by park animals put extra burden on the livelihood of the local people. Beside visible impacts, Human wildlife conflict (HWC) has indirect or hidden impacts as well (Barua et al., 2013). Hidden impacts include disruption of livelihood and food security through crop or livestock loss. It also involves health impacts, transaction (time and money spent in mitigation measures and claiming compensation) and opportunity cost (lost income) and are often psychological or social in nature (Barua et al., 2013; Ogra, 2008). These hidden impacts are often delayed and are poorly documented. But it becomes important to understand these impacts or else they have the potential to jeopardize the whole conservation efforts. This is because these direct and hidden adverse effects have the potential to generate resentment and hostility towards wildlife and park authorities (Hough, 1988), further exacerbating already volatile situation. These types of conflicts occur worldwide and their frequency and severity have been rising annually (Treves, 2009). The causes of these conflicts not only depend upon the ecology of the wildlife species or aspects of damages but also are rooted in economics, social and institutional, technological arrangements (Treves, 2009).

Effective management of human-wildlife conflict often involves ensuring the welfare of the local communities and at the same time achieving conservation goals. Reconciling these two factors represents the fundamental challenge for sustainable solution to HWC (Treves et al., 2006). Hence, it becomes important to understand the two aspects of HWC, ecology as well as the socio-economic nature of human-wildlife conflict (Messmer, 2000). Understanding the nature and ecology of HWC and combining it with increased public awareness can provide the desired solution. Economic, personal and social incentives in terms of income, sense of well-being and community recognition can also encourage landowners in managing wildlife and conflicts with it. As HWC is closely associated with the economic and social well-being of the local people, it becomes utterly important to involve them and other stakeholders in formulating management decisions (Redpath et al., 2004). Short-term mitigation tools and long term preventive strategies are two approaches suggested by (Distefano, 2005) in solving

HWC. The preventive strategies include artificial and natural barriers; guarding and relocation of human settlements, while mitigative strategies include compensation, insurance and incentives schemes and wildlife relocation. But it is important to note that there is no single solution to the conflict and every preventative and mitigative strategy should comply with the community development and wildlife conservation goals.

1.2 Human wildlife conflict in Chitwan National Park

Chitwan National Park has achieved huge success in conserving some of the most endangered species like the Great One Horned Indian Rhinoceros (*Rhinocerous unicornis*) (hereafter referred as rhino) but often at the price of recurring conflicts between park authorities and local people (Mishra, 1982). Despite efforts from park management, these conflicts are now more intense and of greater magnitude in Chitwan National Park (Nepal and Weber 1995). Wildlife population has increased after the establishment of protected areas (Studsrød and Wegge, 1995), particularly because of strict protection measures. But this has also resulted in more incidences of wildlife wandering out of park for food and spaces. Another challenge for conservation in Chitwan National Park is the wildlife of global significance living in close proximity to an area that has one of the highest human population densities in the country.

As identified by Nepal and Weber (1995), crop damage and threats to human and animal life by wildlife from park are two of the five major causes of park-people conflict in Chitwan National Park. Restriction placed on the use of park resources is another important source of conflict. Crop damages by the rhinos are a major source of conflict between farmers and wildlife in communities that surround Chitwan National Park (Bailey, 2011). The Rhino is often regarded as the most destructive raider (Uprety, 1995) and prefers crops such as maize, rice, vegetables and mustard resulting in substantial losses to the local farmers (Studsrød & Wegge, 1995). Other frequent crop raiders include elephant (*Elephas maximus*), wild boar (*Badel*) (*Sus scrofa cristatus*), and spotted deer (chital) (*Axis axis*). Regarding damage to properties and loss/injury of human lives, elephants and Bengal tiger (*Panthera tigris*) are the major sources of conflict. For farmers living in proximity to park boundaries, crop loss and damage to property represent a considerable barrier in securing a sustainable livelihood, especially crop loss as it is closely related to food security and income. These disruptions of livelihoods and food insecurity, together with diminished psychological well-being, are often categorized as hidden impacts of HWC. Approaches for framing and mitigating these impacts

are poorly addressed (Barua et al., 2013). Crop damage is a particular risk to households that are less resourced and don't have access to diverse sources or any source of income (Mulonga et al., 2003). Apart from economic burden, these conflicts are responsible for inflicting other losses and risks such as injury/death while protecting crops and property, increased manpower for guarding crops and an increased level of risk of contracting diseases both from wildlife and environmental factors.

Loss of livestock is also a severe problem around Chitwan National Park (Mishra, 1982). A study by Spiteri and Nepal (2008) found that almost 45% of those raising livestock around Chitwan National Park suffered from livestock loss with tiger, leopard (*Panthera pardus*), and jackal (*Canis aureus*) being the most common predators. Wildlife from the park often wanders out of park and kills livestock. Also there are incidences where people take their livestock inside the park illegally for grazing. If their livestock are attacked by wildlife from the park, they lose their asset and at the same time they don't have any claim on compensation. Loss of human life from wild animals is anther serious source of conflict around Chitwan National Park. A study of UNESCO-IUCN (2003) estimates that rhinos and tigers kill eight to ten people annually in and around Chitwan National Park. Another estimate puts human causalities at 45 cases in the year 1999/2000 which was 25 and 35 in the year 2009/2010 and 2010/2011 respectively (Budhathoki, 2010). Other wild animals responsible for attacking humans include sloth bear and wild pig. Also, as noted earlier restriction placed on use of park resources is another important source of conflict. The local people lacking alternative sources of energy (Sharma and Shaw, 1993) continue to trespass on the park to collect firewood, fodder and allow grazing of their livestock. The restriction placed on these activities by the park authorities results in local people having antagonistic behavior towards the park and conservation efforts as a whole (Nepal and Weber, 1995). These conflicts are often compounded by lack of education, unemployment, lack of community development and park related employment opportunities (Nepal and Weber, 1993). Even when available, benefits such as yearly grass cutting programs and revenues from tourism are insignificant.

1.3 Mitigative measures against wildlife damages

The words mitigative, adaptive and defensive measures have been used interchangeably throughout the thesis to define measures respondents use to protect their crops and livestock from wildlife damages. Farmers residing adjacent to protected areas around the world employ

a number of measures to ward off potential damages to their crops and properties (Bailey, 2011). This includes erecting a fence, digging a trench, guarding and use of fire to deter the wildlife and many others. Since crop damages are closely related to the livelihood the local people, it is important to reduce the damages that occur. Osborn & Parker (2003) divides defensive measures into two broad categories: passive and active. Passive methods are designed to prevent the movement of wildlife into agricultural land through the use of barriers such as different types of fences and digging trenches (Nyhus et al., 2000). While on the other hand, active methods include measures to frighten or chase away the wildlife and include making noise through shouting, banging tins and patrolling fields (Hill, 2000). Fernando et al., (2008) classified the crop protection measures as traditional crop protection measures and organized crop protection and elephant barriers as physical barriers (Wire fences, log and stone fences, ditches and biological fences) and physiological barriers (electrical fencing and cleared boundaries and simple demarcation of fields). Treves, 2007 (figure 1) classifies methods to mitigate human-wildlife conflict into direct and indirect methods.

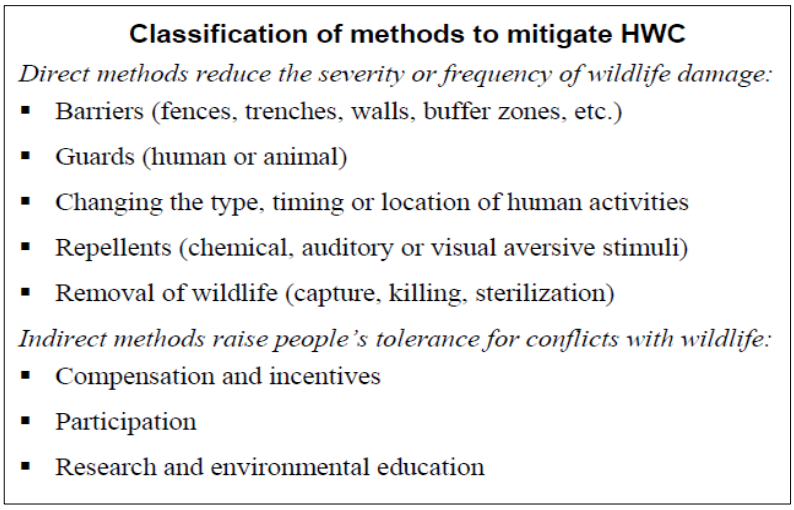


Figure 1 Classification of methods to mitigate human-wildlife conflict

Thapa, 2010 classifies measures to protect crops into: modern means and traditional means. Modern means include watchtower (*machan*), barbed wire fence, trench and scaring devices (such as loudspeakers) while traditional means include bio-fencing, scarecrow and tin hitting. While different studies have been carried out to study the problems associated with crop damaged caused by wildlife, there is a lack of studies that shed light on the effectiveness of these damage control measures (Sitati et al., 2003). The effectiveness of the measures in warding off potential damages depends upon a number of factors including material and

design of the construction and the target species (Osborn and Parker, 2003). Usually fences constructed from branches and wooden fences, are ineffective against larger mammals such as elephant and rhino. Also the effectiveness of the defensive measures can diminish over time because the target animals can become habitual to methods as fire, noise (Taylor, 1999). These types of measures are temporary in nature and drive the wildlife away momentarily, only for the wildlife to come back and inflict further damage. Trenches are more effective when the construction is new but a lack of maintenance diminishes their effectiveness overtime (Thapa, 2010). Also, lacks of maintenance of barbed wire, often damaged by people who trespass for illegal resource collection, bring additional problems rather than solving any. So, it is important to note that no single method is enough for damage control but a combination of measures depending upon the invading wildlife, crop patterns and household economic condition should be used. Like crop guarding with noise and fire using *Machan* is quite effective against larger mammals as each of these measures provide individual benefits and combining them can be financially viable and safe as well.

1.4 Mitigative measures against wildlife damages in Chitwan National Park

While many studies have focused on identifying and quantifying wildlife damages in Chitwan National Park and other protected areas of Nepal, studies dealing with the measures employed for protection against wildlife damages and its effectiveness are limited. In this chapter, the most common measures employed in and around Chitwan National Park and other protected area in lowland *terai*, Bardia National Park, will be discussed. A study done by Thapa (2010) identified 10 measures, both traditional and modern, for protection against crop damages around Bardia National Park and concludes that Machan (watch towers) combined with other measures as throwing flaming sticks and group shouting were the most effective and safest for protecting crops against all kind of animals. A study on defensive measures employed against crop damages from rhino around Chitwan national park, Bailey (2011) states that farmers employ measures that ranges from erecting a fence to more extreme measures such as the use of a firearm. Other measures include crop switching and electric fencing. Furthermore he adds that the effectiveness of defensive tactics depends upon a number of factors as the types of measure, nature of damaging animal and levels of efforts applied. Bhattarai (2009) in his study in Bardia national park adds that mitigation measures may not be universal because of differences in because socio-political, cultural, economic and geographic situations between the localities.

1.5 Compensation Schemes

Damage compensation scheme which is classified as indirect method to mitigate HWC, is a tool that distributes the costs between those who benefit from conservation and those who suffer the cost of damages (Fourli, 1999). It hopes to reduce the negative consequences of human-wildlife conflicts and aims at increasing people's tolerance towards wildlife damages (Treves, 2007). It shifts the economic responsibility to a broader public, as those living in close proximity to the park and wildlife are the ones who bear most of the costs while benefits are more universal. In absence of an effective compensation program, revenge killing or poaching may be more likely (Nyhus et al., 2003). When implemented under ideal conditions, a compensation scheme has the potential to promote positive park-people relationship. An increased tolerance for gray wolves has been observed among the public or cattle ranchers living near Yellowstone National Park and most of this is attributed to the successful compensation for loss incurred (Nyhus et al., 2005). But in the context of rural and remote areas of developing countries the conditions are seldom ideal and there are many obstacles that prevent compensation programs from being successful (Ogra and Badola, 2008). Some of these obstacles are discussed in Chapter 3. There are basically two types of compensation schemes:

- Ex-post compensation: where damages is compensated after it has occurred
- Ex-ante (Compensation in advance): based in estimation of expected loss

Most compensation schemes take the ex-post form, which pays compensation based on estimating the actual damage that that has occurred. The type and level of damages are monitored directly and in most cases checked by inspectors. The other type of compensation scheme, ex-ante (compensation in advance), is based on the estimation of the expected loss and depends upon factors such as potential consumption of resources by a certain species and the number of those species present in a certain area (Nyhus et al., 2003). In ex-post compensation, there is a greater degree of uncertainty in determining the cost of damages as it is done on a case-by-case basis. In compensation in advance, damages are estimated indirectly based on potential consumption of resources by a certain species and the number of those species present in a certain area. The actual amount of damage has no influence on the compensation. In compensation in advance, damages are predicted. Damages that are distributed homogeneously in terms of area and time can be easily predicted and are well suited for compensation in advance and hardly possible for spatially and temporally varied

damages (Schwerdtner & Gruber, 2007). The main difference between both schemes is the way that the damage is assessed: either directly when the damage occurs, as in ex-post schemes; or indirectly and exclusive of actual damage occurrences by means of the number and distribution of animals for compensation in advance. Search and information costs are much higher in ex-post compensation schemes, because every case requires a determination of damage costs. However, compensation in advance generates fewer transaction cost (TC) as compared to ex-post compensation scheme and also provides a more clear idea of the amount of TC required. A similar picture can be drawn for decision-making costs. Using ex-post compensation, they can arise in each case; however, this is not predictable. Using compensation in advance, decision-making costs only occur in the beginning, when the amount of compensation is fixed. Compensation in advance provides incentives to avoid damages by investing in mitigation measurements while ex-post compensation doesn't (Schwerdtner & Gruber, 2007*)*.

1.6 Compensation scheme in Chitwan National Park

The compensation scheme currently employed in Chitwan National Park is ex-post compensation that was started in 1998/1999 with the establishment of a relief fund of NRs. 500,000. The park data suggests approx. 2400 HWC cases (human casualties, livestock and crop depredation and property damage) were registered between 1999/00 to 2008/09 and Rs 8.46 million (on average Rs. 0.85 million per year) had been paid-out as compensation (PCLG, 2012). Keeping in view the incidences of damages and to generalize the claims for a particular damage, the government of Nepal recently revised the guidelines for wildlife related loss of lives, physical damage to people and poverty, and livestock and crop depredation (Table 1). The new compensation policy was introduced in 2009, increasing the compensation amount for human death by three times and injury by 2.5 times (Khatri, 2010).

Table 1 Compensation guidelines for wildlife related losses (Khatri, 2010)

Category of losses	Compensation (Rs)
Minor physical damage	5,000
Seriously wounded	50,000
Loss of lives	150,000
Loss of livestock	10,000
Loss of house/shed	4,000
Loss of stores grains	5,000
Loss of food and fruit crops	5,000

1.7 Justification of study

Park-people conflict in Chitwan National Park (CNP) often centers on the issue of poverty and meeting basic survival needs. These conflicts pose serious challenges to conservation of biodiversity around Chitwan National. People who once enjoyed free access to the resources are no longer able to extract it due to restriction placed after the establishment of the park. Hence, in this context it becomes important to study what detrimental effects these restrictions have especially among the poor who lack access to alternatives. Also, each year significant amount of crop and number of livestock are lost to wildlife that enters human settlements from the park. These wildlife damages are not equally distributed among the households and depend upon a number of factors. It becomes important to study what factors as geographical location of farms, crop types and household's effort to defend their fields can better explain these damages and suggest ways to mitigate these damages. Since, these damages can have a substantial impact on the local people, it becomes important to study what effect these loss have on the livelihood and wellbeing of the people living in the vicinity of the park. Additionally, benefits of conservation have failed to trickle to the grassroots levels of society and compensation measures have been found to be ineffective in mitigating human-wildlife conflicts. In this context it is important to study what perception people have towards wildlife and the park itself and what are the factors that shape these attitudes. This study aims at generating new sets of information regarding these indicators through regular monitoring of socio-economic indicators and wildlife damages and to be helpful in minimizing park-people conflict.

Finally, considering that crop damages often represent a serious threat to their livelihood, local farmers employ a number of measures in mitigating these damages. Protection measures against wildlife damages represent a significant investment in terms of money and time for the households but few quantitative evaluation exits. Hence it becomes important to study the types of methods employed by these people and at the same time quantify the cost of these measures. These data can provide the decision makers with additional insight into the problems and helping them to acquire knowledge and tools to deal with the complex problem (Bailey, 2011).

1.8 Objectives of study

The broad objective of the study deals with two aspects, one regarding wildlife damages and other is regarding the strategies adopted by households in dealing with these damages. This study tries to examine how these wildlife damages and defensive measures affect people's livelihood by examining the distribution of different costs and benefits based on caste/ethnicity and poor and rich. This study is based on framework provided by United Kingdom Department for International Development (DFID, 1999) (Sustainable Livelihood Framework). The results are to be compared between two study areas to observe the differences and common aspects. For this the following research questions were asked:

Specific Objectives

- To document the key households assets and livelihood strategies and outcomes in the buffer zone of Chitwan National Park
- To identify the major human-wildlife conflict issues in and around the study area and estimate the cost associated with such conflicts on the local people
- To identify and estimate the cost of local protection measures against wildlife damages
- To study the current buffer zone management policy and compensation scheme being employed in the park

Research questions

- What are the major characteristics associated with wildlife damages and the mitigation measures against such damages?
- What are the costs associated with wildlife damages and investment into protection measures and how are they related to local people's income and livelihood?
- What are the factors that determine wildlife damages and mitigative measures against wildlife damages?
- What are the factors that shape people's attitude towards the park and determine the participation in buffer zone or other social programs?
- How is the distribution of costs and benefits as compared to different caste/ethnicity and between rich vs. poor?

2. Study Area

2.1 Protected Areas in Nepal

The beginning of modern conservation efforts in Nepal can traced back to the overthrowing of the Rana regime in 1950s (Heinen and Kattel, 1992) and subsequent publication of the first wildlife law in 1957. This law gave legal protection to rhinos and their habitat and in the year 1961 rhino petrol (*Gaida gasti*) was created in Chitwan to protect rhino from poaching (Adhikari, 2002). Despite these conservation efforts, this period also coincides with the malaria eradication program (Heinen and Kattel, 1992) which resulted in the settlement of migrant people from mid hills to the grassland and forestland areas of lowlands (Terai). Subsequent deterioration of forest resources and declining wildlife population provided the impetus for more conservation efforts like the enactment of the National Parks and Wildlife Conservation Act in 1973.

Nepal embarked upon a modern era of wildlife conservation with the enactment of the National Parks and Wildlife Conservation Act in 1973, the same year Chitwan National Park was established as the first national park of Nepal. The fourth amendment of the NPWC Act in 1992 incorporated provisions for Conservation Areas (CAs) and Buffer Zones (BZs). Subsequently, the Buffer Zone Management Regulations 1996 and Guidelines 1999 were approved to design programs compatible with National Park management and to facilitate public participation in the conservation, design and management of BZs (DNPWC, 2006).

Figure 2 Map of Protected areas in Nepal

Table 2 List of Protected areas in Nepal (DNPWC, 2012)

SN	Name of Protected Areas	Gazzated Year	Area (Sq. km.)
	National Parks		
1.	Chitwan National Park (World Heritage Site 1984)	1973	932.00
2.	Langtang National Park	1976	1710.00
3.	Rara National Park	1976	106.00
4.	Sagarmatha National Park (World Heritage Site 1979)	1976	1148.00
5.	Shey Phoksundo National Park	1984	3555.00
6.	Khaptad National Park	1984	225.00
7.	Bardia National Park	1984	968.00
8.	Makalu Barun National Park	1991	1500.00
9.	Shivapuri Nagarjun National Park	2002	159.00
10.	Banke National Park	2010	550.00
Sub Total			10853.00
	Wildlife Reserves		
1.	Suklaphanta Wildlife Reserve	1976	305.00
2.	Koshi Tappu Wildlife Reserve (Ramsar Site 1987)	1976	175.00
3.	Parsa Wildlife Reserve	1984	499.00
Sub Total			979.00
	Hunting Reserve		
1.	Dhorpatan Hunting Reserve	1987	1325.00
Subtotal			1325.00
	Conservation Areas		
1.	Annapurna Conservation Area	1992	7629.00
2.	Kanchanjunga Conservation Area	1997	2035.00
3.	Manaslu Conservation Area	1998	1663.00
4.	Krisnhasar Conservation Area	2009	16.95
5.	Gaurisankar Conservation Area	2010	2179.00
6.	Api Nampa Conservation Area	2010	1903.00
Sub Total			15425.95
	Buffer Zones		
1.	Chitwan National Park	1996	750.00
2.	Bardia National Park	1996	507.00
3.	Langtang National Park	1998	420.00
4.	Shey Phoksundo National Park	1998	1349.00
5.	Makalu Barun National Park	1999	830.00
6.	Sagarmatha National Park	2002	275.00
7.	Suklaphanta Wildlife Reserve	2004	243.50
8.	Koshi Tappu Wildlife Reserve	2004	173.00
9.	Parsa Wildlife Reserve	2005	298.17
10.	Rara National Park	2006	198.00
11.	Khaptad National Park	2006	216.00
12.	Banke National Park	2010	343.00
Sub Total			5,602.67
Grand total			34,185.62

The earlier concept of conservation in Nepal was the "fences and fines" approach, which failed because of its top-down nature, ignorance to traditional use rights as well as social and economic interests of local people and lack of local involvement in decision-making activities (Paudel, 2002). The conservation policy has evolved from this early emphasis on species preservation and research with strict law enforcement practices; to a more conciliatory and participatory approach (DNPWC, 2005) through the establishment of different conservation areas and buffer zones. The Protected Area (PA) system now covers 23.23% of total Nepal's area (WWF Nepal, 2010) with 10 national parks, 7 conservation areas, 1 hunting reserve and 3 wildlife reserves (Figure 2 and Table 2).

2.2 Chitwan National Park

Chitwan National Park (formerly known as Royal Chitwan National Park) lies in the sub-tropical lowlands in the inner *terai* region of Chitwan, Makwanpur, Nawalparasi and Parsa districts of Nepal. It was established as the first protected area of Nepal in the year 1972 and presently covers 932 km^2 with altitude ranging from 110m to 850m above the sea level. An additional 750 km^2 was designated as a buffer zone surrounding the park in the year 1996. This buffer zone also contains *Beeshazari* Lake, a RAMSAR site (The convention on Wetland). Chitwan National Park is renowned worldwide for its unique and diversified ecosystems and is home to many endangered flora and fauna species and is considered as the most important among the five protected areas in the Teari for the current and long-term viability of the endangered one-horned Indian rhinoceros (Straede & Helles, 2000) (Bailey, 2011). In recognition to these features, UNESCO designated it as a world heritage site in the year 1984. Chitwan National Park is one of the best studied protected areas in Nepal with most of the studies focusing on park-people conflict arising from resource denial, fair and equitable sharing of benefits and services and most importantly wildlife damages (Nepal and Weber, 1995) (Jnawali, 1989).

2.2.1 Social Characteristics

Thirty-six Village Development Committees (VDC, the smallest administrative unit in Nepal) of great ethnic diversity bound CNP (Mclean and Straede, 2003). Brahmin, Chettri, and the indigenous Tharu are the main castes and farming is the primary livelihood activity (Nepal and Spiteri, 2011). The Tharus are the indigenous of this area while other migrated from different parts of the country especially from the hills. In 1971, before the establishment of CNP, Chitwan's human population was 183,644 but by 2001 it increased to 468,699 and by

the latest census the population has reached 579,984 due to high immigration and birth rates (Gurung et al., 2008) (Census, 2011).

2.2.2 Other Characteristics

CNP consists of four major vegetation types, climax sal (*Shorea robusta*) covering nearly 70% of the parks area, riverine forest, grassland and Chir pine (*Pinus roxburghii*) forest (Straede and Helles, 2000). Riverine forest and grasslands occupies nearly 7% and 20% of the parks area respectively and mostly cover areas along the banks of the rivers and islands (Mishra, 1982). The most common species in riverine forest are *Bombax cebia, Trewia nudiflora, Acacia catechu* and *Dalbergia sissoo* while the grassland is dominated by species *Saccharum spontaneum*, *Imperata cylinderica* etc. Water bodies occupy the remaining 3% of the area of the park. CNP has a subtropical climate dominated by southeast monsoon with a mean annual rainfall of 1900- 2500 mm most of which falls in the summer monsoon period of June through September. Two other seasons are pronounced: the post monsoon season (November to January) and hot and dry season (March to May). The minimum daily mean temperature ranges from 7 to 20^{o}C and maximum at 25 to 40^{o}C with the maximum being reached during the months of May–July (Gurung, 2004) (Straede and Helles, 2000) (Mishra, 1982). The park is mostly famous for some of the most charismatic species as the one horned Indian rhinoceros and tigers (*Panthera tigris*) and is also home to other larger number of mammals and reptiles as leopards (Panthera pardus), gaur bison (*Bos gaurus*), sloth bear (*Melursus ursinus*), wild Asian elephant (*Elaphas maximus*), marsh mugger crocodile (*Crocodylus palustris*), gharial (*Gavialis gangeticus*) and the Gangetic dolphin (*Platanista gangetica*). A total of 68 species of mammals, 56 species of herpetofauna, 126 species of fish and 544 species of birds have been recorded in the park (DNPWC, 2012).

2.3 Study Sites

Two VDC Baachauli and Meghauli were randomly chosen from a set of 34 VDCs around the Chitwan National Park (Figure 3). Megahuli VDC lies on the central/kasara while Bachhauli VDC lies in the eastern/sauraha sector of the park with the park being divided into four management sectors: the Eastern/Amaltari, Central/Kasara, Western/Sauraha and Southern/Madi sectors. Meghauli VDC lies about 28km from Bharatpur (the district head quarter) at the western border of Chitwan district covering an area of 3067.2 ha and a population of 14,149 with 3,086 households (Census, 2011). The boundaries of the VDC are Sukranagar VDC and Rapti River in the east, Narayani River (CNP) in the west, Dibyanagar

VDC in the north and Rapti River (CNP) in the south. Meghauli VDC is habituated by a mixed community, mostly dominated by Brahmins, Chhetri and Tharu living in 33 settlements (Paudyal, 2008). Meanwhile, Bachhauli VDC covers an area of 2111.12 ha with a population of 10,905 and 2,321 households (Census, 2011). Sauraha in Bachhauli VDC is a major tourism trade area and the gate way into Chitwan National Park. The boundaries of the VDC are Rapti River to the south, Kumroj VDC to the east, Ratnanagar to the north, Barandabhar corridor forest to the east and Khairhani VDC on north-east. Bachhauli VDC. Like Meghauli VDC, Bachhauli VDc is also habituated by a mixed community predominantly of consisting of Tharus, Brahmins and Chhetri (Maniratna, 2008).

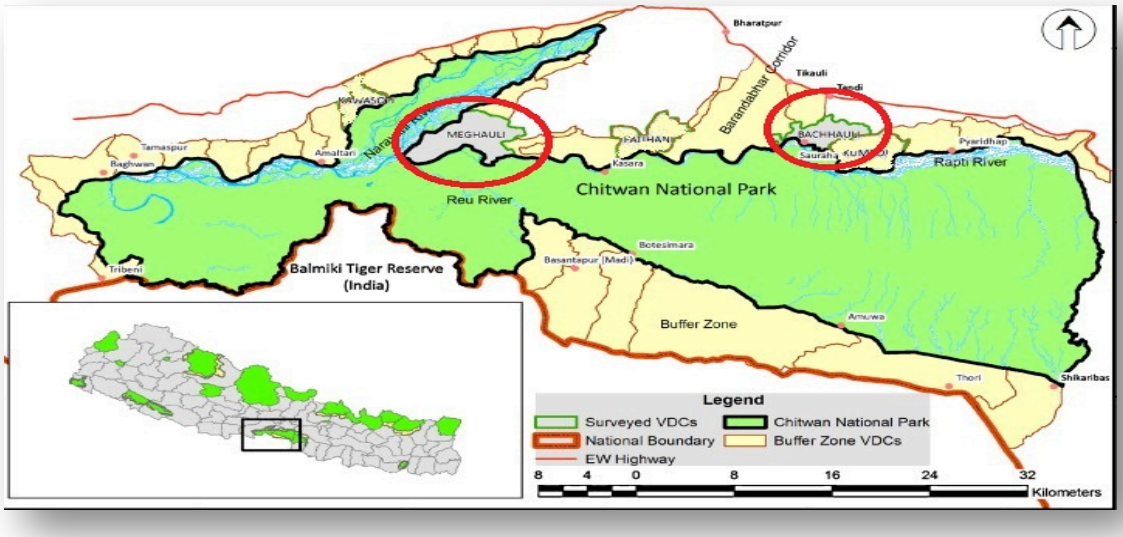


Figure 3 Map depicting Chitwan National Park and Study Areas

3. Theoretical Framework and Review of Literature:

3.1 Sustainable Livelihood Framework

Poverty has been generally assessed in terms of income or consumption criteria. However recently income is considered as only one aspect and poverty is broadly defined in terms of vulnerability, health, literacy, participation and influence in decision-making. A sustainable livelihoods (SL) approach draws on this improved understanding of poverty, bringing together relevant concepts to allow poverty to be understood more holistically (Farrington et al., 1999). The sustainable livelihood approach or framework arose from the broad context of rural development theory (Schuit, 2011) and attempted to go beyond the conventional definitions and approaches to poverty eradication and the integrated rural development (Mbaiwa et al., 2008). The World Commission on Environment and Development (1989) and the UN Conference on Environment and Development (1992) were critical to its formation (Krantz, 2001) and some of the prominent work on this concept includes those of Chambers and Conway (1992), Scoones (1998) and Ellis (2000). This concept now has been developed and implemented by a number of organizations as the United Nations Development Program (UNDP), British Department for International Development (DFID), CARE international, Oxfam and other research institutes as well (Brocklesby and Fisher, 2003).

One of the limitations of the framework is the challenge associated with monitoring the impact of transforming structures and processes on livelihood and project outcomes. This is because the effects of policies, organizations, laws and social relations on livelihoods are diffused and long-term. Also, the concepts of culture, power relationships, politics, and historical experience do not easily fit into the framework (Adato and Meinzen-Dick, 2002). Still, sustainable framework is one of the most widely used livelihood framework and its flexible design and openness to changes make it adaptable to diverse local contexts (Kollmair and Gamper, 2002). Hence, the sustainable livelihood framework derived by DFID is taken as basic tool for the analysis of livelihood impact in this study.

Sustainable development as defined by the World Commission on Environment and Development (the Brundtland Commission) (Brundtland, *1987)* "is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*"*. Furthermore, livelihood is often defined as the means of support or subsistence. Thus sustainable livelihoods literally means "the capacity of people to make a living by surviving shocks and stress and improve their material condition without jeopardizing the livelihood options of other people's, either now or in the future" (Hoon et al., 1997). While, according to the definition by Chambers and Conway (1992), modified and adapted by DFID (1999), "a livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base". The five key elements of this definition as recognized by Scoones (1998) are: creation of working days; poverty reduction; wellbeing and capabilities; livelihood adaptation, vulnerability and resilience and lastly natural resource base sustainability. Figure 4 below illustrates the interaction between the internal and the external factors of livelihood, which determine household livelihood strategies and outcomes. Internal factors are the five capital assets—human, natural, physical, financial and social—which a household has access to. External factors are the vulnerability context (trends, shocks and seasonality) and the transforming structures and process (institutions, organizations, policies and legislation) that influence the access to the assets (livelihood strategies) and shape livelihood (livelihood outcome). In this study the livelihood capitals will be analyzed in a wider context while the vulnerability context will be analyzed only in terms of shocks that result from conflicts between humans and wildlife. While analyzing the transforming structure and processes, national park and wildlife conservation act of Nepal (1972), buffer zone management policy (1992) will be studied.

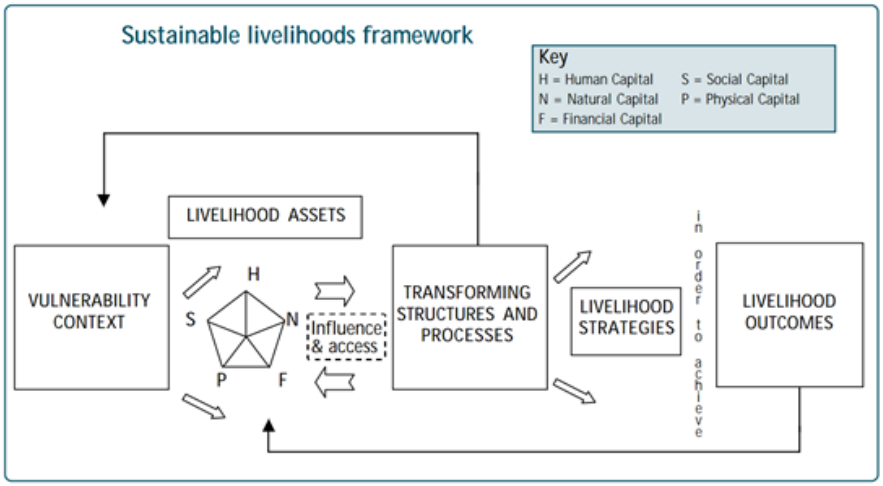


Figure 4 Sustainable Livelihood Frameworks (DFID, 1999)

The five livelihood or household assets with example are described below in the chapter 3.1.1. The words household assets and livelihood assets are used interchangeably here.

3.1.1 Livelihood/household assets

Ellis (2000) describes household assets as "stocks of capital that can be utilized directly or indirectly, to generate the means of survival of the households". The assets or capitals that are generally recognized within sustainable livelihood theory are listed below. These five capitals are at the core of the DFID Sustainable Livelihood Framework, as seen in the Figure 4 (DFID, 1999).

a. **Natural (Environmental) Capital**: Natural capital, such as land and forests, water, wildlife, biodiversity, environmental service (Krantz, 2001) are particularly important as people derive some or most of their livelihood from these sources. But the importance of natural capital goes beyond only livelihood, as we cannot even survive without these resources (DFID, 1999). Also, these capitals often define the adaptive capacity and resilience of the communities depending upon these resources. Hence it becomes important to document these resources.

b. **Physical Capital**: Physical capital is comprised of **1.** Basic infrastructure (water, sanitation, energy, transport, communications, housing), and **2.** Tools and technology (tools and equipment for production) (Kollmair and Gamper, 2002). The opportunity costs associated with poor infrastructure can have negative impacts on levels of education, access to income generation activities, health services and market places (DFID, 1999). The components of infrastructure that are considered for this study include transport and

roads, water and sanitation, access to information (communication) and market places. One of the limitations of this study is that it looks only into the availability of infrastructure and hypothesizes that the infrastructures support services and are appropriate.

c. **Human Capital**: Human capital represents the health, nutrition, education, knowledge and skills, information and the ability to work (Majale, 2002) that together enable people to pursue livelihood strategies and achieve livelihood objectives (DFID, 1999). It is required in order to make use of any of the four other types of assets, and is hence considered quite important. Some of the information collected to analyze the human capital in this study includes the formal education among respondents and the exclusion, if any, from accessing these based on gender/ethnicity.

d. **Social Capital**: Social capital are the social resources upon which people draw on in pursuit of their livelihood objectives (Gaire, 2006), and are developed through relationships of trust, formal and informal groups, membership of groups, networks, access to wider institutions and participation in decision making (Majale, 2002). Social capital may not always be positive (Schuit, 2011) but can be particularly important for the poor and vulnerable as being the "resource of last resort" (DFID, 1999). Some of the information that will be collected for this study includes participation of respondents in different groups. In particular, levels of participation among females and respondents from the so-called lower caste or underprivileged groups, and also the frequency and continuation of these programs will be looked at. Also questions will be asked if there is any improvement of general awareness and capacity after involvement in these types or groups.

e. **Financial Capital**: Financial capitals are the financial resources people use to achieve their livelihood objectives. It includes two types of resources, available stocks and regular inflow of money (Kollmair and Gamper, 2002). Saving cash, bank deposits or liquid assets represents available stocks whereas remittances, pension or other government support represents the regular inflow of money. Credit is also considered a type of financial capital (McLeod, 2001a cited from Majale, 2002). Financial capital is considered one of the most important types of capital but it is also the asset that tends to be the least available to the poor (DFID, 1999). Some of the information collected in this study to analyze the financial capital are:

- What types of financial capital exits?
- Who – which groups or types of people – has access?
- How many households have remittance and pension as a source of income? How much money is involved?

3.1.2 Livelihood strategies and outcomes

"Livelihood strategies are the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals" (DFID, 1999). It is a dynamic process and consists of enormous diversity of activities undertaken at different times, across different levels, sectors and geographical areas. While on the other hand livelihood outcomes are the achievements or outputs of the current configuration of livelihood strategies. More income, increased well-being, reduced vulnerability, improved food security and sustainable use of natural resources represents the achievements of livelihood strategies. The following types of issues are considered while analyzing the livelihood strategies and livelihood outcomes for this study:

- Income among different social groups and from different sources
- Choices that people made or are making e.g. migration of people for employment or land, participation or non-participation in social groups
- Choices that people make when faced by threats e.g. wildlife damages to crops
- How secure are people and their assets against wildlife damages?
- To what extent do particular groups have access to the institutional setup or political process?
- How good is the access of different groups to core services (e.g. education, sanitation, health)?

3.2 Literature Review

3.2.1 Human wildlife conflict: Sources and consequences

Most literature review on natural resource conflicts, particularly human-wildlife conflict, focuses mainly on any one of the ecological, social or economic natures of the conflicts (White et al., 2009). Ecological aspects deal with factors such as the types of wildlife species and their population dynamics, and habitat requirement while the economic factors are income gained and lost, risk factors and investments made in dealing with these conflicts. The social factors on the other hand are closely associated with attitude, behavior, norms and values of population and individuals concerned. While ecological and economic aspects are important, social aspects are equally important, as conflicts related to natural resources are often inherently social in nature (White et al., 2009). Hence, it becomes apparent to take into account the ecological, economic and social nature of conflicts while studying human-wildlife conflict. Table 3 classifies the research questions based on the nature of the conflict. It is important to note that the elements associated with the nature of conflicts are often closely associated. Income and household resources are economic in nature but are often shaped by social factors such as social status and power relations. Also perception of risk is often social in nature but can be shaped by the economic status of households and availability of resources. This study tries to answer what consequences these elements have on each other and how that shapes the ultimate human-wildlife conflicts across two study sites and how they vary across these sites.

Table 3 Nature of conflicts and corresponding research questions

Nature of conflict	Research questions
Ecological	How does the distance from park affect the severity and frequency of damage? What are the major wildlife species responsible for damages and what is the damage pattern?
Economic	How big are the wildlife damages and investment into protection measures and how are they related to local people's income and livelihood? What are the factors that determine the cost of damages to crops and the cost of mitigative measures against wildlife damages?
Social	Do wildlife damages affect the poor or the rich? What are the factors that shape people's attitude towards the park and determine the participation in buffer zone or other social programs? Do those who benefit from the park also suffer from the wildlife damages?

The use of park resources is often considered as one of the major sources of park-people conflicts all over the world (Bailey, 2011). The establishment of protected areas and national parks worldwide and imposition of various rules and regulations often restricts the utilization of natural resources among local people (Nepal & Weber, 1995). This is also true for Chitwan National Park where people for generations enjoyed free access to these resources but now no longer have legal access. They have restored to means such as smuggling firewood, grazing livestock and collecting timber and grass (Uprety, 1995) to meet their needs of energy, timber and grazing. The park-people conflict in CNP centers around meeting these basic survival needs because of the widespread poverty and unemployment (Upadhyay, 2009). Also, the injection of revenues to communities and implementation of compensation measures has also not been effective. All this has resulted in serious conflicts (Shrestha, 1996) and exacerbated an already bitter conflict between local inhabitants and park authorities (Bailey, 2011).

Apart from the use of park resources, crop damage has often been referred to as being the most important source of conflict between people and protected areas worldwide (Hockings and McLennan, 2012; Hill et al., 2002; Kharel, 1997; Studsrød and Wegge, 1995). Livestock loss and loss/injury of humans are the other major source of conflict (Nyhus, et al., 2000) between people who live adjacent to the protected areas and wildlife that are literally being confined inside the rigid boundaries of these protected areas. In the context of Nepal, especially in low land *Terai* protected areas, human-wildlife conflict is an ever-increasing problem (Lehmkuhl et al., 1988; Sharma, 1990; Heinen, 1993; Nepal & Weber, 1993, Studsrød and Wegge 1995). Wildlife as rhino (*Rhinoceros unicornis*), elephant (*Elephus maximus)*, wild boar (*Sus scrofa*), deer (*Axis axis*) and monkey (*Macaca mulatta*) has been identified as the major source of conflict in most of these protected areas (Baral, 1998; Tamang and Baral, 2008; Bailey, 2011). The type of animals involved, types of crops (Hill, 1997; Dickman, 2010) and season (Linkie et al., 2007), distance from protected areas boundaries (Hill, 1997; Hill, 2000; Naughton-Treves, 1998; Sekhar, 1998) and use of damage control measures (Sekhar, 1998; Dickman, 2010) are some of the most important factors influencing the extent of crop damage inflicted by wild animals (Figure 5).

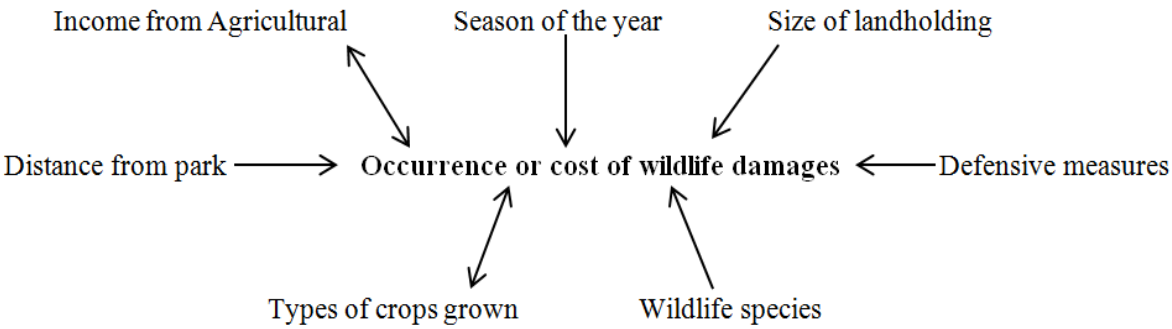


Figure 5 Factors affecting the occurrence or the cost of wildlife damages to crops

The figure 5 depicts a number of factors that affect the occurrence or the cost of wildlife damages to crops. The two tailed arrow indicates that the relation is both ways between the factors: as types of crops grown influences the occurrence or extent of crop damage (e.g. wheat is highly susceptible to damage from rhino) and on the other hand the occurrence or nonoccurrence of wildlife damages determines which type of crop is grown (e.g. farmers in certain regions of Chitwan National Park has stopped growing wheat because its highly susceptible to loss from rhino).

The HWC has been found to have a negative impact on the wellbeing and livelihood of the local people worldwide and in Chitwan National Park as well (Barua et al., 2013; Coad et al., 2008; Thapa, 2010; Wang et al., 2006; Bailey, 2011). Studies have shown that usually poor people and people from marginalized groups suffer particularly high economic losses and food insecurity resulting from HWC (Barua et al., 2013; Magige, 2012). These households are vulnerable because of the lack of resources and alternative sources of income available to them, lack of investment in protective measures and involvement in decision-making process. The poorest without large landholding and alternative sources of income, face a compounding vulnerability (Naughton et al., 1999). Another consequence of human wildlife conflict is the negative attitude or sentiment that local people may grow towards wildlife, park authorities and the whole conservation effort. These attitudes depend not only on human-wildlife conflicts but also on the restriction placed on the use of resources and can vary depending upon demographic characteristics as such gender (Gore and Kahler, 2012) and factors such as household income, length of residency (Nyerges, 1992), participation in social groups and knowledge about that particular species. And at the same time the attitude are shaped by the presence or absence of benefits such as effective compensation schemes (Archabald & Naughton-Treves, 2001) and access to services that park and government authorities can provide such as health, education, electricity and drinking water (Figure 6). Hence it becomes important to investigate if and how people's attitudes and behaviors towards conservation are shaped by the availability or lack of these benefits and services.

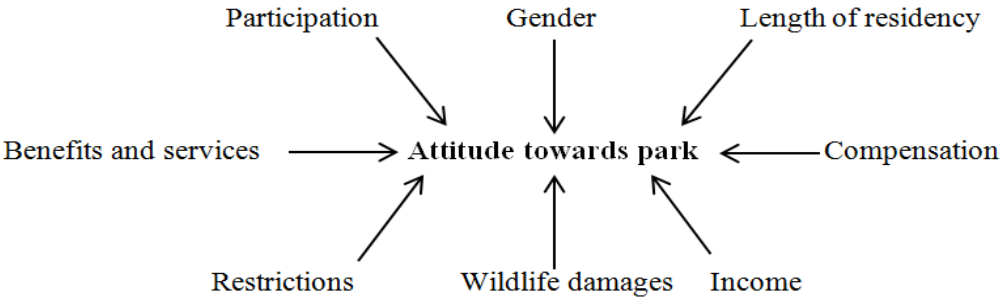


Figure 6 Factors shaping attitude towards the park and park authorities

3.2.2 Mitigative/adaptive measures against damages

HWC is not only characterized by the severity and frequency of losses but also by numerous social, environmental and technological factors that relate to individual vulnerability and risk (Treves, 2007). As seen in many cases, alternative sources of income and investment in defensive measures can alleviate the losses and can help reduce the risk of wildlife damages respectively. The analysis of factors that make households vulnerable and factors that elevate risk can help in innovating the interventions and methods to cope with the wildlife damages (Treves, 2007) thus balancing wildlife and human needs most effectively. Different scholars have classified these interventions differently as:

- Direct and indirect intervention (Treves, 2007)
- Passive and active (Osborn & Parker , 2003)
- Lethal and non-lethal methods (Vantassel, 2012)
- Prevention or control measures (Distefano, 2005)

The farmer's choice of these interventions depends on a number of factors such as the presence and severity of crop damages (Bailey, 2011), the availability of local resources and the specific type of animal causing the destruction (Weladji & Tchamba, 2003), the wealth of the household (Wang et al., 2006), economic consideration and risk factors. It is interesting to note here the cases where farmers associate larger risk to larger animals but tend to forget about the chronic problems of smaller animals. This is mentioned here to emphasize that risk factors are not universal but depend on individual household's perception and vulnerability. Lastly, it is important to note that not a single factor in isolation but a myriad of these factors influence the choice of a farmer to employ defensive measures.

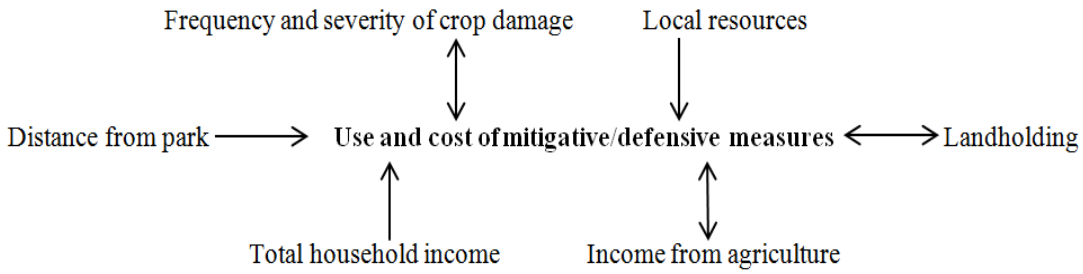


Figure 7 Factors that affects the use and cost of mitigative/defensive measures

Figure 7 depicts a number of factors that affect the use or the cost of measures employed for protection or mitigation against wildlife damages. The two tailed arrow indicates that the relation is both ways between the factors: as income from agriculture determines if a farmer considers it worthwhile to use or not to use the protection measures and on the other hand the use or lack of use of mitigation measures can determine the income from agriculture (income can be lost because of damages due to lack of protection measures). Here, the frequency and severity of crop damage in itself depends upon a number of factors such as types of crops, crop raiding wildlife and season of the year.

3.2.3 Compensation as a mitigative measure

Compensating farmers for wildlife damages is an important component of so called integrated conservation and development program (ICDP), which encourages people to utilize the natural resources in a sustainable way (Barrett and Arcese, 1995). But there exists great challenges in implementing these programs. Compensation program as a solution for mitigation of human-wildlife conflict has mixed success from different parts of the world (Fourli, 1999; Nyhus et al., 2003; Morrison et al., 2009). Compensation does not eliminate the conflict from occurring in the first place (Wagner et al., 1997). Little quantitative evidence exists to support the claims on impacts these schemes have on people's attitude or the impact on the wildlife population of conservation interest (Nyhus et al., 2003). Even if there are some, the impacts are known to be ambiguous. Studies suggest that the poor, illiterate, women and individuals lacking social capital are less likely to pursue compensation (Barua et al., 2013). Also, the introduction of compensation removes the impetus for protecting crops and livestock (Bulte and Rondeau, 2005) as such that the individuals are less likely to adopt new/improved management practices that would discourage conflict from occurring in the first place. Because it is often prohibitively expensive, and as there is often a lack of technical manpower at the disposal of the park authorities, it is almost impossible to directly monitor the off-farm abatement efforts undertaken by the farmers (Rollins and Briggs, 1996). In this kinds of scenario farmers will be tempted to reduce their current levels of investment and preventive actions and simply receive the compensation payments (often referred to as moral hazard and is discussed below). Subsequently this results in an even higher level of damages (Bulte and Rondeau, 2005).

The core elements what makes a compensation scheme successful are the accuracy and rapidness of damage verification, transparent and swift payment mechanism and positive impacts on wildlife population and livelihood of local people (as noted by Morrison et al., 2009). Some of the challenges faced by these types of compensation scheme as outlined by different scholars include: issues related to transparency and governance, verifying damage and making payment, moral hazards and migration of outsiders hoping for benefits and other challenges (Nyhus et al., 2003; Fourli, 1999; Rollins and Briggs, 1996; Rondeau and Bulte, 2007). Moral hazard refers to a situation where compensation may remove the impetus among the farmers for protecting crops and livestock as such that they are less likely to adopt new/improved management practices that would discourage conflict from occurring in the first place. In this kind of scenario farmers will be tempted to reduce their current levels of investment and preventive actions. Subsequently this results in an even higher level of damages (Bulte and Rondeau, 2005). Also, compensation may attract outsiders hoping for benefits, ultimately increasing the number of people exposed to damages. Since migration leads to more land conversion, this may even reverse any potential effects that compensation may have and further deteriorate the net impact of compensation on conservation (Rondeau and Bulte, 2007). Also, it has been found that payments do not necessarily raise the tolerance for the damaging wildlife among recipients, as documented by Naughton-Treves et al., 2003 in their study on wolves in Wisconsin, United States. Rather, studies have shown that landowners who felt a moral obligation towards wildlife are more tolerant towards wildlife depredation (Van Tassell et al., 2000). Finally, it is important to realize that although compensation is an important tool for HWC mitigation, it cannot work in isolation. Hence an integrated strategy to address human wildlife conflict should be developed which includes compensation together with other tools, such as land use planning, direct incentives, preventative management measures and raising awareness among others.

4. Methodology

4.1 Household Socio Economic Survey

4.1.1 Survey Design and Sample Size

Two village development committees (VDCs) out of 37 VDCs and 2 municipalities with in the buffer zone of Chitwan National park were randomly selected. The socio economic survey was conducted using both structured and semi-structured questionnaires. A total of 140 households, 70 from each of the VDCs, were selected for the questionnaire survey which represents 2.58% of the total households in these VDCs. The latest National population and housing census data, 2011 for Nepal were used and the total number of households in the two study areas combined was found to 5407. The households were selected randomly. All the name of the households provided by the village development committee office were noted down separately for each VDC and 70 households from each VDC were chosen randomly. The interview was carried out in Nepali, the national language and on instances where it was not understood help was sought from volunteer translators. Whenever possible the household head was interviewed but other members of the family also supplemented his information. Before conducting each individual interview, the purpose of the study was made clear and respondents were made assured of confidentiality and anonymity. The fieldwork was conducted from beginning of January to end of March 2013.

4.1.2 Questionnaire Survey

Before conducting the formal survey, the questionnaires were tested in randomly selected households in the study areas and necessary modifications were made. This was done in the last week of December 2012. The questionnaires were developed into four main parts:

- Household information and capitals,
- Compensation, participation and perception of national park
- Wildlife damages and
- Wildlife damage control methods

a. Household Information and different types of capitals

In this section, respondents were asked question regarding household demographics, education, income, expenditure and saving, household assets including the land holding, residency, access to services as electricity, education, health etc. in addition to this

information on agriculture were also collected regarding crop production and its sufficiency, cropping patterns and livestock holding. Livestock numbers were converted into livestock unit (LU) by applying the conversion factors taken from Sharma, 2000) (Annex 7). Also, questionnaire was developed to study the issues related to the social and public capital. For the purpose of our study, social capital characterizes the relations where households belong to a set of formal and informal organizations that may provide direct or indirect assistance in economic activities for example membership in a community user group or women's group etc. While the public capital, which includes the access to public goods and services. These include a range of services and infrastructure from health care, education and telephone access to electricity, drinking water and roads. These social and public capitals were used to access the capacity of households to undertake income-generating activities and capacity building particularly among women and marginalized groups.

To calculate the total household assets/wealth, total household income and net household income the following composites were used:

- **Total Household assets/wealth**= value of land + value of building + value of livestock + value of bicycle/motorbike + other machineries + savings
- **Total Household income=** income from agricultural production + income from livestock + non-agricultural income + compensation
- **Total Household coast=** agriculture production cost + livestock rearing cost + wildlife damages cost + wildlife damage control cost + interest on loans
- **Net household income=** total household income – total household cost

Income from agriculture production was noted in kilogram (kg) and whenever local units (*Muri, pathi etc*) was used it was converted into standard production unit (Kg) by using conversion factors provided by Nepal & Weber (1993) (Annex 6). The agricultural income was calculated by multiplying the sale of the particular type of crop type by the local market price while the expenditure was obtained by multiplying the quantity of input type by market price per unit of that input. While income from livestock were calculated by multiplying the quantity of livestock product sold with its market price while the cost associated with livestock ownership was calculated by directly asking the respondents the individual costs associated (as fodder cost, vet services cost etc.)

b. Issues related to Compensation, Participation and National park

Information regarding compensation and involvement in buffer zone related programs especially among women, ethnic and marginalized groups was collected. It was also tried to capture local people's perception and attitude towards National park and park authorities and why they have a particular opinion (either positive, neutral or negative) towards them.

c. Wildlife damages:

The questions were asked to ascertain the major types of wildlife damages and the wildlife responsible for such damages, the season of the year when damages occur, the types of crops damaged and the frequency of damages to crops and livestock. While the cost of damage to livestock was calculated directly by asking the respondents, the cost of damages to the crops was calculated using the formula:

Volume of loss = average yield ×%area planted ×% of yield lost

Value of crop loss = volume of loss ×value of crop

The self-estimation of damage costs is often found to be flawed because people tend to overestimate the loss, particularly compensation seekers and those making fraudulent claims (Nyhus et al., 2005). Hence this indirect method of estimation of crop damage costs was employed. The respondents were asked to estimate the percentage of yield lost to wildlife damages. The reference for the average yield for particular crop for Chitwan district was taken from the Statistical Information of Nepalese Agriculture 2011/2012, published by Ministry of Agricultural Development, Government of Nepal (2012).

Crop damages on the fields noted in *kathha* (local unit) was converted in hector (Annex 8). Also the monetary value of the different crops was based on the average price in the local market as of March, 2013 (in this case Tandi bazar for both the VDC). The price as stated by the retailers were wheat at NRs 35/kg, paddy NRs 20/kg, maize NRs 22/kg, banana NRs 30/kg, vegetables in general NRs 30/kg, buckwheat NRs 20/kg, *Mashuroo* NRs 60/kg and Mustard NRs 100/kg. US $1= NRs 94.30 as of 25.07.2013.

d. Wildlife damage control:

Terms as defensive, adaptive and mitigative measures were used interchangeably to define the measure for protection of crops and livestock from wildlife damages. Information on the methods for wildlife damage control was collected, by asking respondents about the types of methods used and the particular wildlife for which the method was employed. For convenience of this study only direct protective measures were studied and were categorized into 3 as repellents, construction and guarding.

Also, respondents were asked to rank all the control measures based on the level of effectiveness to control wildlife, cost, labor involved and other factors they deem important in choosing a particular type of control measure. This was on a scale of rank 1 to rank 5 and was given a score from 0 (highly ineffective) to 5 (highly effective). Finally, individual rank score and frequency of response for each mitigative or adaptive measure was multiplied and these scores were added to get cumulative score for each measure. On the basic of this score, the respondent's perceived level of effectiveness of each method was calculated and analyzed.

- Rank 1: Highly Ineffective,
- Rank 2 Ineffective,
- Rank 3 Moderately effective,
- Rank 4 Effective and
- Rank 5 Highly effective

e. Cost of control measures

The construction cost of the defensive measures consists of the investment cost and the labor cost. The investment cost is obtained from the monetary cost during construction while the labor cost and maintenance/repair cost was beyond the scope of this study and hence was not added as the cost of control measures. This was due to time limitation but this study recommends future studies incorporating all costs of control or mitigative measures.

4.1.3 Benefits and cost variables

The benefits were broadly classified as direct benefits and indirect benefits. The benefits that are considered direct benefits are the targeted initiatives and include yearly grass cutting inside the park and compensation for wildlife damages. Indirect benefits that are considered are the positive spillovers from the projects and activities (access to loan from different buffer zone or social groups, tourism, community development works, other park related income, electricity and programs targeted towards buffer zone residents). The cost variables concern with the households that have suffered wildlife damages related to loss of crops, livestock and/or property. The relevant time period for costs is the last 12 months. This differs from the time periods associated with the different benefits. But it can be assumed that there is some temporal stability in terms of whether a household suffers from these costs (Tumusiime and Sjaastad, 2013) and our analysis follows this assumption.

To investigate the question regarding if a recipient of one particular benefit is also more likely to be recipient of other benefit, an analysis of interdependence among the five most frequent benefits was done. For this, the two most frequent benefits were examined for significant clumping separately and so on for the five most frequent benefits. Extending the number of benefits may result in both expected and observed frequency being zero as realization of benefits decreases beyond the first few most realized benefits; hence the five most frequent benefits were analyzed. The difference in observed and expected frequency was divided by standard deviation to obtain the deviate for respective benefits combination. This was then checked for respective level of significance. To investigate issue related to distribution of costs and benefits, a cross tab is performed between the cost variable (occurrence of wildlife damages) and different benefits variables (as described previously in this chapter) to obtain the expected and observed frequency. We then analyze if there is clumping or repulsion and if it is significant in terms of chi-square statistics for expected and observed frequency. A significant clumping implies that households that have suffered wildlife damages were more likely to have beneficiaries from that particular benefit variable while a significant repulsion implies that households that have suffered wildlife damages were less likely to have beneficiaries from that particular benefit variable.

4.2 Data Analysis

Data were analyzed using various statistical tools in different computer programs. Questionnaire responses were coded and analyzed using Statistical Package for Social Survey (SPSS) version 20 by giving each household the ids from 1 to 70 for each VDC and by defining variable for all the information. Most of the calculation and analysis were made on this software program. Qualitative form of data and information were also coded and analyzed similarly. Cross tabulation were made between education/landholding category/access to loan facilities of the respondents and caste/ethnicity of respondents. Also distance category from park was crossing tabulated with crop loss and mitigative/adaptive measure. Finally, wildlife damages were cross tabulated with household economic variables and benefits realized in the buffer zone of the park.

Gini coefficient (G) was used to measure inequality of income and wealth distribution. It is normally a ratio with values ranging between zero 0 and 1 where 0 value means indicates equality while 1 value means perfect inequality. Low Gini coefficient indicates more equal income or wealth distribution while high Gini coefficient indicates more unequal distribution (Wapalila, 2008). Mathematically, "the Gini Coefficient is the area between a given Lorenz Curve and the Lorenz Curve for an economy in which everyone receives the same income, expressed as a proportion of the area under the curve for the equal distribution of income" (Dorfman, 1979). The Gini coefficient was calculated using equation provided by Druckman and Jackson (2008).

$$G = \frac{1}{2n^2\eta}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|y^i - y^j\right|$$

Where, y^i and y^j are the income/wealth of i^{th} and j^{th} household, n is the average income/wealth and n is the total number of households.

Binary logistic and multiple regression along with correlation was used to examine relationships between variables. The chi-squared test for independence was employed to assess whether two categorical variables were related. Charts and graphs were generated from Microsoft Excel using data obtained from SPSS. The relationship between dependents variables such as wildlife damages, mitigation measure, participation and reasons for positive attitude towards park and corresponding independent variables was examined using binary logistic regression in SPSS. Logistic regression identifies significant variables affecting the

log odds-ratio in binary variables as presence or absence of an event. It is the most common technique for such analyses and compares well against other methods (Sitati, 2005). While multiple regression was used to determine which factors among location, sex of household head, area of landholding, caste/ethnicity, damage and mitigation costs were significantly related to total income of a household per year. Here total income refers to income without wildlife damage and mitigation costs. For the analysis of factors affecting the incidences and non-incidences of wildlife damages and use or non-use of mitigative measures, the independents variables were grouped into two categories, one household variable and other damages characteristics variable. The level of statistical significance was defined at 0.1, 0.5 and 0.01 levels. The data were screened for co-linearity and outliers prior to analysis.

5. Basic Sample Statistics

The general characteristics of the respondents in terms of sex, age group, caste/ethnicity, education, occupation and landholding are shown as:

Table 4 General characteristics of the respondents

Category		No. of respondents		Percentage	
		Bachhauli VDC	Meghauli VDC	Bachhauli VDC	Meghauli VDC
Sex	Male	65	54	92.86	77.14
	Female	5	16	7.14	22.86
Age group	<15 years	0	0	0.00	0.00
	16-34 years	6	6	8.57	8.57
	35-59 years	46	42	65.71	60.00
	>60 years	18	22	25.71	31.43
Caste/ethnicity	Brahmin/chhetri/thakuri	24	30	34.29	42.86
	Gurung/magar/tamang	6	4	8.57	5.71
	Tharu	34	18	48.57	25.71
	Damai/kami/sarki	0	5	0.00	7.14
	Darai/kumal/praja	3	12	4.29	17.14
	Newar	3	1	4.29	1.43
Education	Primary Level	10	16	14.29	22.86
	Secondary Level	21	22	30.00	31.43
	Higher Secondary	4	0	5.71	0.00
	University Level	2	1	2.86	1.43
	Illiterate	33	31	47.14	44.29
Occupation	Agriculture	42	55	60.00	78.57
	Service	5	5	7.14	7.14
	Teaching	1	0	1.43	0.00
	Business	10	5	14.29	7.14
	Wage labour	3	2	4.29	2.86
	Others	8	2	11.43	2.86
	None	1	1	1.43	1.43
Landholding	Landless	3	1	4.29	1.43
	<10 Kathha	30	13	42.86	18.57
	10-20 Kathha	18	19	25.71	27.14
	1-4 Bigha	19	34	27.14	48.57
	>4 Bigha	0	3	0.00	4.29

The average family size for Meghauli and Bachhauli VDC was found to be 6.21 and 5.40 respectively. The number of households with male head of family was found to be 65 (92.85%) and 68 (97.14%) respectively for Meghauli and Bachhauli VDC respectively.

5.1 Income Sources and Livelihood Strategies

Land, forest, water, crops, livestock and knowledge are some of the most essential resources in generating the livelihoods. A livelihood includes not only the income generating activities pursued but also a combination of non-income activities (e.g. social institutions, intra-house relation) as well that help to diversify income and meet household needs. The major sources of income in the study area (Rs per year per HH) are listed on Table 5. The top three major sources of income were found to be business, livestock products and remittance.

Table 5 Major sources of income (Rs/HH/Year)

Income variables	Bachhauli VDC (Rs/HH/year)	Meghauli VDC (Rs/HH/year)
Food crops	4057.14	15312.86
Pulses	6077.14	5228.57
Cash crops	11400.71	21198.71
Business	58057.14	32400.00
Livestock products	43817.16	29031.48
Wage labor	4971.48	19731.48
Remittance	56914.32	93714.12
Government support	85.68	1285.68
Service	10114.32	0.00
Mean income per year per HH	195495.09	217902.9

Although agriculture is not among the three main sources of income, the importance of agriculture in livelihood strategy is highlighted by the fact that nearly 70% of the population in the two research areas combined have agriculture as their main occupation and livelihood strategies in the study areas are shaped to a great deal by agriculture. While in only Meghauli VDC, nearly 79% of the respondents had agriculture as their main occupation followed by service and business. Other types of occupation people were involved in included service, business and wage labor. 60% of the respondents in Bachhauli VDC had agriculture as their main occupation followed by business at 14.28%. Also, agriculture provides them with food crops apart from the additional income they gain from selling pulses, food or cash crops. The

average agricultural production per household per year was found to be NRs 41,740.14 for Meghauli VDC and NRs 21,534.99 for Bachhauli VDC. The mean income per household per year from business, which is one of the most important sources of income in the study areas, was found to be Rs. 58,057.14 for Bachhauli VDC and Rs. 32,400 for Meghauli VDC. 30% of people receive remittance in Meghauli VDC with mean remittance of Rs 93,714.12/HH/year with just 1 respondent receiving government support (widow support). While in Bachhauli VDC 22.85% of the respondents receiving remittance of Rs 56,914.32/HH/year with 1 respondent receiving elderly support (*Briddha bhatta*). Also, many households in the study area depend on their livestock: goat, chicken and buffalo for subsistence income. Livestock provide nutrition supplements in the forms of milk and meat and draft power to plough the field. Hence livestock rearing is another important livelihood strategy for the local people. The mean income per household per year from livestock products was Rs. 43,817.16 for Bachhauli VDC and Rs. 29,031.48 for Meghauli VDC.

Migration, either seasonal or permanent, is another common and important livelihood strategy. 48.57% and 51.42% of the respondents in Bachhauli and Meghauli VDC respectively has been either living there for generations (origin), while 27.14% and 25.71% of the respondents in Bachhauli and Meghauli VDC respectively have been residing there for more than 25 years (Figure 8).

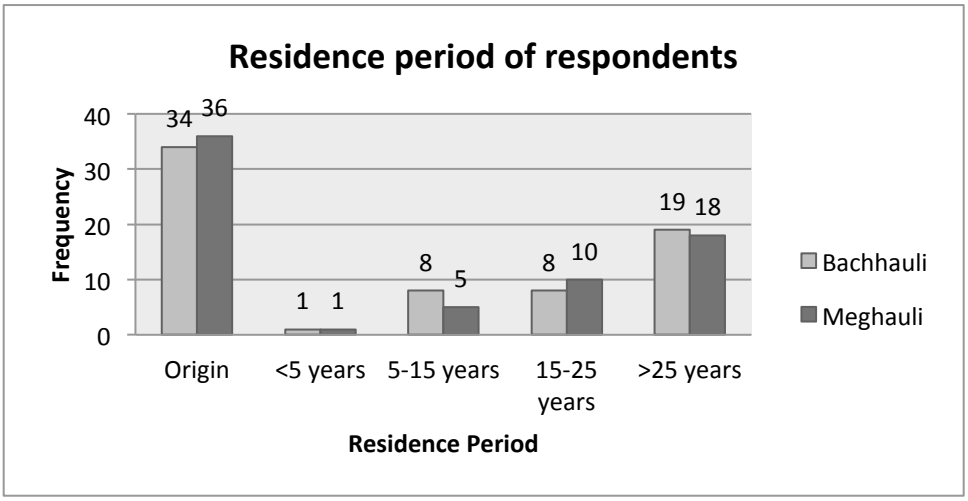


Figure 8 Residence period among the respondents

Availability of land for agriculture was found to be the major reason for the migration of people (figure 9). Most of them migrated from the hilly region of the district to this lowland area. Employment and family reason were other important factors responsible for migration of people. The decade long conflict in Nepal between Maoist rebels and the government at the turn of the century was also responsible for displacement of people from the original habitat and ultimate settlement in these areas. Some of the others reasons included better medicinal and educational services, transport facilities.

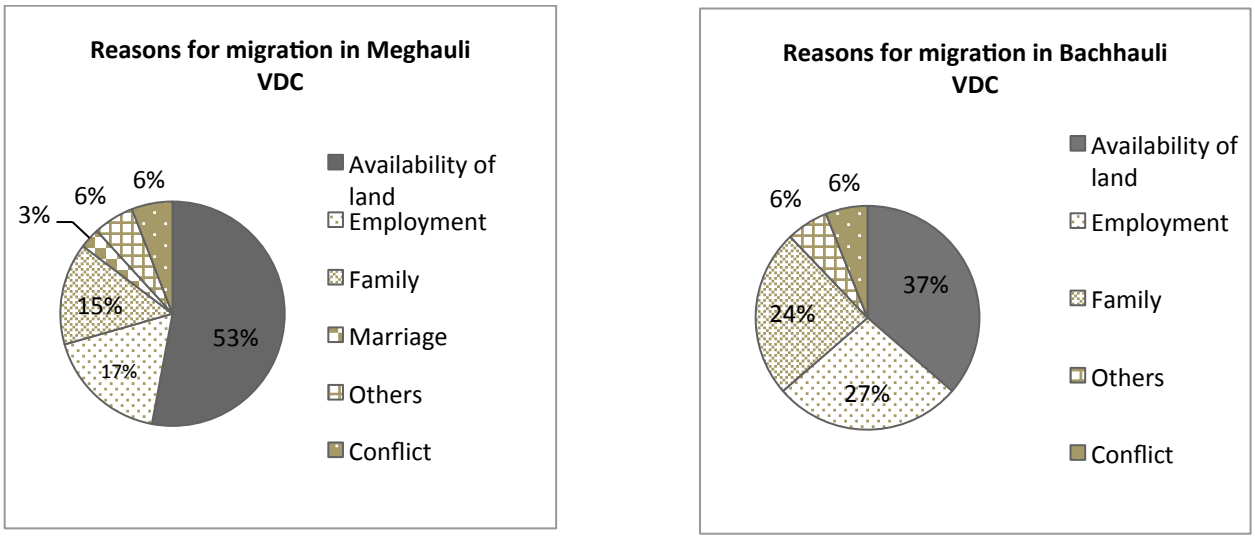


Figure 9 Reasons for migration

5.2 Education

Education is an important source of human capital. A large number of respondents were illiterate in both Meghauli and Bachhauli VDC (Table 6). 44.28% of the respondents in Meghauli VDC were illiterate while in bachhauli VDC the illiteracy was at 47.14%. Among the female respondents in Meghauli VDC (56.25%) were illiterate. While among the female respondents in Bachhauli VDC the illiteracy was extremely high at 80%. Only 3 respondents from both sides have a university degree. Illiteracy was also high among the Tharu communities in Meghauli VDC with 61.11% of the Tharu respondents being illiterate followed by Darai/kumal/praja where the rate of illiteracy was at 50%. 2/3rd of the respondents from the higher class as Brahmin/chhetri/thakuri were educated while 3 out of 4 Gurung/magar/tamang people were educated in Meghauli VDC while in Bachhauli VDC literacy was fairly high among the Brahmin/chhetri/thakuri at 54.16%.

Table 6 Caste ethnicity and education of the respondent cross tabulation

Caste/ethnicity of Respondent	Education of respondent in Meghauli VDC				Total
	Primary Level	Secondary Level	University Level	Illiterate	
Brahmin/chhetri/thakuri	8	12	0	10	30
Gurung/magar/tamang	1	2	0	1	4
Tharu	3	3	1	11	18
Damai/kami/sarki	2	1	0	2	5
Darai/kumal/praja	2	4	0	6	12
Newar	0	0	0	1	1
Total	16	22	1	31	70

Caste/ethnicity of Respondent	Education of respondent in Bachhauli VDC					Total
	Primary Level	Secondary Level	Higher Secondary	University Level	Illiterate	
Brahmin/chhetri/thakuri	1	8	3	1	11	24
Gurung/magar/tamang	0	1	0	0	5	6
Tharu	7	8	1	1	17	34
Darai/kumal/praja	2	1	0	0	0	3
Newar	0	3	0	0	0	3
Total	10	21	4	2	33	70

5.3 Awareness

The BZUC's record as observed during the field visit showed that several skill development and awareness generation training programs have been conducted in the study areas. In Meghauli VDC, 68.6% respondents believe that there has been increase in general awareness and capacity of the local people after the commencement of the buffer zone program; while in Bachhauli VDC it was 65.7%. A majority of people (51.4%) in Meghauli VDC responded that there aren't any specific program to increase the general awareness and capacity building of Women or other ethnic/marginalized people; contrary to a majority of people (51.4%) in Bachhauli VDC who responded that there are specific program to increase the general awareness and capacity building of Women or other ethnic/marginalized people.

5.4 Services and Infrastructures

According to DFID, the physical capital comprises the basic infrastructure and producer goods needed to support livelihoods (DFID, 1999). It was found that respondents of Bachhauli VDC have better and extensive access to services as electricity, communication and toilets as

compared to Meghauli VDC. But services as piped drinking water and sewage facilities are still scarce in both of these VDCs (Table 7).

Table 7 Number of respondents having access to different services

Basic services	Meghauli VDC		Bachhauli VDC	
	No.	%	No.	%
Electricity	34	48.57	60	85.71
Drinking water	21	30.00	33	47.14
Sewage	12	17.14	21	30.00
Communication	45	64.29	65	92.86
Latrine	24	34.29	58	82.86

Regarding to access to services as health, education and market places, both these VDC have quite easy and quick accesses. Both of the VDCs have access to up to higher secondary levels of education but for university level education, people need to go to nearest urban centre (*Narayangadh*). Mean distance to nearest primary, higher secondary and secondary school were all found to be within <5.0 km for Meghauli VDC and <2.0 km for Bachhauli VDC. The primary, secondary and higher secondary levels refers to school which has students up to grade five, grade eight and grade twelve (+2). While mean walking distance to nearest health post/hospital/clinic was found to be 4.25 km for Meghauli VDC and 3.06 km for Bachhauli VDC. People have access to only health posts and clinics and don't have access to hospitals in their near vicinity. Also, mean distance to nearest urban (which in this case was Narayangadh) was found to be 15 km for Bachhauli VDC and 27 km for Meghauli VDC while distance to nearest market places was found to be within walking distances for most of the respondents.

5.5 Land Holding

In Meghauli and Bachhauli VDC respectively, 91.4% and 95.7% of the respondents owned their own land. While only a small proportion of people rented or contracted land or both. Very few people in the study area are landless (nearly 3% only) and very few have landholding >4bigha (nearly 2%) (Table 8). In Meghauli VDC the greatest number of people, 48.57%, have landholding of 1-4 bigha while in Bachhauli VDC 42.85% of the people have landholding <10

kathha. If 1 bigha is considered as cut off point between people having smaller or larger landholding, no clear distinction is found between Tharu and Darai/kumal/praja as both of these groups have 50% of respondents in each category in Meghauli VDC. Also, 56.66% of Brahmin/chhetri/thakuri has landholding greater than 1 bigha in Meghauli VDC. While in Bachhauli VDC majority of the Tharu respondents have landholding less than 1 bigha (67.64%). Interestingly 70.83% of the Brahmin/chhetri/thakuri have landholding <1 bigha in Bachhauli VDC and that can be explained by the fact that majority of respondents (68.57%) have <1 bigha of landholding here (landless are not included in <1bigha category).

Table 8 Area of landholding based on caste/ethnicity cross tabulation

Caste/ethnicity of respondent	Area of landholding in Meghauli VDC					Total
	Landless	<10 Kathha	10-20 Kathha	1-4 Bigha	>4 Bigha	
Brahmin/chhetri/thakuri	0	3	10	17	0	30
Gurung/magar/tamang	0	1	1	2	0	4
Tharu	0	4	5	7	2	18
Damai/kami/sarki	1	1	1	2	0	5
Darai/kumal/praja	0	4	2	5	1	12
Newar	0	0	0	1	0	1
Total	1	13	19	34	3	70

Caste/ethnicity of respondent	Area of landholding in Bachhauli VDC				Total
	Landless	<10 Kathha	10-20 Kathha	1-4 Bigha	
Brahmin/chhetri/thakuri	0	9	8	7	24
Gurung/magar/tamang	0	5	1	0	6
Tharu	3	13	7	11	34
Darai/kumal/praja	0	2	0	1	3
Newar	0	1	2	0	3
Total	3	30	18	19	70

5.6 Crop Produced

Cash crops as buckwheat and vegetables were the most common type of crops that were grown in Bachhauli VDC followed by pulses. Some of the most common types of pulses that were grown included lentil (*mashoroo)* and pigeon pea (*rahar*). Food crops mostly wheat was grown albeit by a small number of respondents only. While in Meghauli VDC the combination of food

crops and cash crops were the most prominent. Among the food crops, wheat was the most common type followed by paddy and maize (Annex 3). These are illustrated on figure 10 below.

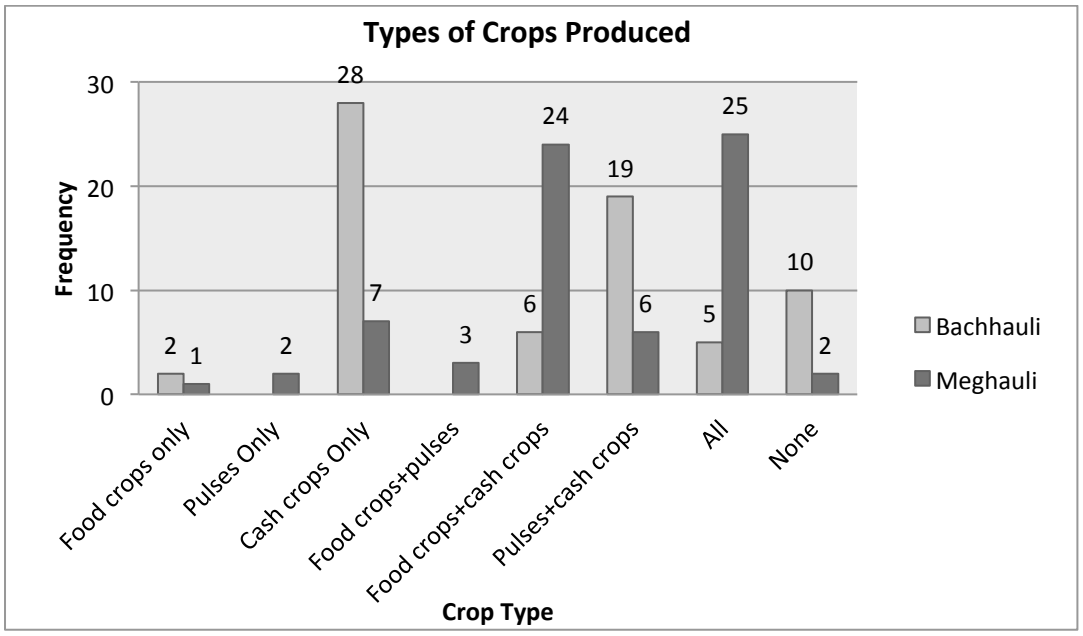


Figure 10 Types of crops produced

5.7 Status of Sufficiency of Food Crops

Majority of respondents in both VDC (65.71% in Bachhauli and 51.43% in Meghauli VDC) were food crop deficient (Figure 11). This is understandable in the case of Bachhauli VDC due to the fact that very few respondents grow these types of food crops and depend upon buying and bartering to fulfill their needs. While in Meghauli VDC it may be due to a number of factors as larger family size, lack of land, shifting pattern from agriculture towards business and services and shifting pattern in crop production from food crops towards cash crops and pulses.

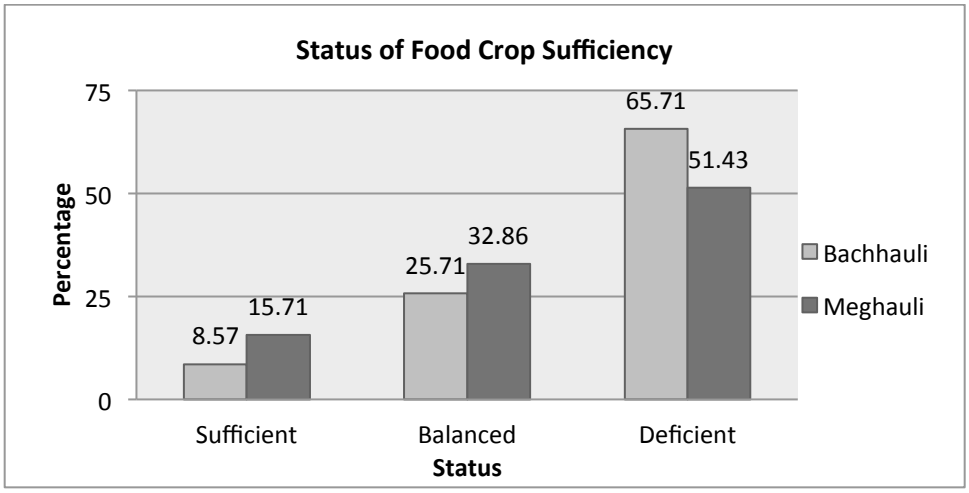


Figure 11 Status of food crops sufficiency or deficiency

Majority of the respondents 51.4% of the respondents in Meghuali were food crop deficient, 28.6% of them were deficient for a period of 1-3 months while nearly 14.3% were deficient for 3-6 months. For Bachhauli VDC, 67.1% of the respondents were food crop deficient and 25.7% of the respondents were deficient for a period of more than 6 months up to 1 year while 24.3% were deficient for a period of 1-3 months (Annex 4).

5.8 Livestock and Products

The average livestock unit per household for Meghauli VDC and Bachhauli VDC was found to be 1.6386 LSU (livestock unit) and 1.13 LSU (livestock unit) respectively. The most common types of livestock reared were cow, goat and buffalo. Other types of livestock that were reared include ox and sheep. 35.71% and 42.9% of the respondents didn't produce any type of livestock products while among those who produced livestock produced; milk was the most common in both VDCs. Other types of livestock products that were produced in the study areas included meat, eggs and butter (Annex 5). These types of livestock products provided households with an alternative source of income for the rural poor.

5.9 Household Wealth/Assets and Costs

The total assets/wealth per household for Meghauli VDC was found to be NRs 1,771,421.43 (Annex 1). The mean income per year per household was been found to be NRs 217,902.9 (Table 5). The mean cost per household per year was found to be NRs 14,781.43. The cost here includes agriculture production cost and cost for livestock rearing. While for Bachhauli VDC, the total household assets/wealth per household was found to be NRs 1,883,707.45 (Annex 1). The mean income per year per household has been found to be NRS 195,495.09 (Table 5). The mean cost per household per year was found to be NRs 17,560.13. Here, the mean income does not include the income from compensation while the mean cost doesn't include the total wildlife damage cost (cost of damages and mitigation measures). The net income per household including all variables is discussed in the discussion section.

5.10 Access to Loan Facilities

Fairly good access to loan facilities with 63% and 66% of the respondents in Meghauli VDC and Bachhauli VDC had access to both formal as well as informal types of loans (Figure 12). The buffer zone inhabitants use different sources for credit activities. During informal discussion it was found that a large proportion of households still depend on informal sources of loan as fellow villagers, moneylenders and different buffer zone groups. Very few reported that they got loan from financial sources irrespective of presence of banks and cooperatives in their localities.

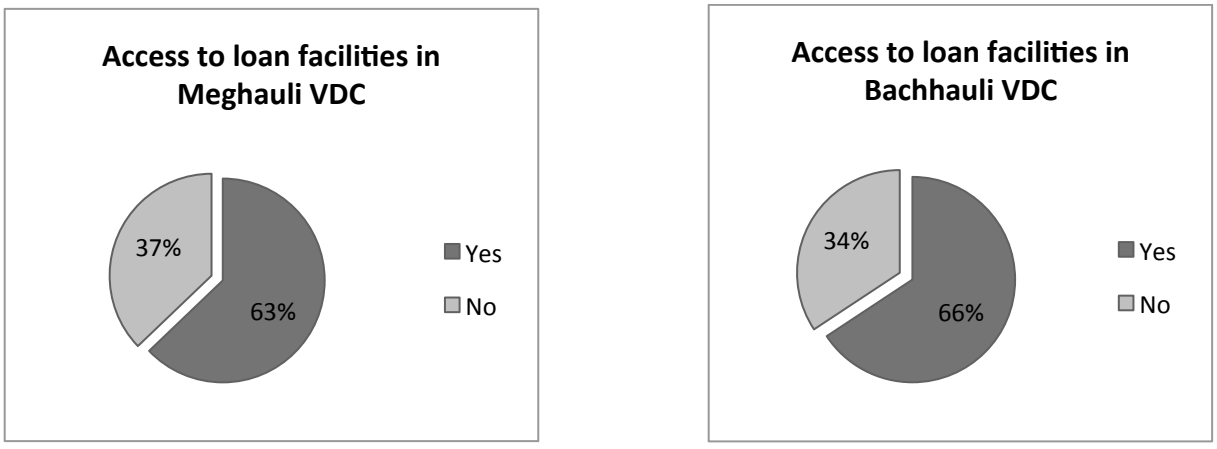


Figure 12 Access to loan facilities

Of the 50 respondents in both VDC who don't have access to any loan facilities, 44% are from so called low caste social groups (Tharu, Damai/kami/sarki and Darai/kumal/praja). 62.96% of so-called higher social groups (Brahmin/chhetri/ thakuri) have access to loan facilities and Tharus too have a good access to loan facilities (69.23%). Social groups considered at the bottom of the social order (Damai/kami/sarki and Darai/kumal/praja) too have good access (14 out of 20, 70%) (Table 9).

Table 9 Access to loan facilities based on caste/ethnicity cross tabulation

Caste/ethnicity Meghauli	Access to loan facilities		Total
	Yes	No	
Brahmin/chhetri/thakuri	18	12	30
Gurung/magar/tamang	1	3	4
Tharu	13	5	18
Damai/kami/sarki	4	1	5
Darai/kumal/praja	8	4	12
Newar	0	1	1
Total	44	26	70

Caste/ethnicity Bachhauli	Access to loan facilities		Total
	Yes	No	
Brahmin/chhetri/thakuri	16	8	24
Gurung/magar/tamang	3	3	6
Tharu	23	11	34
Darai/kumal/praja	2	1	3
Newar	2	1	3
Total	46	24	70

5.11 Buffer Zone and Related Activities

A majority of respondents in both the VDCs were involved in Buffer zone programs as user groups and user committees established for skill development, awareness generation and income generating activities (Figure 13). Other forms of programs among socially interacting groups included: *aama samuha* (mother groups), bakhra *paicho* (goat lending).

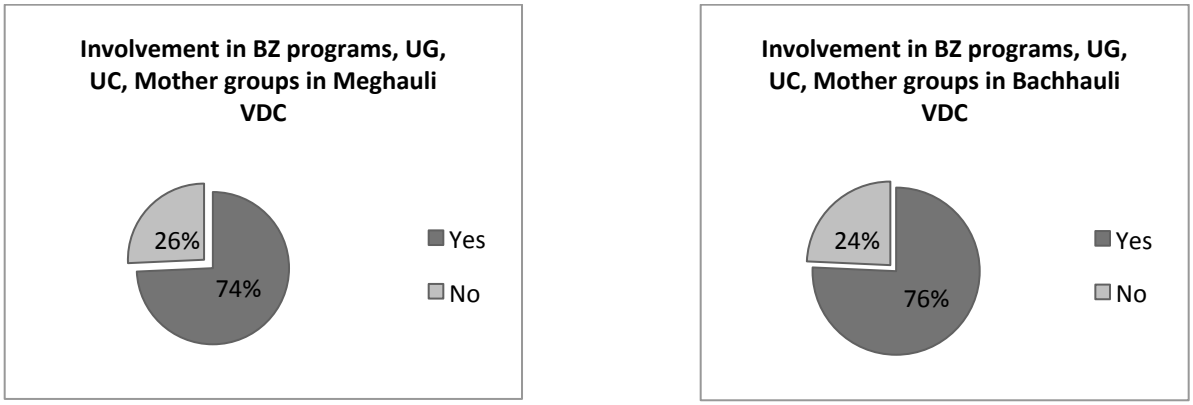


Figure 13 Involvement in buffer zone programs and related social programs

Regarding the frequency of participation, majority of the respondents frequently participate in these types of programs in Bachhauli VDC while majority in Meghauli VDC participate sometimes (Figure 14). Here, frequently is defined as participation in more than 90% of the programs while sometimes and rarely is defined as participation in more than 50% and less than 10% programs respectively.

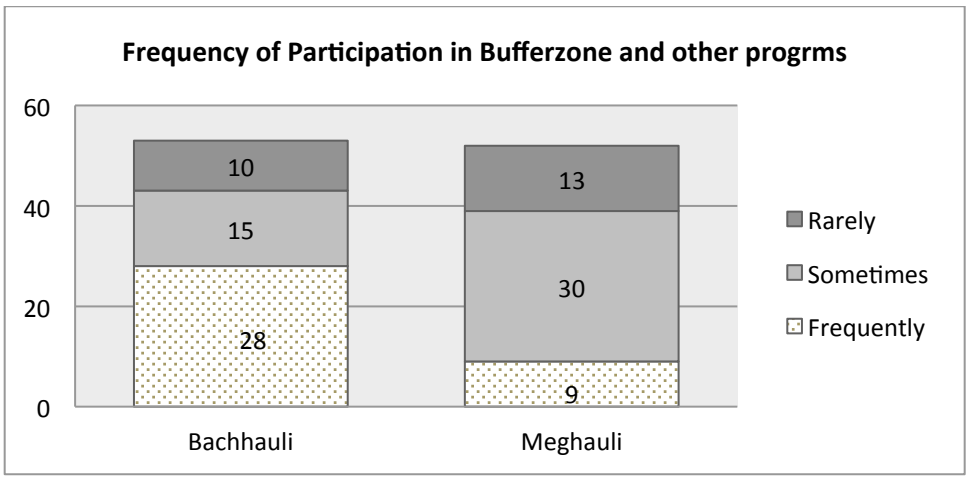


Figure 14 Frequency of participation in Buffer zone and other programs

68.57% and 65.7% of the respondents in Meghauli VDC and Bachhauli VDC believe that there has been a general improvement in the awareness and capacity of the local people since the inception of the buffer zone and related programs. While 48.57% and 51.4% of the respondents believe that there are no specific programs that are targeted towards women and marginalized groups for increasing awareness and capacity building.

6. Wildlife Damages and Mitigation Measures

Nearly 2/3rd of the respondents in Meghauli suffered some sort of damages from wildlife while in Bachhauli VDC only about 17% of the respondents suffered damages (figure 15).

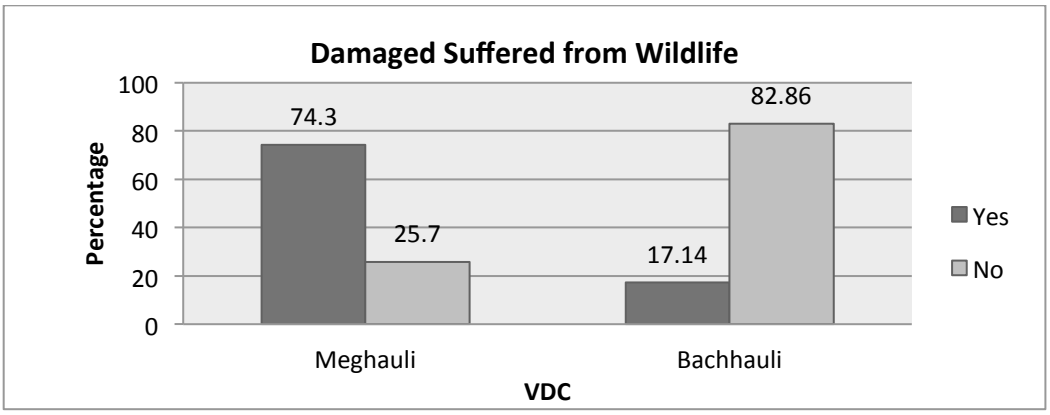


Figure 15 Percentage of respondents suffering damages from wildlife

6.1 Wildlife damages

Crop loss was the most common damage suffered in both of the study area with 51 incidences of crop loss (44 crop loss + 7 crop loss together with livestock loss) in Meghauli VDC and 12 incidences in Bachhauli VDC. Only 1 incidence of loss to property was observed among the two studies areas (in Meghauli VDC) (Figure 16).

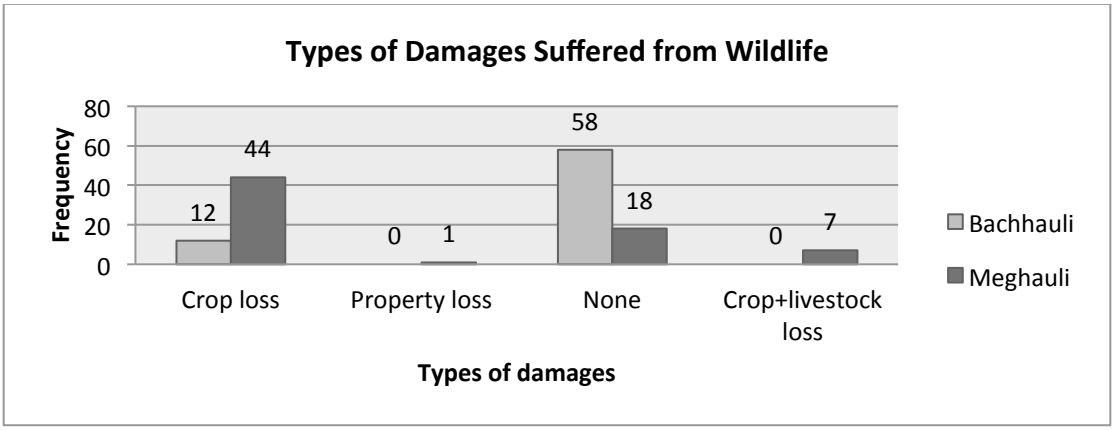


Figure 16 Types of damages suffered from wildlife

Rhino, wild boar, elephant and deer were the main crop raiders. Rhino was responsible for nearly 66% and 50% of damages to crops in Meghauli and Bachhauli VDC respectively (Figure 17). Most of the HHs reported that the damages to crops from rhino were extensive throughout the year. Chital and Wild Boar were the main crop-raiders during both monsoon and winter seasons while elephant was another major crop raider during monsoon season.

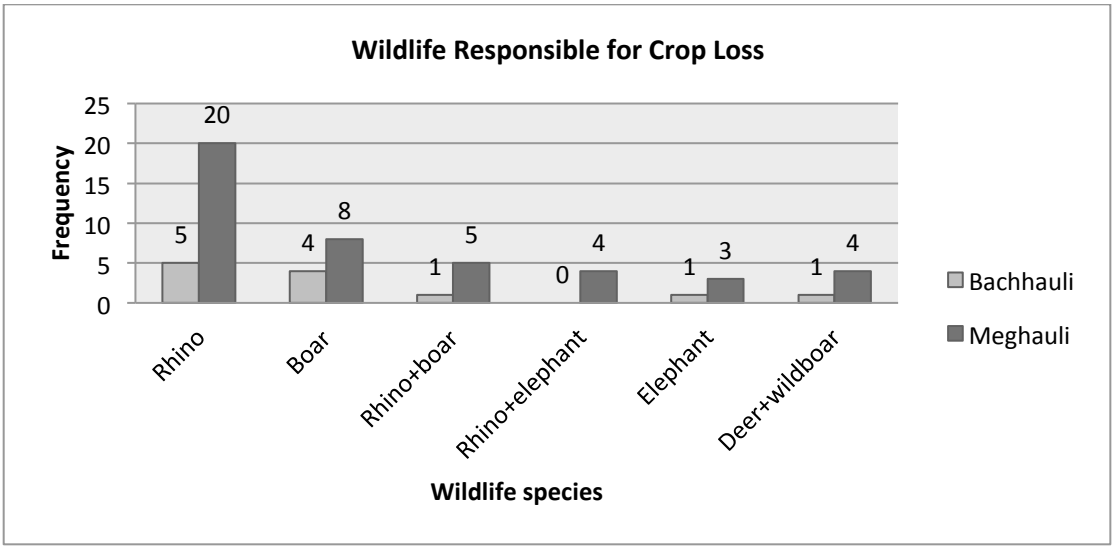


Figure 17 Wildlife responsible for loss of crops

Regarding wildlife responsible for loss of livestock and property, there was no reported incidence of damage to livestock or properties during the past 12 months in Bachhauli VDC. While in Meghauli VDC, 7 incidences of livestock loss were observed and bear was responsible for nearly 57% of those incidences. Other wildlife responsible for loss of livestock includes rhino, tiger and elephant. Only 1 incidence of damages to property was observed in Meghauli VDC (no incidences in Bachhauli VDC). Goats were the animals most preyed upon followed by cattle. Elephant was responsible for the damage and the monetary value of loss to property could not be determined.

6.2 Compensation measures for wildlife damages

Among the respondents from Bachhauli VDC, none of them received compensation for any of the losses. While in Meghauli VDC an overwhelming 93% of the respondents suffering from wildlife damages didn't received any compensation. A total of NRs 10,500 was received as compensation in Meghauli VDC that corresponds to a mere NRs 150 per household. And of those who received compensation, all claimed that the compensation measures were not enough in terms of monetary value and questioned its merit in reducing future damages.

6.3 Types of mitigative or adaptive measures against wildlife damages

71% of the HHs used some sort of measures to protect against wildlife damages in Meghauli VDC while only 4% employed such measures in Bachhauli VDC. 3 categories of measures repellents, construction and guarding were used with repellent being the most commonly used measure in Meghauli VDC (Figure 18). 66%, 34% and 10% of the respondents used different types of repellents, physical construction and guarding respectively as a method for wildlife damage control in Meghauli VDC. While in Bachhauli VDC, repellents and guarding were used as mitigative/adaptive measure against wildlife damages with no use of physical construction being observed.The mitigative/adaptive measures employed in the study areas for wildlife damage control has been classified in terms of repellents, physical construction and guarding and are discussed below in figure 18.

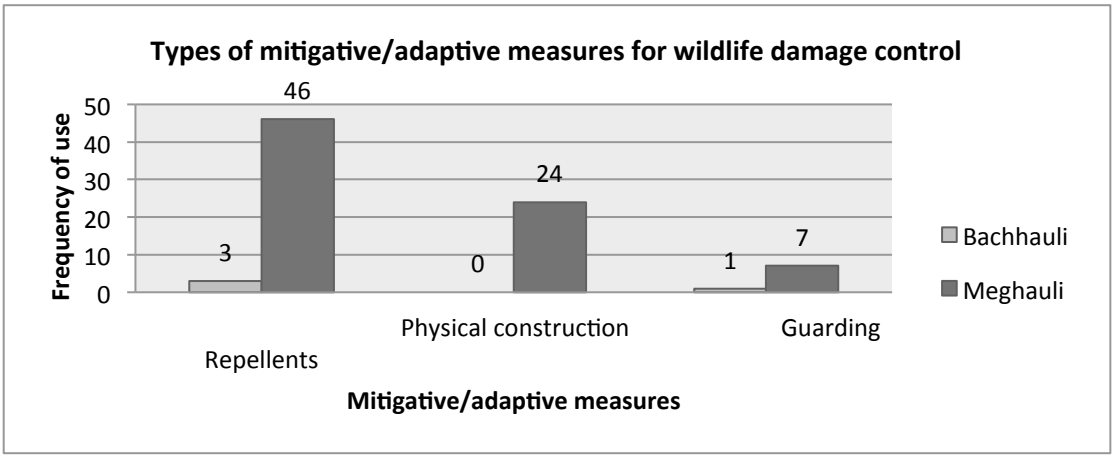


Figure 18 Types of mitigative/adaptive measures used against wildlife damages

In Meghauli VDC, fire making, noise making, chemicals and firecrackers were the types of repellents used for protection against wildlife damages in Meghauli VDC with noise making being the most frequently used method to scare away the wild animals. These measures are more active measures in scaring away the damage inflicting wild animals. Shouting and beating drums/tins/metal objects were the most common ways of producing sound to scare away wild animals during the crop-raiding process or when the animals were passing the fields. Making fire around the edge of the field or chasing the wild animals with a torch or flame was also frequently used (25 incidences of fire making). Other uses of repellents included use of chemicals and exploding firecrackers (Figure 19). While in Bachhauli VDC, only noise making was used as a repellent and it was used in 3 incidences.

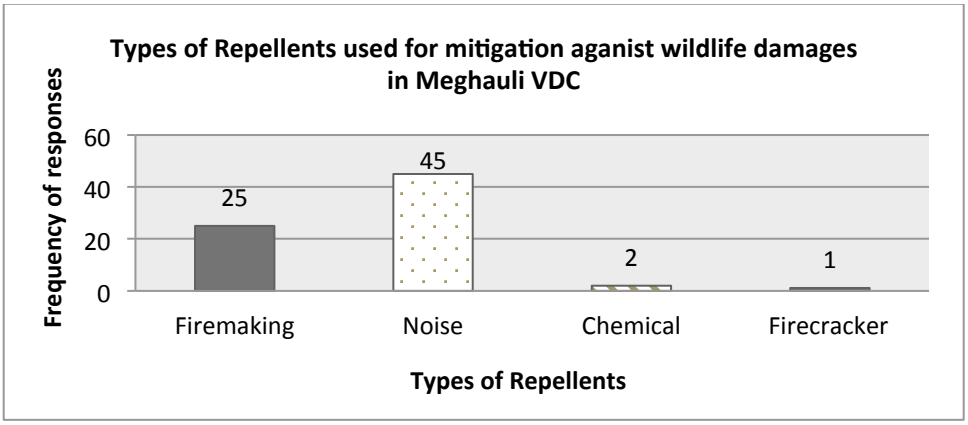


Figure 19 Types of repellents used against wildlife damages

Construction was another important category of mitigative/adaptive measures employed against wildlife damages. In Meghauli VDC, villagers guarding their crops used watchtowers locally known as *Machan*. It was the most common type of construction (17 incidences) used by the households to protect their crops and livestock (figure 20). Barriers as fencing, natural barriers and trenches were used to prevent the wildlife from entering the fields. For the construction of fencing and physical barriers, branches, twigs and poles were mostly used. Fences in the form of densely spaced pieces of wood were also frequently used. Scarecrow was mainly constructed of farm materials like thatch grass, branches and twigs and also reused materials as clothes and ropes. While in Bachhauli VDC, no use of construction was observed.

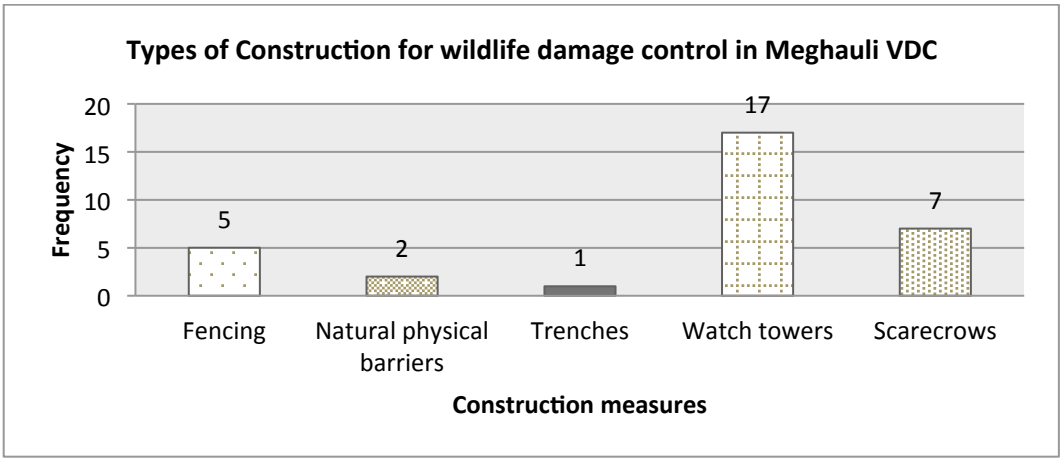


Figure 20 Types of construction used for wildlife damage control

The third and another important category of mitigative/adaptive measures employed against wildlife damages was guarding. In Meghauli VDC, 10% of the respondents used guarding as a method for wildlife damage control in Meghauli VDC especially spending nights to guard their crops. For households living closer to national park border, guarding was more frequent than respondents living further from the border. Guarding was most frequently practiced during nighttime and more prevalent in monsoon season. The adult male family members were responsible alone for most of the guarding, but in some instances children and wives were also involved. While in Bachhauli VDC, only one instance of guarding was used as a damage control measure against wildlife damages.

6.4 Target wildlife species against mitigative/adaptive measures

In Meghauli VDC, repellents in the form of fire, noise, chemicals and firecrackers were most commonly used for deterring rhino followed by wild boar (Figure 21). These repellents were not just targeted against one particular species but used for a range of species including elephant, deer and monkey. Because of this character, many respondents placed repellents high based on its level of effectiveness in damage control (see table 10). While in Bachhauli VDC, in all the 3 incidences of use of noise making, it was targeted towards rhino and elephant.

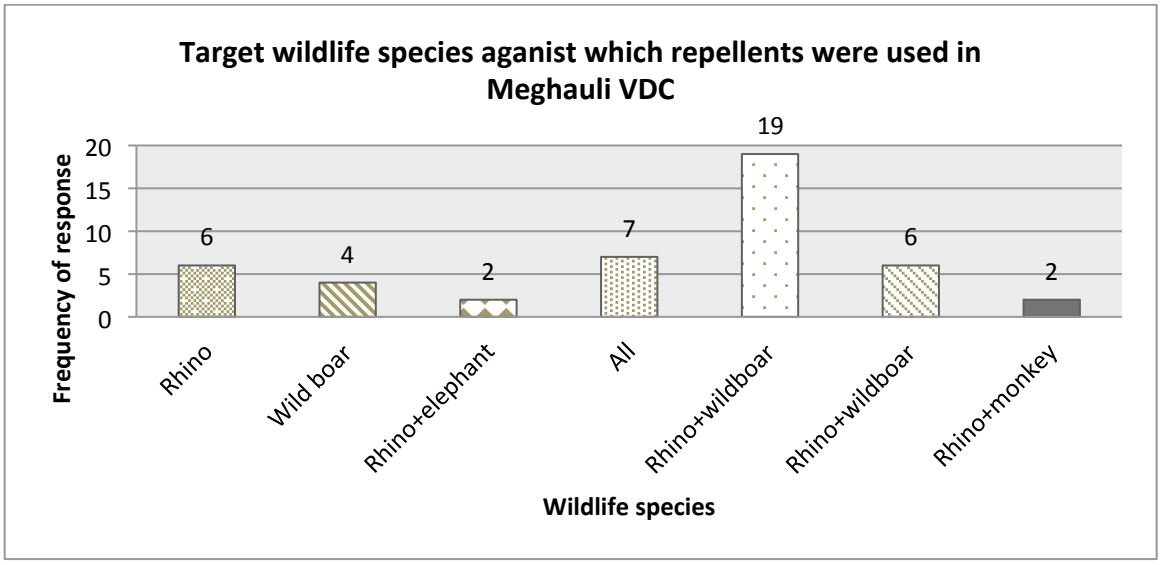


Figure 21 Target wildlife species for use of repellents

In Meghauli VDC, construction of different barriers, scarecrows and watchtowers was particularly used against rhino (22 incidences) followed by wild boar (21 incidences) (Figure 22). While scarecrows and watchtowers were aimed at larger mammals like rhino and elephant, fences and trenches were used against animals like wild boar and deer. That was obvious because the fences and trenches were not strong enough in holding these larger animals and at the same time scarecrow and watchtowers provided the safety in terms of distance and space between guards and raiders. No use of construction was observed in Bachhauli VDC.

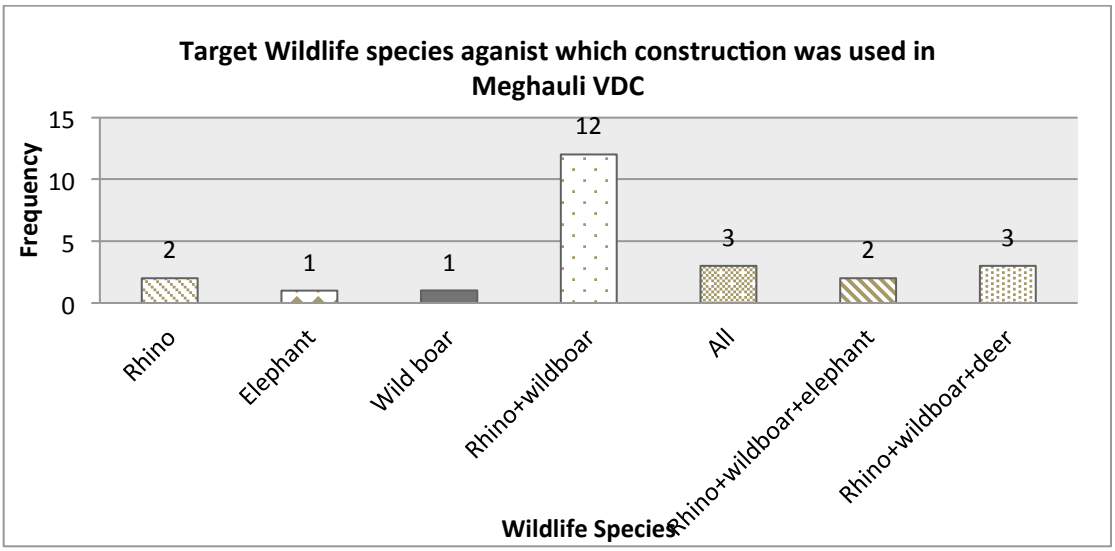


Figure 22 Target wildlife species for use of construction

In Meghauli VDC, among the 7 incidences guarding for protection against wildlife damages, its use was frequent against rhino raiding. 1 of the household used it for protection against wild boar while in 2 other incidences; HHs responded that they use guarding not just for a particular wildlife but the entire crop raiding wild animals (Figure 23). While in 1 incidence of use of guarding in Bachhauli VDC, it was used against rhino and wild boar.

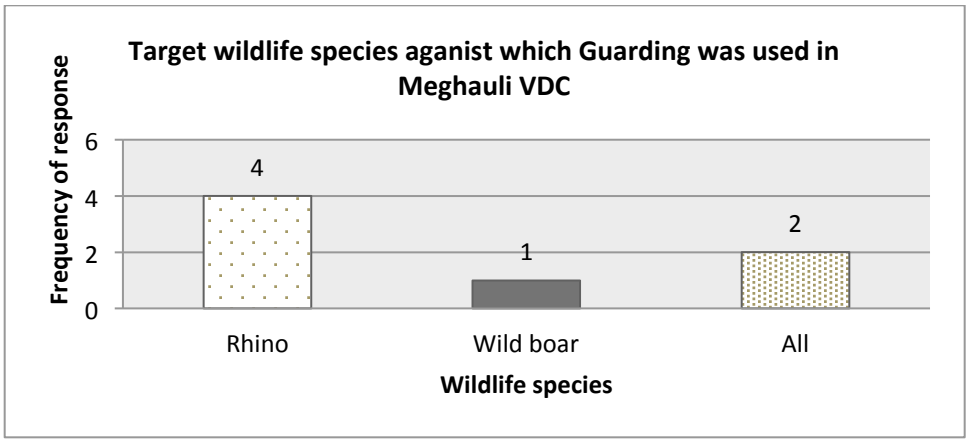


Figure 23 Target wildlife species for use of guarding

6.5 Ranking of mitigative/adaptive measures

Farmers indicated varying views regarding the degree of effectiveness of wildlife damage control methods. Noisemaking, fire and watch tower were considered by the respondents as being the most effective of methods. Rank scores ranged from highly effective to ineffective. Some of the most important factors mentioned by respondents, which play an important role in the choice of methods for wildlife damage control, are time and cost involved. The apparent cost associated with these methods, as noise making and burning fires are extremely low as compared to methods such as different kinds of construction. Hence the respondent's perceived level of effectiveness for noise making and fire are quite high. Use of watchtowers was also reported as being effective. This is particularly true because of the perception of the people that it can be used for a number of larger mammals as elephant and rhino and also provides a safety space between those guarding and the raiders. Respondents perceived that guarding when used with other methods is quite effective and had a low capital investment but often is tedious and time consuming. This in turn put constraints on other activities as income generation, household chores and children's school attendance. The use of fencing, natural physical barriers, trenches

and scarecrows had their own shortcomings. Fencing which was primarily targeted for animals as wild boar and deer, was considered quite capital intensive and inappropriate for larger animals like rhino and elephant, latter also being the biggest disadvantage of natural physical barriers. Animals as wild boar may tunnel below the fences and may even pass through the natural physical barriers, as they are not sturdy. Scarecrow was also used as a method for damage control. It was considered easily constructed and worked best with monkeys and birds (not covered by this study) but rarely worked for animals as rhino, elephant and wild boar.

Table 10 Ranking of different defensive/mitigative measures based on perceived level of effectiveness among the respondents

Method	Perceived level of Effectiveness	Ranking Score (A)	Frequency of Responses (B)	Cumulative score (∑A×B)
Fencing	Moderately effective	2	2	7.00
	Ineffective	1	3	
Natural physical barriers	Ineffective	1	2	2.00
Trenches	Moderately effective	2	1	2.00
Watch towers	Effective	3	6	40.00
	Moderately effective	2	11	
Scarecrows	Moderately effective	2	3	10.00
	Ineffective	1	4	
Noisemaking	Effective	3	10	97.00
	Moderately effective	2	31	
	Ineffective	1	7	
Fires	Effective	3	2	44.00
	Moderately effective (2)	2	15	
	Ineffective (1)	1	8	
Chemical	Highly effective	4	2	8.00
Firecracker	Moderately effective	2	1	2.00
Guarding	Effective	3	2	19.00
	Moderately effective	2	6	
	Ineffective	1	1	

7. Wildlife Damages: Economic and Social Issues

7.1 Economic nature of wildlife damages

32.83 hector of land was cultivated in Meghauli VDC with nearly 44% of the cultivated area suffered from crop loss resulting from wildlife damages. While in Bachhauli VDC 20.87 hector was cultivated and 28% suffered from crops loss. During monsoon season paddy was the most common food crop that was cultivated with nearly 42% of the total cropland was used for growing food crops followed by maize with nearly 30%. As for the winter crops, wheat was the most widely grown food crop with nearly 29% and buckwheat was grown on nearly 67% of the total land cultivated among other types of crops. In Meghauli VDC the average household faced a crop loss of NRs 15,972.19 (annual total crop loss of NRs 1,118,053.3) while in Bachhauli VDC it was significantly less at NRs 8,583.70 per year (annual total crop loss of NRs 600,859.00). Crop loss was most serious in Meghauli VDC accounting for nearly 65% of total economic loss for both VDCs combined. Wheat accounted for nearly 19% of the total economic loss followed by paddy at nearly 17%. No loss of livestock and property was observed in Bachhauli VDC. While in Meghauli VDC the average loss per year per household for loss of livestock and property was found to be NRs 1,685.71.

Also, the cost of use of defensive or mitigative measures for both the VDCs was found to be NRs 109,320. While the average cost per household per year was found to be NRs 3,194.43 for Meghauli VDC and NRs 128.57 for Bachhauli VDC. The cost was quite low for Bachhauli VDC. This was because only 3 incidences of defensive measure, in the form of repellents and guarding, were observed as compared to 71% of the households using defensive measures in Meghauli VDC.

7.2 Factors affecting wildlife damages

To determine the factors affecting the occurrence or nonoccurrence of wildlife damages, a binary logistic regression was done. Here the variables were divided as household characteristics and other variable were termed as damage characteristics. The following table shows the logistic regression of the factors affecting the presence (coded 0) and absence (coded 1) of wildlife damages among 140 households in the 2 study areas.

Table 11 Binary logistic regression of the factors affecting the occurrence or non-occurrence of wildlife damages

Independent variables	Coefficient (B)	SE	Sig	Exp (B)
Household characteristics				
Location	4.099	1.298	.002***	60.264
Household wealth	0.000	0.000	.010***	1.000
Area of landholding	-0.005	0.023	.824	0.995
Total income	0.000	0.000	.063*	1.000
Income from agriculture	0.000	0.000	.742	1.000
Caste (Higher)			.641	
Caste (Lower)	0.611	0.988	.536	0.155
Caste (Indigenous Tharus)	-1.866	3.058	.542	1.842
Damage characteristics				
Occurrence of Rhino	4.208	1.797	.010*	67.194
Cost of mitigative measures	-0.053	0.016	.001***	0.949
Distance from park	-0.005	0.661	.003**	0.995
Constant	-4.104	2.697	.128	0.000

*, ** and *** indicates significant at levels of 0.1, 0.05 and 0.01, N=140

The results of above binary logistic regression suggest that location of the household, household wealth, total income, occurrence of rhino, cost of mitigative measures and distance from park were significant predictors of presence or absence of wildlife damages. While variables as area of landholding, income from agriculture and caste didn't have a significant impact on the occurrence or nonoccurrence of wildlife damages (see table 12 below). A negative coefficient (B) indicates reduced likelihood of raiding, whilst a positive coefficient indicates increased likelihood of wildlife damages. Here, location refers to the two study areas and it was found location is a significant predictor in the occurrence or nonoccurrence of wildlife damages. The exp (B) value for location refers that controlling other variables, the likelihood of occurrence of wildlife damages is nearly 60 times higher in Meghauli VDC as compared to Bachhauli VDC. It is concurrent to result according to which 74.3% suffered some sort of damage in Meghauli VDC

as compared to 17.14% households in Bachhauli VDC. Household wealth and total income were significant predictors of wildlife damages. Also the occurrence of rhino and incidences of damages (especially crop loss) were significantly related. The likelihood of suffering from crop damages is nearly 67% higher in places of occurrence or presence of rhino. Additionally, it was found that rhino was responsible for 66% and 50% of all crop loss in Meghauli and Bachhauli VDC respectively (Figure 17.). While it was also found that with an increase in cost of mitigative measures, the occurrence of wildlife damages decreases. Finally, distance from park is also another important predictor in determining the incidences of wildlife damages. With an increase in distance from park boundaries, the incidences of wildlife damage decreases. People residing closer to the parks suffer most damages. This is shown in the cross tabulation between distance from park and occurrence or non-occurrence of wildlife damages. The proportion of people suffering crop loss decreases with an increase in distance from park (78.5%, 61.9% and just 4% for <1 Km, 1-3 Km and >3Km respectively).

Table 12 Distance category and incidences of wildlife damages cross tabulation

Distance Category	Occurrence of Crop loss		Total
	Yes	No	
<1 Km	22	6	28
1-3 Km	39	24	63
>3 Km	2	47	49
Total	63	77	140

7.3 Factors affecting use of mitigative measures

While, to investigate the factors responsible for the use or non-use of wildlife damage mitigation measures, a binary logistic regression was done. Here too the variables were divided as household characteristics and other variable were termed as damage characteristics. The table 13 shows the logistic regression of the factors affecting the use (coded 0) and non-use (coded 1) of mitigation measures among 140 households in the 2 study areas.

Table 13 Binary logistic regression of the factors affecting the use or non-use of wildlife damage mitigation/adaptive measures

Independent variables	Coefficient (B)	SE	Sig	Exp (B)
Household characteristics				
Location	6.055	1.554	.000***	426.263
Household wealth	0.000	0.000	.026**	1.000
Area of landholding	0.035	0.019	.064*	1.036
Total income	0.000	0.000	.193	1.000
Income from agriculture	0.000	0.000	.944	1.000
Damage characteristics				
Occurrence of Rhino	-0.248	0.686	.718	.780
Cost of wildlife damages	0.000	0.000	.445	1.000
Distance from park	-1.676	0.531	.002***	.187
Constant	-5.972	1.581	.000	.003

*, ** and *** indicates significant at levels of 0.1, 0.05 and 0.01, N=140

The results of binary logistic regression suggest that location of the household, household wealth, area of landholding and distance from park boundaries were significant predictors of use or non-use of mitigative measures. While variables such as total income, income from agriculture, occurrence of rhino and cost of mitigative measures were not found to have a significant impact on the dependent variable. It is interesting to mention that the cost of wildlife damages was not a significant predictor of use or non-use of mitigative measures. This means that households that suffer more costs of wildlife damages don't necessarily use mitigative measures to protect their crops, livestock or property but the use of mitigative measures is determined more by factors as household wealth, area of landholding and distance from park. Often people use mitigative measures in anticipation of wildlife damages rather than after an actual damage have occurred. This is particularly true for people having a larger landholding because having a larger landholding usually corresponds to a larger area under agriculture and an extra impetus for use of mitigative measures. The negative or positive coefficient (B) for the significant indicators signifies a reduced or increased likelihood of use or non-use of mitigative measures. Controlling other variables, the exp. (B) value for location variable indicates that the likelihood of use of mitigative measures is nearly 426 times higher in Meghauli VDC as compared to Bachhauli VDC. This is it was found that the use of mitigation measures was 71% in Meghauli VDC as compared to only 4% in Bachhauli VDC.

Finally, it was found that distance from park was significantly but negatively related to use of mitigative measures meaning household living closer to park boundaries tend to use mitigative or protection measures more than those who live further from park boundaries. In Meghauli VDC, nearly 80% and 84% of the respondents with in 1km and 3km of the park used some sort of mitigative/adaptive measures against wildlife damages as compared to only 35% of the respondents living more than 3km from the park boundaries. Very few cases of use of protection measures in Bachhauli VDC were observed; hence the following table 13 depicts only the case of Meghauli VDC.

Table 14 Distance category and households using or not using mitigative/protective measures cross tabulation

Distance Category	Use of protection measures in Meghauli VDC		Total
	Yes	No	
<1 Km	12	3	15
1-3 Km	32	6	38
>3 Km	6	11	17
Total	50	20	70

7.4 Impact of wildlife damages and mitigation costs

Gini coefficient of the total income was found to be 0.7529, which means there is more than 75% inequality in the total income distribution. Also, it was found that the poorest 50% of the population have just 4.50% of the total income. Gini coefficient of the total wealth was found to be 0.5135, meaning there is more than 51% inequality in total household wealth. Additionally, it was found that the poorest 10% of the people have just 0.91% of the total household wealth. Inequality was lower in terms of household wealth still the level of inequality is significantly higher for both total income and household wealth. While Gini coefficient for net income (total income-wildlife damage and mitigation cost) was found to be 0.7814 meaning that there is more that 78% inequality in net income. So it can be concluded that wildlife damage and mitigation cost leads to increased inequality in income distribution.

Correlation and multiple regression analyses were conducted to examine the relationship between total income and independent variables location of household, sex of household head, area of landholding, caste/ethnicity, household wealth, wildlife damage cost and mitigation cost. These variables statistically significantly predicted total income, F (7, 132) = 5.172, p < .0001, R^2 = .215. Of the seven variables, only damage costs (p<0.1) and cost of mitigation measures (P<0.001) added statistically significantly to the prediction. Table 15 summarizes the descriptive statistics and analysis as well as regression results for significant predictor variables, wildlife damage costs and mitigation costs.

Table 15 Correlation and result from the Regression Analysis of the factors affecting total income

Variables	Correlation with Total income	Multiple Regression weight	
		B	β
Wildlife damage costs	0.212***	-1.159*	-0.194
Mitigation costs	0.426***	44.106***	0.543

*, ** and *** indicates clumping at significance levels of 0.1, 0.05 and 0.01, N=140

The correlation coefficient for wildlife damage costs and mitigative costs is positively and significantly related to household income, indicating higher damage and mitigative costs tend to have higher income. But as the damage costs have significant negative weight, it indicates that respondents that have higher costs of wildlife damages were expected to have a lower income controlling all other variables in the model. At the same time as the costs of mitigative measures have a significant positive weight; it indicates that respondents having higher costs of mitigation measures have a higher income controlling all other variables. This can be explained by the fact that higher mitigation costs corresponds to a lower wildlife damages to crops and livestock and hence a significantly lower impact on income. So that in absence of mitigation measures, costs of wildlife damages increases which then corresponds to a decrease in income.

7.5 Wildlife damages and distributional issues

7.5.1 Coverage of benefits

Among the respondents having a positive and in some instances having a neutral attitude towards the park and park authorities, yearly grass cutting program, loan facilities from buffer zone groups and other benefits from participation in buffer zone and related social programs were considered the main factors form them to have such an attitude. Community development programs and wildlife conservation was also considered by the respondents to have influenced their attitude towards the national park. Also, benefits as access to electricity and communication are important in shaping the attitude towards the park and park authorities. Because these benefits are closely associated with the attitude towards the park, it is important to investigate the coverage of benefits i.e. if a recipient of one particular benefit is more likely to be a recipient of other benefits. The most frequent benefits were involvement in buffer zone programs (75%), electricity (67.14%), access to loan facilities (64.28%), yearly grass cutting (53.57%), and tourism (39.28%) while the least frequent benefits were compensation (1.42%), park related income (12.14%) and community development works (32.14%). Here access to electricity is chosen over other benefits as latrine and communication as it represents more of a collective characteristic as compared to later benefits which often represents a household preference. Especially communication, as most of it was available in the form of mobile phones and it depended on individual households to have or not to have it.

Table 16 Benefit combinations and clumping

Benefit combination	Exptd. (a)	SD (b)	Obsvd. (c)	Diff. (d=c-a)	Deviate (d/b)
Two most frequent benefits	0.5036	0.0423	0.5143	0.0107	0.2541
Three most frequent benefits	0.3237	0.0395	0.3357	0.0120	0.3030
Four most frequent benefits	0.1734	0.0320	0.2143	0.0409	1.2770
Five most frequent benefits	0.0681	0.0213	0.1357	0.0676	3.1731***

*, ** and *** indicates clumping at significance levels of 0.1, 0.05 and 0.01, N=140

The table displays the expected frequency, standard deviation, observed frequency, difference between expected and observed frequency and standardized deviate. It can be seen that beyond the four most frequent benefits, there is a significant clumping of benefits. That means those respondents who benefit from tourism are also likely to enjoy other benefit categories. This is

particularly true for Bachhauli VDC where 67.14% of the respondents claim to benefit from tourism as compared to only in 11.42% in Meghauli VDC. At the same time a higher proportion of respondents claim to have benefitted from buffer zone activities, yearly grass cutting, electricity and access to loan facilities in Bachhauli as compared to Meghauli VDC.

7.5.2 Equality issues

Furthermore, to answer the question of distribution of wildlife damages among the poor or wealthy household we tabulated a cross tabulation between occurrence or nonoccurrence of wildlife damages and different households variables that are indicators of respondents economic status. These variables include mean income, mean wealth and land holding size. Those households that have income and wealth less than the mean income are considered poor households and vice versa. Also landholding is also considered as an indicator of household's economic stature and households having less than 1 Bigha are considered as having a lesser economic stature here.

Table 17 Cross tabulation between household economic variables and occurrence of wildlife damages

HH Economic variables		Suffered damages from wildlife		Total
		Yes	No	
Household Wealth**	< Mean wealth	50	44	94
	>Mean wealth	14	32	46
Household income***	<Mean income	51	45	96
	>Mean income	13	31	44
Landholding size	Landless	0	4	4
	<1 Bigha	31	49	80
	>1 Bigha	33	23	56

A chi-square test was run to analyze the relationship between wildlife damages and income category of households. It was found that household wealth category was significantly related to wildlife damages $\chi 2$ (1)= 6.445, p=0.011<0.05. Out of 64 respondents suffering from wildlife damages, 78.12% have wealth less than mean wealth while 21.87% have wealth greater than mean wealth. Also a majority of respondents having wealth less than mean wealth suffered wildlife damages. This is also true for household having income less than the mean income with

a majority of such respondents suffering from wildlife damages. There was a significant relation between wildlife damages and household income category, $\chi 2$ (1) = 6.760, p=0.009<0.01. 79.68% of the respondents who suffered wildlife damages have income less than the mean income. But in the case of landholding, the wildlife damages were more or less evenly distributed between those having >1 Bigha (51.56%) and those having <1 Bigha (48.43). So it can be concluded that comparatively poor people (those having a lower mean income and household wealth) tend to suffer more from wildlife damages as compared to wealthy households and these variables, household wealth and income, can significantly predict if a household suffers damages from wildlife or not (Table 11, regression result).

7.5.3 Justice issues

A part of any conservation initiative is to ensure that community development or other initiative be targeted to households that are adversely affected by the park wildlife. Hence, while accessing the success or failure of any conservation effort it is important to examine whether those who suffered from conservation costs are the same as those who accrued conservation benefits. This question corresponds to justice issues and here we try to answer some of the issues related to this question. The cost variables concerns with the households that have suffered wildlife damages related to loss of crops, livestock and/or property over the last 12 months. The benefits that are considered direct benefits are yearly grass cutting inside the park and compensation for wildlife damages. Other benefits that are considered are the positive spillovers from the projects and activities (access to loan from different buffer zone or social groups, tourism, community development works, other park related income, electricity and programs targeted towards buffer zone residents).

Table 18 Expected and observed frequencies from cross tabulation of occurrence of wildlife damage and realization of various benefits

		Wildlife damages last 12 months			
Benefits realized		Yes	No	Relationship	Sig
Access to loan	Yes	40 (41.1)	50 (48.9)		
	No	24 (22.9)	26 (27.1)	Independence	
Yearly grass cutting	Yes	23 (34.3)	52 (40.7)		
	No	41 (29.7)	24 (35.3)	Independence	
Tourism	Yes	12 (25.1)	43 (29.9)		
	No	52 (38.9)	33 (46.1)	Repulsion	**
Community development	Yes	18 (20.6)	27 (24.4)		
	No	46 (43.4)	49 (51.6)	Independence	
Park related income	Yes	6 (7.8)	11 (9.2)		
	No	58 (56.2)	65(66.8)	Independence	
Compensation	Yes	2 (0.9)	0 (1.1)		
	No	62 (63.1)	76 (74.9)	Independence	
Electricity	Yes	34 (43)	60 (51)		
	No	30 (21)	16 (25)	Repulsion	***
BZ activities and programs	Yes	59 (48.0)	46 (7.0)		
	No	5 (16.0)	30 (19.0)	Clumping	***

Among the benefit categories, only buffer zone activities/programs exhibit significant clumping with costs. Here clumping represents a relationship where households that have suffered wildlife damages in the last 12 months were more likely to have realized particular category of benefit. The table shows that respondents that have suffered from wildlife damages were more likely to have benefited from buffer zone activities and programs. While on the other hand benefits such as tourism and electricity exhibited significant repulsion with costs. This means that households that suffered damages were less likely to have benefited from tourism or to have access to electricity. This can be explained by the fact that these benefits were realized more by people in Bachhauli VDC than Meghauli VDC while experiencing less incidence of suffering from wildlife damages in the last 12 months. Out of 60 respondents who didn't suffered from wildlife damages but have access to electricity, 96.66% were in Bachhauli VDC while out of 30 respondents who suffered from damages but didn't have access to electricity 66% were in

Meghauli VDC. Similarly, out of 43 respondents who didn't suffered from wildlife damages but have benefited from tourism, 90.6% were in Bachhauli VDC and out of 52 respondents who suffered from wildlife damages but didn't have benefited from tourism, 92.30% were in Meghauli VDC.

8. Participation Issues and Park Relations

8.1 Factors affecting Participation

Binary logistic regression was conducted to determine which independent variables were significant predictors of participation (coded as 0) or non-participation (coded as 1) in buffer zone and related programs. From the eleven-predictor variables fitted in the binary logistic regression model, four variables (total income, total damage cost, gender and perception of increase in general awareness and capacity) had a significant impact on influencing household participation in buffer zone activities, while seven variables (age of the household head, area of landholding, HH wealth, caste, occupation, education and location of HH) were not significant.

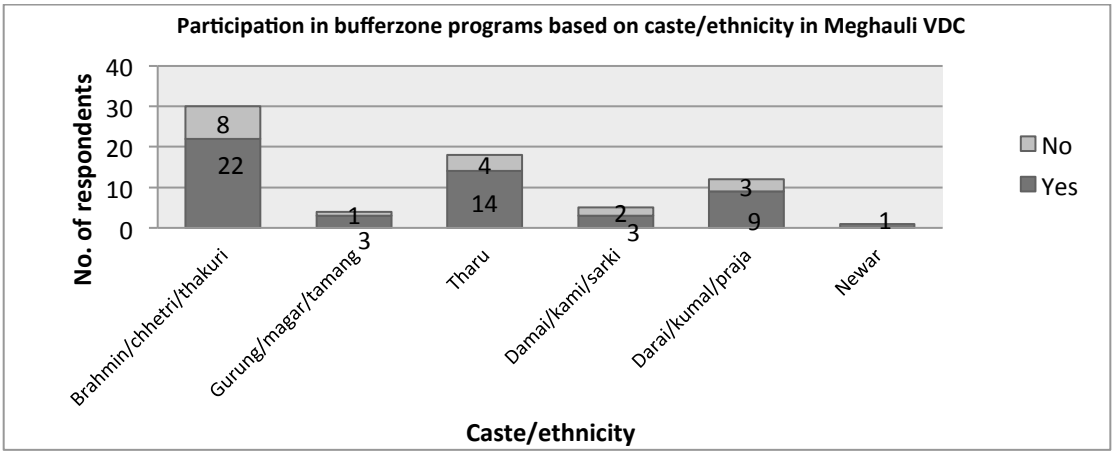
Table 19 Binary logistic regression of the factors affecting the participation or nonparticipation in buffer zone and related social programs

Independent variables	Coefficient (B)	S.E.	Sig.	Exp B
Age Household head	.036	.025	.146	1.036
Area of landholding	.006	.017	.728	1.006
Total income	.000	.000	.000***	1.000
HH wealth	.000	.000	.068*	1.000
Total damage cost	.000	.000	.025**	1.000
Caste (Higher)			.991	
Caste (Lower)	.093	.870	.915	1.097
Caste (Indigenous Tharus)	.080	.726	.912	1.083
Occupation (Agriculture)			.106	
Occupation (Business)	1.544	.793	.051*	4.683
Occupation (Others)	1.454	1.060	.170	4.280
Household head Gender	3.810	1.032	.000***	45.15
Education	-.106	.684	.877	0.899
Improvement in General awareness	1.753	.647	.007***	5.771
Location of HH	.010	.672	.989	1.010
Constant	-4.326	1.760	.014	0.013

*, ** and *** indicated significance level of 0.1, 0.05 and 0.01 respectively, N=140

The negative value of coefficient B implies a decrease in household participation in buffer zone activities while a positive value implies an increase. Gender of household head, total income, household wealth, total damage cost and perception of increase in general awareness were

significantly and positively related to participation in buffer zone activities. Controlling other variables, being a male the likelihood of participation in buffer zone and related social programs are nearly 45 times greater as compared to being female. Also, with an increase in income, household wealth and damages costs the level of participation among the household increases. Additionally, it is interesting to note that respondents who have business as main occupation were nearly 4.6 times more likely to participate in buffer zone programs as compared to agriculture, keeping other variables constant. Finally, respondents who perceive that there has been an increase in general awareness and capacity from buffer zone programs are more than 5 times more likely to participate in these types of programs. Caste/ethnicity were not found to be significant predictor of participation or non-participation on buffer zone and related social programs. Regarding participation based on caste/ethnicity, fairly high levels of participation among Brahmin/chhetri/thakuri (83.33% and 73.33% in Bachhauli and Meghauli respectively) and Tharus (70.58% and 77.77% in Bachhauli and Meghauli). Also, out of 20 respondents (both study area combining) from Damai/kami/sarki and Darai/kumal/praja (belonging to so called lowest orders in social hierarchy), 15 (75%) participate in buffer zone and other social programs. So it can be concluded that a fairly high level of participation was found in buffer zone and other social programs among all the social groups in both of the VDC.



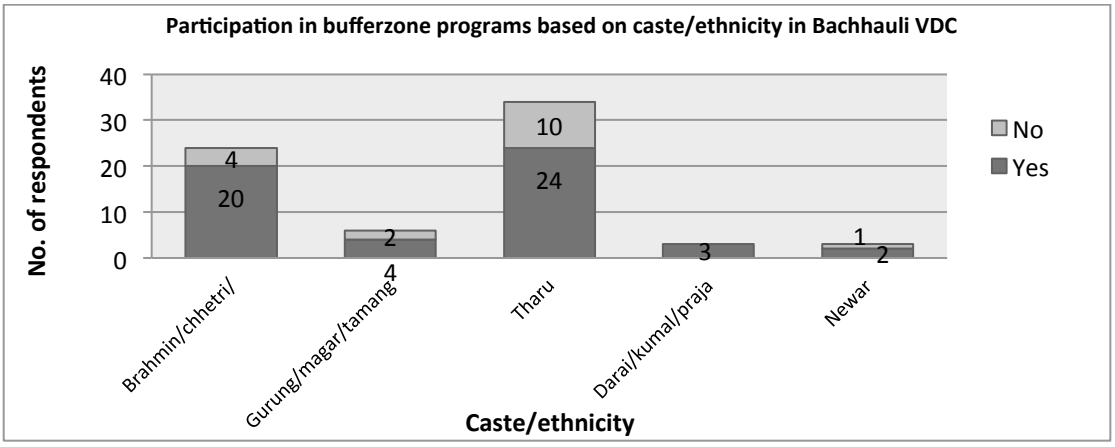


Figure 24 Participation in buffer zone and related programs based on caste/ethnicity

8.2 Implication of Wildlife Damages on Attitude towards Park

An overwhelming majority of the respondents (91.40%) in Bachhauli VDC have either a positive or extremely positive towards the park and park authorities as compared to just 41.41% in Meghauli VDC (Figure 25).

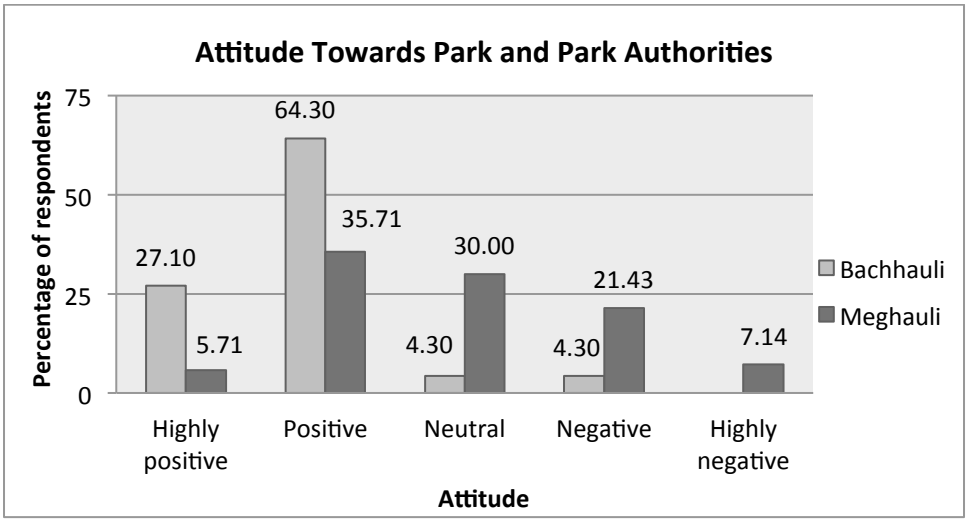


Figure 25 Attitude of the respondents towards park and park authorities

Of the respondents (28.57%) having a negative or highly negative attitude towards park in Meghauli VDC, 85% considered wildlife damages as the major reason for such attitude (table 20). Restriction placed by parks and issues related to compensation were other important reasons

for such attitudes. So it can be concluded that wildlife damages have serious implications on peoples having negative attitude towards the park.

Table 20 Reasons for negative attitude towards park and park authorities

Reasons for negative attitudes	Bachhauli	Meghauli
Restrictions placed by park	2	1
Restrictions placed by park+ wildlife damages	1	5
Restrictions placed by park+ fines	0	1
Restrictions placed by park+ compensation	0	1
Wildlife damages	0	9
Wildlife damages+ compensation	0	3
None	67	50
Total	70	70

8.3 Factors affecting the attitude towards the Park and Park Authorities

A binary logistic regression was run to determine which variables were significant predictors of people having (Yes, coded 0) or not having (No, coded 0) a positive towards the park and park authorities. The responses were observed on an ordinal 5-point scale (Strongly positive, positive, neutral, negative and strongly negative). But it was converted on a binary scale by making a base question. Do you have a positive attitude towards the park? The responses were categorized as yes (Strongly positive and positive responses) and no (for other responses).

Table 21 Binary logistic regression of the factors affecting the attitude of the respondents (either have a positive attitude or don't have) towards the park and park authorities

Independent variables	Coefficient (B)	S.E.	Sig.	Exp (B)
Location	-1.430	.686	.037**	0.239
Gender	-.732	.728	.315	0.481
Total income	.000	.000	.545	1.000
Household wealth	.000	.000	.695	1.000
Caste (Higher caste)			.142	
Caste (Lower caste)	.131	.767	.865	1.140
Caste (Indigenous Tharus)	-.193	.638	.523	0.824
Education	-.123	.546	.822	0.884
Wildlife damages	-1.998	.702	.004***	0.136
Park restrictions	-3.063	1.233	.013**	0.047
Participation in BZ	1.719	.681	.012**	5.581
Access to basic services	1.263	.572	.027**	3.535
Constant	3.151	1.437	.028	23.363

Location of household, wildlife damages, park restrictions, participation in buffer zone programs and access to basic services were found to be significant predictor of attitude towards the park. Positive values of coefficient (B) indicate increased likelihood of having a positive attitude towards park and park authorities while a negative value indicates a decreased likelihood. More people in Bachhauli VDC have a positive attitude than Meghauli VDC. 91.40% of respondents in Bachhauli VDC answered yes when asked if they have a positive attitude towards the park while it was just 41.41% in Meghauli VDC. Also, people who participated in buffer zone programs are more than 5.5 times more likely and people who claim to have access to services are more than 3.5 times more likely to have a positive attitude towards the park and park authorities. Finally, people who claimed to have suffered wildlife damages and restriction in accessing park resources were less likely to have a positive attitude towards the park. Of the respondents who have a positive attitude towards the park authorities, nearly 72% have not suffered wildlife damages for the last 12 months while respondents who didn't have a positive attitude nearly 80% suffered wildlife damages.

Table 22 Cross tabulation between either having a positive attitude towards the park authorities or not and wildlife damages

Wildlife damages	Do you have a positive attitude towards park and park authorities?		Total
	Yes	No	
Yes	26	38	64
No	67	9	76
Total	93	47	140

9. Discussion

9.1 Livelihood assets and strategies

Human, physical, natural, financial and social capitals, the five major livelihood assets or capital, as described by DFID (1999) were analyzed. Only 3% of the respondents in the study areas were landless and regarding landholding based on caste/ethnicity, no clear distinction was found. So it can be concluded that there was a fair and equal distribution of land size among the different caste/ethnicity. A fairly good access to services such as health and education and infrastructures as roads and market place was found. Although, services as electricity, communication and toilets were extensive in Bachhauli VDC as compared to Meghauli. Overall it can be concluded that availability and access to the physical capitals is bound to have a positive influence on the sustainability of livelihood system currently employed in the two study areas. Lack of these often leads to opportunity costs or trade-offs precluding education, access to health services and income generation activities (Kollmair and Gamper, 2002). At the same time financial service such as loan was found to be widespread. The buffer zone inhabitants use different sources for credit activities. A large number of the households still depend on the informal sources of loan such as villagers, moneylenders and the BZ groups and only a very few reported that they got loan from financial sources such as bank and cooperatives. Nevertheless, these types of credit or loan facilities represent one of the diverse livelihood benefits that BZ program and other participatory benefits provide to the local peoples (Paudel et al., 2010). On a negative side, among those who didn't have access to loan, both VDCs combined, 44% were from so called low caste social groups that comprise of Tharus, Damai/kami/sarki and Darai/kumal/praja. Also a high rate of illiteracy was found particularly among women and indigenous Tharu communities. While, the rate of literacy was found to be fairly high among the higher caste group of Brahmin/chhetri/thakuri. Also, 50% of respondents in both study area combined responded that there aren't any specific programs to increase the awareness and capacity of women and other marginalized groups. Education and training not only can help people with diversifying their income and livelihood but also can help in disseminating innovate technique and build capacity to increase public understanding concerning HWC and untimely resolve or prevent such conflicts (World Bank, 2009). Lack of education and training especially among lower castes and women implies vulnerability in terms of both achieving sustainable livelihood and mitigating wildlife damages.

Cash crops were the most common type of crop grown in Bachhauli VDC while in Meghauli VDC the combination of food and cash crops was most prominent. Some of the most common crops that were grown in these areas included paddy, maize and wheat (food crops), buckwheat, vegetables and oilseeds (cash crops) and different types of pulses. The average livestock unit (LSU) for Meghauli and Bachhauli VDC were found to be 1.63 and 1.13 respectively. Cow, goat and buffalo were the major livestock reared and provided with important source of income and nutritional supplements for the respondents. The total household income per year for Meghuali and Bachhauli VDC was found to be NRs 218,052.9 and NRs 195,495.09 respectively. The Gini coefficient 0.7529 for total income indicated that there was higher inequality in income distribution. While the Gini coefficient for household wealth indicated that although the inequality was lower for household wealth still it was significantly high at 51.35%. The net income was then calculated as NRs 184,180.43 per household per year for Meghauli VDC and 169,252.69 per household per year for Bachhali VDC.

Assets, activity and income diversification lie at the heart of livelihood strategies. A lack of alternative to these may intensify the potential consequences of resources destruction by wildlife (Dickman, 2010). Hence these alternatives are a key part of coping strategies in reducing vulnerability (Naughton-Treves & Treves, 2005). Agriculture was the main source of livelihood in both the study areas. Previous studies have found that agriculture is the main source of food, income, and employment for the people in Nepal (Lamsal, 2012) and in buffer zone around Chitwan National Park as well (Gurung, et. al. 2008; Nakarmi, 2009). 79% and 60% of the respondents in Meghauli and Bachhauli VDC respectively have agriculture as their major occupation. Other major sources of occupation in the two study areas were services, business, wage labor and teaching. Business, livestock products and remittance were found to be the three major sources of income for both VDCs. Other sources of income included service and wage labor. High level of income from business and remittance and the proximity to urban areas and engagement in off-farm activities can create opportunities for income diversification (Barrett et al., 2001). The diversified household incomes not only changes and improves the livelihood conditions but also plays a positive role in dealing with vulnerability from wildlife damages. But the inequality in income and wealth distribution poses a great challenge in achieving equality and justice that are often integral part of conservation goals. Additionally, the dependence of majority of respondents on agriculture for income and food is a source of vulnerability in obtaining a sustainable livelihood. This is

particularly true for poor as the impacts of wildlife damages are two folds for them. Damage to crops reduces the food supply and also the option for earning cash by selling surplus harvest. Loss of livestock to wildlife also represents the same situation. Alternative livelihood strategies, as a shift away from agriculture based livelihood towards wildlife tourism, can be a solution in dealing with conflicts related to wildlife damages (Sitati et al., 2003). However, these alternative livelihoods may not always be available particularly in developing countries (Parker & Osborn, 2006). Hence it is important to explore how feasible are these alternative livelihood strategies in dealing with conflict mitigation and this study recommends future research into that.

9.2 Wildlife damages

There was significant difference in occurrence or incidences of wildlife damages between the two study areas $\chi 2$ (1, N=70) =46.053, p=0.00<0.05. Nearly 74% of the respondents in Meghauli suffered some sort of damages from wildlife while in Bachhauli VDC only about 17% of the respondents suffered damages. Three types of direct costs of wildlife damages, crop loss, loss of livestock and property were observed. While the indirect cost was calculated in terms of money spent for prevention or mitigation of wildlife damages. Crop damage was the most common damage suffered from wildlife. 44% and 28% of the total cultivated area in Meghauli and Bachhauli VDC suffered crop loss. More incidences of crop loss were observed in Meghauli than Bachhauli (51 as compared to 12). During informal discussion and field visit it was observed that there is a functioning electric wire fences that runs across the boundary of the park in Bachhauli VDC. People claimed that since the construction of these fences in 2008 by park authorities there has been a dramatic decrease in the number of incidences of wildlife damages. Maniratna, 2008 reported an 80% reduction in crop damages in Bachhauli and adjacent Paithani VDC after the installation of electric fences. While Bailey, 2011 reported that there has been a dramatic decrease in crop damages from rhino in places where electric fences are installed. Since such fences are no more functional in Meghauli VDC, greater incidences of damages were observed there. Also, there was significant difference between these study areas in type of wildlife responsible for crop damages $\chi 2$ (1, N=70) = 35.66, p=0.00<0.05. Rhino was the main crop raider being responsible for 62.5% of the damage (nearly 66% in Meghauli and 50% in Bachhauli). Jnawali (1989) documented very high crop losses caused by rhino in villages adjacent to Chitwan National Park. In another study by Uprety (1995), rhino accounted for 40.3% of the all crop damages in Patihani and Jagatpur area of the park. Other major crop raiders included wild boar, elephant

and deer or *chital*. These 4 wildlife species (Rhino, deer, wild boar and elephant) were responsible for all the crop damages that occurred in the study areas. A study by Nepal and Weber, 1995 also found that crop raiding was mainly associated with these three ungulates rhino, wild boar and chital. Most of the HHs reported that the damages to crops from rhino were extensive throughout the year. Chital and Wild Boar were the other crop-raiders during both monsoon and winter seasons while elephant was another major crop raider during monsoon season. No incidences of loss or injury to humans were observed in both study areas while 7 incidences of livestock loss and 1 of property loss, both in Meghauli VDC, were observed. Total monetary loss of livestock was found to be NRs 47,250 for the last 12 months. In terms of livestock loss, goats were the most prayed followed by cattle while bear was responsible for most of the damages. Other wildlife responsible for loss of livestock was rhino, tiger and elephant. Elephant was also responsible for the only incidence of damage of property that was observed.

Binary logistic regression revealed that location of the household, household wealth, total income, occurrence of rhino, cost of mitigative measures and distance from park were significant predictors of wildlife damages. It was found that the likelihood of occurrence of wildlife damages is nearly 60 times higher in Meghauli VDC as compared to Bachhauli VDC. Also, distance from park boundaries was found to be one of the most important factors determining the occurrence and extent of crop loss. Household living closer to park boundaries tend to suffer higher incidences and costs of crop losses as compared to people living further from park boundaries (Mackenzie and Ahabyona, 2012). All human settlements and agricultural field with in 1 km of the park boundaries are in the high-risk zone for the damage from the park wildlife (Sharma, 1990). Other studies (Newmark et al., 1994 and Thapa, 2010) have also shown that distance to the park is statistically significant in relation to losses incurred. In our study 78.5% of the people living within <1 Km of the park boundaries in both the study areas suffered some sort damages as compared to only 4% for living >3 Km of the park boundaries. Costs of mitigative measures are negatively related wildlife damages. Respondents having a higher level of investment in mitigation measures were found to have suffered less from wildlife damages. But these mitigation measures incur significant costs for subsistence farmers (Sitati and Walpole, 2006). Additionally the time and labor required for these protection measures against wildlife damages represents a considerable opportunity cost for the farmers and this reason is often associated with negative perception of the problem among the farmers (Gillingham and Lee, 2003). Occurrence of rhino was found to be

significantly related to wildlife damages as rhino was responsible for majority of damages in both the study areas. Occurrence of rhino in an area on the other hand depends upon a number of factors as season and subsequent stages of crops. Studies have found that raiding often occurs at the peak availability of crops especially during crop harvesting seasons (Warren et al., 2007). While, Thapa (2010) in her study in Bardia National park found that frequency of visits by wildlife in crop fields depended on the crops grown and the season. For instance during the season of growing paddy in the farmland, which is September and October, elephants made a daily visit. Largest damages not always correspond with frequency of visits but depend upon the size of crop raiding wildlife. Larger-bodies species as elephant and rhino usually causes a greater damage as compared to small ones as a single visit by elephant or rhino can flatten a whole crop field. Hence, it can be concluded that a combination of season and type of crop raiding wildlife better explains the frequency and extent of damage to the crops. Also, total income and household wealth were found to be significant predictors of wildlife damages. With an increase in household income and wealth, there is an increase in wildlife damages.

Finally, total wildlife damage per year per household (cost of wildlife damages and mitigation measures) was found to be Rs. 19,091.04 for Meghauli VDC and Rs. 8,712.27 for Bachhauli VDC, which was 8.75% and 4.45% of the mean household income for Meghauli and Bachhauli VDC respectively. According to a study by Upadhyay (2009) in Kalyanpur VDC in buffer zone of CNP, an average household lost Rs 4,015.22/year to wildlife damages. While another study by Bhattarai and Basnet, 2004 estimated a loss Rs. 1,167.09 due to crop loss by wild ungulates in the eastern side of Barandabhar corridor forest, Chitwan. The costs mentioned in above studies are quite low as compared to this study because of the fact that both studies didn't include the cost of mitigation measures while the later only estimates crop loss by wild angulates.

9.3 Mitigation measures

When faced with the shocks related to wildlife damages, defensive measures against such damages represent one of the most important strategies employed by the households in obtaining a sustainable livelihood. Example: switching from growing maize to cultivating chilly, which is less palatable to elephants, can reduce conflicts with wildlife and improve livelihood security (Parker & Osborn, 2006). Households can decrease the risk of wildlife damages by better protecting their crops and livestock from wildlife through the use of

different mitigative or defensive measures. But these measures may have some unintended side effects or may be expensive, so it is important not only to study about the types of methods employed but also its effectiveness in terms of cost, time, efforts and usefulness against particular wildlife species. Farmers' investment in defensive measures included both direct and indirect costs. Indirect costs of crop raiding such as labor investment and lost opportunities were beyond the scope of this study. The direct costs associated with wildlife damages mostly included material costs involved in use of repellents and construction. The average cost per household per year was found to be NRs 3,194.43 for Meghauli VDC and NRs 128.57 for Bachhauli VDC. The cost was quite low for Bachhauli VDC because only 3 incidences of defensive measure were observed here.

Repellents were the most commonly used measure in Meghauli VDC with 66% of the respondents while other measures included different types of construction or structures and guarding. Noise making was the most commonly used repellent against wildlife damages in Meghauli VDC followed by fire making, firecrackers and use of chemicals. According to households, use of repellents is more universal i.e. it can be used against almost all types of wildlife. Watchtowers were the most common type of construction that was built for protection against wildlife damages in Meghauli VDC. Fencing and scarecrows were other important types of construction. Repellents and construction were most frequently practiced against rhino followed by wild boar. This is due to the fact that rhino and wild boar were responsible for nearly 93 % of the damages to crops in Meghauli VDC (Figure 16). Repellents and construction was also practiced against elephant, deer, wild boar and monkey. Based on the type of wildlife (size, time of raiding) different types of construction were used. Fences and trenches were mostly used against small animals such as wild boar and deer while watchtowers were predominantly targeted towards rhino, elephant and other larger mammals. Scarecrow was used against monkeys and birds and on some incidences in combination with watch towers. The third type of mitigative or defensive measures employed in Meghauli VDC was guarding with 10% of the respondents using it as a method for wildlife damage control. Guarding was most frequent during night times and among respondents living closer to park boundaries. Also, guarding was most prevalent in monsoon season (June-September) as compared to other seasons. Guarding was mostly targeted towards rhino, wild boar and elephant.

A binary logistic regression was used to examine which variables were significant predictors of the use or non-use of mitigative measures. It was found that location of household, household wealth, and distance from park was significant predictors of use of mitigative measures. Regarding location, there was a significant difference in use of defensive measures between Meghauli and Bachhauli VDC $\chi 2$ (1, N=70) = 67.07, p=0.00<0.01. 71% of the HH used defensive measures against wildlife damages in Meghauli VDC as compared to only 4% in Bachhauli VDC. Only a small proportion of respondents faced wildlife damages in Bachhauli and this explains the subsequent low use of mitigative or defensive measures against wildlife damages. Distance from park was another significant variable in determining the use of mitigative/adaptive measures. Of the respondents using some sort of mitigative measures against wildlife damages, 88% live within 3km of the park. This is because of the frequency of damages and subsequently the use of mitigative/adaptive measures is quite higher in households living closer to the park boundaries as compared to those living far. Cost of wildlife damages was not significant in determining the use of wildlife damages but it was found that household wealth and area of landholding was significant predictor. Household having a higher wealth and area of landholding tend to use more mitigative measures as compared to households having a lower household wealth and landholding who simply can't afford to invest in these measures. These coping strategies are key factors in reducing vulnerability associated with wildlife damages. These coping strategies are related to alternative assets and income and can nullify the potential consequences of resources destruction associated with wildlife damages (Dickman, 2010).

Farmers indicated varying views regarding the degree of effectiveness of wildlife damage control methods. Cost, time and efforts associated with these control methods were some of the most important factors that respondents considered in choosing one particular method over another. The cost associated with methods such as noisemaking and burning fires are extremely low as compared to different construction methods. Hence the respondent's perceived level of effectiveness for noisemaking and fire are quite high. Also the perceived level of effectiveness was found to be high for methods such as use of chemicals and construction of watchtowers. Although construction of watchtowers involves a higher level of investment, its perceived level of effectiveness is high due to the fact that can be used for a number of larger mammals such as elephant and rhino and also provides a safety space between those guarding and the raiders. Respondents perceived the practice of guarding as being tedious and time consuming although it had a low capital investment. Guarding was

found to have hidden impacts as constraining income generating activities, missed school, additional labor costs, loss of sleep and fear.

9.4 Impacts of wildlife damage costs on income and livelihood

The issue of inequality, particularly income distribution, was examined by studying the effect of wildlife damage and mitigation costs on the distribution of income using the Gini coefficient. It was found that the inequality in term of Gini coefficient increased from 75.29% to 78.14% when wildlife damage and mitigation cost was incorporated in total income. Hence, it can be concluded that wildlife damage and mitigation cost increases inequality in income. At the same time it is important to note that there was inequality in distribution of income and wealth even before incorporating damages and mitigation costs. It was found that there was almost 75% inequality in the total income distribution and 51% inequality in total household wealth in our study area. Furthermore to study the impact of wildlife damage and mitigation costs on the total income of the respondents, a correlation and multiple regression analyses were conducted. This included examining the relationship between total income and independent variables location of household, sex of household head, area of landholding, caste/ethnicity, household wealth, wildlife damage cost and mitigation cost. While, location of household, sex of household head, area of landholding, caste/ethnicity and household wealth were not significantly related to total income, it was found that respondents that have a higher costs of wildlife damages were expected to have a lower income and those having a higher costs of mitigation measures have a higher income controlling all other variables in the model. Weladji and Tchamba (2003) found that in the Bénoué Wildlife Conservation Area of North Cameroon, annual percentage loss of crop income from wildlife damage ranged between 25 and 62%. Since, livestock and agriculture are important components of livelihood and income in rural areas, such losses can have profound effects on livelihoods and economic welfare of rural people. On the other hand, higher mitigation corresponds to a lower wildlife damages cost and hence a significantly lower impact on income even though mitigation in itself involves some costs. The human-wildlife conflicts resulting from these loses are more intense and contributes to people being less tolerant to wildlife losses especially in developing countries (Kumssa and Bekele, 2013) undermining management efforts. Hence it is important to employ measures to deal with these loses and compensation measure is often considered an important tool to mitigate HWC (Fourli, 1999; Treves, 2007). But in our study, 97% of the respondents didn't receive any sort

of compensation for wildlife damages. Lamsal (2013) in her study in Chitwan National Park found that only 4% of the respondents received compensation and at the same time those receiving it indicated that the compensation was not sufficient to cover their losses. This may have serious consequences on the attitude of the local people towards the park authorities (Wang et al., 2006) and an increased hostility towards the damage inflicting wildlife (Treves, 2007), thus undermining the whole conservation efforts. But at the same time compensation does not necessarily raise the tolerance for the damaging wildlife among recipients (Naughton-Treves et al., 2005). Hence, it is important to realize that although compensation is an important tool for HWC mitigation, it is not a silver bullet in solving the complex issue of human-wildlife conflict. Because of this an integrated strategy to address human wildlife conflict should be developed which includes compensation together with other tools, such as land use planning, direct incentives, preventative management measures, insurance scheme and raising awareness.

Regarding livelihood strategies, crop production was the most important activity and important source of income for the households in both of the study areas. People depended on crop production not only for income but for food as well. Also, income from livestock production was among the three highest sources of income. Livestock on the other hand also provided important sources of food and animal products. Given the households reliance on crop and livestock production, reduced yields due to wildlife damages could have a devastating impact on livelihoods and ability of the households to cope with shocks. Reliance, particularly on crop production and subsequent loss of crops due to wildlife damages can lead to loss of income and food insecurity among the households. The situation is compounding in these two study area as majority of respondents are food crop deficient (nearly 66% in Bachhauli and nearly 51% in Meghauli) and the deficiency ranges from 1-3 months to over a year. Women, children, people from marginalized groups and households having a lower income are particularly vulnerable. So it can be concluded that HWC can lead to poverty by reducing food security and options for cash generation and thus have serious consequences on the livelihood of the local people (Mulonga et al., 2003).

9.5 Distributional issues:

Are the ones who suffer from wildlife damages and who benefit from the park the same or different? To answer this research question distribution of benefits associated with park and costs associated with wildlife damages were cross tabulated and analyzed for clumping. The benefits that were realized by the households were first studied and were divided as direct benefits and positive spillovers from park projects and activities. Direct benefits realized in the buffer zone were found to be yearly grass cutting programs and compensation scheme run by the park. While indirect benefits or positive spillovers included access to loan facilities from buffer zone user groups and other activities run by the park in the buffer zone. It also included tourism and other park related income, access to electricity and other community development programs. The cost variable that was considered was the claim by the respondents to have suffered incidences damages to crops, livestock and property from wildlife in the last 12 months. The result showed that buffer zone activities/programs exhibited significant clumping with costs, while tourism and access to electricity showed significant repulsion. That is, households that have suffered wildlife damages were significantly more likely to have benefited from buffer zone activities and programs while they were less likely to have benefited from access to electricity and tourism. While the benefit-cost clumping exhibited by buffer zone activities and programs indicates at least some measures of success, benefit-cost repulsion exhibited by tourism and access to electricity indicates challenges in part of the park authorities. Also, it is important to note that locational aspects plays an important role here as demonstrated by the fact that tourism and access to electricity are concentrated more in Bachhauli VDC (Bachhauli is a major tourism hub) while damages are concentrated more in Meghauli VDC (no functional electric fencing along the park borders as Bachhauli). The allocation of benefits and costs plays an important role in issues related to justice. If the allocation of benefit is locational or reaches only a certain fraction of communities and when poor experience most of the costs, it contributes to inequality. Previous studies of rural communities in developing countries have found that access to conservation-related benefits can positively influence local attitudes (Gillingham and Lee, 1999). However, if benefits are distributed inequitably, it puts constraints on already fragile initiatives for achieving conservation goals.

Additionally, we examined if the incidences or occurrence of wildlife damages are different with respect to household economic indicators. The chi square test revealed that wildlife damages were significantly related to household income category ($\chi 2$ (1) = 6.760,

p=0.009<0.01) and wealth category ($\chi 2$ (1) = 6.445, p=0.011<0.05). additionally, the cross tabulation between wildlife damages and household economic indicators revealed that people having an income and wealth lower than the mean income and wealth tend to suffer more from wildlife damages. Vedeld et al., 2012 in their study around the Mikumi National Park in Tanzania also found that crop riding was largely suffered by the poorest segment of the community. The wildlife costs suffered by poor households represent a substantial portion of their annual income. Hence, the impacts these costs have on their livelihood are quite severe. Wealth acts as a buffer and also allows people to lessen risks by having increased access to capital or labor and enabling the use of more efficient protection measures (Naughton-Treves and Treves, 2005). While on the other hand the poorest face compounding vulnerability because they can neither absorb the losses nor protect themselves from such losses (Dickman, 2008). The poor are getting poorer because they lack resources in the first place and are facing further economic constraints as a result of damages from wildlife and the need to invest into protection measures. Hence it can be concluded that wildlife damages are responsible for creating a greater economic inequality in our study areas.

Finally, it is important to note that distribution of benefits plays an important role in shaping the attitude of the people towards the park (Wang et al., 2006). Hence, it is important to study the collective coverage of benefits i.e. if a recipient of a particular benefit is also more likely to be recipient of other benefits. This question was examined through an analysis of interdependence among the five most frequently realized benefits (adapted from Tumusiime, and Sjaastad, 2013). They were buffer zone programs, electricity, loan facilities, yearly grass cutting and electricity. It was found that beyond the four most frequent benefits, that was a significant clumping of benefits. This suggests that those who benefit from tourism are more likely to get other benefits as well. Tourism benefits in particular are inherently locational in nature and is often associated with better access to other services as well. This is because the institutions and structures that provide these benefits and services are clustered in and around these areas. Bachhauli VDC is a major tourism hub and entry point into Chitwan National Park and has better access to other benefits and services which are often the positive spillovers form tourism industry that is booming in this area. In contrast to this, the costs of wildlife damages are more frequent in Meghauli VDC while lacking a better access to services and benefits. Nepal and Spiteri (2011) found positive attitude towards park management in communities surrounding Chitwan National Park that have higher levels of benefit receipt. While the distribution of conservation costs and benefits reveled that resident

that experience the greatest cost of crop damages are the ones who benefited least from the benefits, especially incentive based programs (Spiteri and Nepal, 2008). Hence, it can be concluded that concentration of benefits and costs based on location aspect often leads to an antagonistic attitude towards the park and park authorities and at the same time contributes to economic and social inequality.

9.6 Participation and park relation

Majority of respondents were involved in buffer zone and other social programs. Participation has a number of benefits not only to the local people but for the park authorities as well including greater access to decision makers and decision making (Agrawal and Gupta, 2005) and providing the platform for constructive dialogue between park authorities and local people (Paudel et al., 2007). Regarding the frequency of participation, majority of the respondents in Bachhauli VDC participated frequently in these programs (>90% of the meetings) while in Meghauli VDC majority of the respondents participated sometimes (>50%). Result of binary logistic regression reveled that gender, total income, household wealth, total damage cost and perception of increase in general awareness and capacity were significant explanatory variables in explaining the participation or non-participation in buffer zone and other social programs. The odds of participation in these programs are more for households that have male as household head as compared to female household head. Also, the participation in these types of programs is higher for households having a higher level of income and wealth irrespective of their caste/ethnicity. So it can be concluded that that in our study areas social class based on caste/ethnicity wasn't significant in determining participation in buffer zone and related programs but household economic stature (in terms of wealth and income) and gender (in terms of female household head) were. Additionally, respondents who perceive that there has been an increase in general awareness and capacity from buffer zone programs are more likely to participate in these types of programs together with people that have a higher damage costs.

As discussed above, caste/ethnicity was not significantly predictor of participation or non-participation in buffer zone and related programs. Overall a fairly high level of participation was observed among all social groups in both of the VDC. It is a step towards the right direction since ethnic groups, especially in Nepal and Bhutan, have little or no opportunity to participate in decision-making processes (Seeland, 2000). Also, a sense of increased level of awareness and capacity building was observed to be a significant predictor regarding

participation or non-participation in buffer zone programs. Since the inception of the buffer zone program, 68.6% in Meghauli and 65.7% in Bachhauli VDC claimed that there has been an increase in awareness and capacity of the local people. Still, a majority of respondents in Meghauli VDC and 48.57% in Bachhauli still believed that there are no specific programs targeted towards women and marginalized groups. This is now changing after the implementation of the concept of buffer zone management in 1996. An emphasis has been given for participation of local people in decision-making especially among women, poor and indigenous people through female representation in UCs, formation of separate women groups and programs that are specifically targeted towards Bote, Musahar and Majhi communities (Budhathoki, 2012). Still buffer zone policies face challenges in addressing the complex livelihood strategies and the needs of such excluded groups and women. Gurung et al., 2008 listed the challenges as poor social concepts, inequitably distributed of benefits and opportunities and lastly passive or marginal participation of excluded groups. Hence future programs needs to focus predominantly on these types of challenges for them to succeed and contribute towards sustainable livelihoods of the local people. Finally, it should be noted here that participation of all relevant stakeholders is quite important because it helps in incorporating different visions and knowledge to mitigate different conflict situations especially related to power relations or gender issues. It is true for human-wildlife conflicts as participation in decision making may raise tolerance for wildlife among the local people even if no measureable reduction in threats have been observed (Treves et al., 2009). Also, participation may help to pacify the consequence of wildlife damages. It can be so because these types of participation enable them to diversify their sources of income and make them knowledgeable about the better methods to protect their crops and properties. Diversifying income makes households less vulnerable to damages and even compensate for these losses by providing what is often referred to as individualist self-insurance (Carter, 1997; Naughton-Treves and Treves, 2005).

Majority of respondents in Bachhauli VDC (91.40%) have a positive attitude towards the park and park authorities as compared to just 41.41% in Meghauli VDC. Wildlife conservation, benefits such as yearly grass cutting, community development and tourism were considered by the respondents as the reason for having a positive attitude towards the park and park authorities. The respondents considered wildlife damages as the major factor responsible for creating the negative attitude towards the park and park authorities. Restriction placed on utilization of natural resources from park and in some instances from buffer zone, issues

related to fines and compensation was also considered influencing the respondent's attitude towards the park. The result of binary logistic showed that location of household, wildlife damages, park restrictions, participation in buffer zone programs and access to basic services were significant factors in determining if the respondents have a positive attitude towards the park or not. This shows that attitude of the respondents in our study area towards parks and park authorities depend mainly on the tangible benefits and costs associated with living in and around protected areas. Also it was found that such attitudes were not influenced by demographic and socio-economic factors. This is in contrary to other findings where it is observed that rural peoples attitude towards natural resource management is influenced by such demographic and socio-economic factors (Wright and Shindler, 2001, Heinen, 1993; Sesabo et al., 2006). Also, respondents who participated in buffer zone programs and who claim to have access to services were likely to have a positive attitude towards the park and park authorities. The result reflects the fact that since the level of positive spillovers or benefits in terms of tourism, electricity, communication and other services are higher in Bachhauli VDC as compared to Meghauli VDC while having a significantly lower level of wildlife damages a significantly higher number of respondents have positive attitude towards the park in Bacchauli VDC as compared to Meghaili VDC. On the contrary, people who claimed to have suffered higher wildlife damages in the last 12 months and who claim to have restriction in accessing park resources were less likely to have a positive attitude towards the park. Mehta and Heinen (2001) also found a significant association between wildlife damages and attitude towards parks in Makalu Barun Consaervation Area. These damages and restriction causes skepticism among local people regarding the benefits of conservation (Shrestha and Alavalapati, 2006). To overcome these Chitwan national park in 1976 introduced an incentive program that allowed local people to harvest grasses for thatch and fodder once a year. But still more incentives programs need to be followed up or else local people will continue to trespass the park boundaries to fulfill their resource needs creating a standoff between local people and park authorities. Although the presence or absence of benefits such as effective compensation schemes is an important factor in shaping the attitude towards park and park authorities (Archabald & Naughton-Treves, 2001), our regression model doesn't include compensation as a variable because so little households claimed to have been compensated for damages from wildlife (only 4% in Meghauli and none in Bachhauli).

9.7 Policies and challenges

National park and wildlife conservation act, 1972 and Buffer management policies, 1992 and regulations, 1996 represent two most important and relevant policies relating to the management of national parks and buffer zone in Nepal and Chitwan National Park as well. The biodiversity conservation in Nepal evolved as a top-down approach based on a centralized-regulatory control model. This approach is reflected in the first National Parks and Wildlife Conservation Act in 1973 that created and empowered the Department of National Parks and Wildlife Conservation (DNPWC) to establish and manage national parks and wildlife reserves (Mehta and Kellert, 1998). People were evicted from and army was deployed for law enforcement. The availability and access to natural resources to the local communities was reduced or narrowed drastically and park-people conflicts escalated. Ironically these restrictions undermined long-term conservation goals National Parks and Wildlife Conservation Act envisioned. These restrictions went one to become one of the major factors responsible for a negative attitude towards the park and park authorities. In this study, 47.82% of the respondents having a negative attitude towards the park claimed restrictions placed by park as being one of the factors responsible for such attitude. Also, the resources use restriction laid down by the park seriously affect the group that relies heavily on agriculture and livestock. This is particularly true for people that depend upon agriculture as their single source of occupation are quite vulnerable as they can lose a season´s entire crop in just on raid by rhino or elephant. This is reflected by the fact that people consider wildlife damages as the major reason having a negative attitude towards the park (73.91% combined for both study areas). The severity of conflict due to the implementation of strict categories of protected area led the government of Nepal to introduce participatory management approaches in protected areas of Nepal (Budhathoki, 2004). The Fourth Amendment to the National Parks and Wildlife Conservation Act of 1973 in the year 1994 and the subsequent Buffer Zone Management Regulations 1996 was aimed at establishing and demarcation of buffer zones to include areas adjacent to and likely to be affected by national parks and reserves (Mehta and Heinen, 2001). The regulations further described prohibited activities in Part 5 (Heinen and Mehta, 2000). One of them was that a written approval was required from the DNPWC to license any industry other than cottage industries and all industries relying on the use of forest products. During informal meetings and discussion with the local residents it was found that people were really skeptic about the above mention provision. People found it really time consuming and arduous preparing all the required documentation and obtaining permit from the notoriously slow government works. Thus it was seen as hindrance for diversifying source

of income by opening new business or industries. The DNPWC issued guidelines based on the Fourth Amendment and the regulations (DNPWC, 1998), which created several types of committees beyond those identified in the regulations. For each protected area, one Buffer Zone Development Council (BZDC) is formed under which user groups (UGs) can be formed. The provisions of Buffer zone community forests user group (BZFUG), Buffer zone user committee (BZUC), User group (UG) and several Functional groups (FO) have created several terms and conditions for the use of resources by people. Some respondents reported that there are simply too many rules and regulations and their subsequent terms and conditions put unnecessary restrictions. Furthermore, response of the local people and review of literature also supports the notion that the new institutional structures unknowingly supported to create boundaries between people and increase the gap between different social classes and wealth classes (Gurung et al., 2008). The inadequate representation of women and indigenous people in decision-making bodies and their lack of control over financial resources continue to pose challenges. According to Budhathoki (2004), 75% of the members in buffer zone management committees are from higher caste while only 16% are people form indigenous groups. Despite the challenges, several positive outcomes have been observed after the implementation of buffer zone management policies and legislations. An overwhelming majority of the respondents in Bachhauli VDC and a fairly high in Meghauli VDC were either positive or extremely positive towards the park and park authorities. Also, respondents considered the integrated programs of community development and wildlife conservation, distribution of revenues most of which comes from tourism and benefits provided in terms of yearly grass cutting programs as some of the positive outcomes of buffer zone management policies. These are in turn the particular reasons on the basis of which people have a positive attitude towards the park and park authorities.

10. Conclusion

- Diversified household incomes: not only changes and improves the livelihood conditions but also plays a positive role in dealing with vulnerability from wildlife damages and even compensate for these losses.
- Availability and access to services and infrastructures: have a positive influence on the sustainability of livelihood system while lack of these leads to opportunity costs or trade-offs precluding access to health services and income generating activities.
- Access to loan and credit facilities especially from informal sources: represents on of the diverse livelihood benefits buffer zone and other participatory programs provide.
- High levels of participation: insures access to decision making and helps incorporating different visions and knowledge to mitigate conflicts situations ranging from power relation, gender issues to wildlife damages.
- Lack of education and training especially among lower castes and women: implies vulnerability in terms of both achieving sustainable livelihood and mitigating wildlife damages.
- High inequality in income and wealth distribution: Wildlife damage and mitigation cost further increasing inequality in income. Higher costs of wildlife damages corresponded with a lower income. Women, children, people from marginalized groups and households having a lower income are particularly vulnerable.
- Human-wildlife conflict leading to poverty: given the households reliance on crop and livestock production, reduced yields due to wildlife damages could have a devastating impact by reducing food security and options for cash generation. Thus having serious consequences on the livelihood and welfare of the local people and ability of the households to cope with shocks.
- The poorest face compounding vulnerability: as they lack resources in the first place and are facing further economic constraints as a result of damages from wildlife and the need to invest into protection measures. Hence wildlife damages are responsible for creating a greater economic inequality.

- Lack of compensation has serious consequence: particularly on the attitude of the local people and an increased hostility towards damage inflicting wildlife.
- Tourism benefits are inherently locational in nature: and are often associated with better access to other services as well. This is because the institutions and structures that provide these benefits and services are clustered in and around these areas.
- Justice issue closely associated with the allocation of benefits and costs: the allocation of benefit especially tourism and access to electricity is locational and reaching only a certain fraction of communities while other groups of people are experiencing most of the costs associated with wildlife damages, thus contributes to inequality and injustice.
- Buffer zone policies face challenges: in addressing the complex livelihood strategies and the needs of excluded groups and women.
- Wildlife damages creating the negative attitude towards the park and park authorities: attitude towards parks and park authorities depended mainly on the tangible benefits and costs associated with living in and around protected areas and not influenced by demographic and socio-economic factors contrary to findings by other scholars.
- New institutional structures: inadequate representation of women and indigenous people in decision-making bodies and financial matters create boundaries and increase the gap between different social and wealth class.

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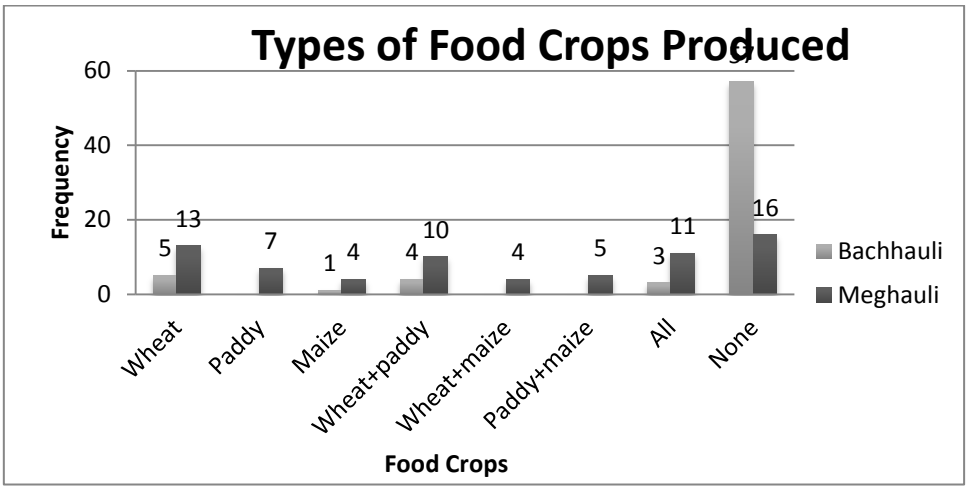
Annex 1 Household assets/wealth

Household assets/wealth	Meghauli VDC	Bachhauli VDC
Estimated value of House	1637214.29	1694857.14
Value of bicycle	3850	6778.57
Value of motor-bike	40600	102785.71
Value of agricultural machinery	5785.71	20521.74
Value of other machinery	20178.57	13350
Estimated value of cow	15928.57	13014.29
Estimated value of buffalo	29642.86	22571.43
Estimated value of goat	8078.57	6400
Estimated value of ox	10142.86	3428.57
Mean household assets/wealth	1771421.43	1883707.45

Annex 2 Positive attitudes towards park and park authorities

Reason for positive attitude towards park	**Bachhauli VDC**		**Meghauli VDC**	
	Frequency	%	Frequency	%
Tourism	4	5.71	0	0.00
Yearly grass cutting program	11	15.71	6	8.57
Community development programs	0	0.00	2	2.86
Community development programs+ tourism	4	5.71	0	0.00
Community development programs+ yearly grass cutting	0	0.00	8	11.43
Community development programs+ wildlife conservation	0	0.00	2	2.86
Community dev+ wildlife conservation+ yearly grass cutting	4	5.71	3	4.29
Wildlife conservation+ tourism	8	11.43	1	1.43
Wildlife conservation+ yearly grass cutting prog	2	2.86	0	0.00
Tourism+ yearly grass cutting prog	16	22.86	0	0.00
All	15	21.43	7	10.00
None	6	8.57	41	58.57
Total	70	100	70	100

Annex 3 Types of food crops produced



Annex 4 Deficit periods for food crop deficiency

Deficit Period	Bachhauli		Meghauli	
	Frequency	%	Frequency	%
<1months	0	0.00	2	5.56
1-3months	17	36.17	20	55.56
3-6months	12	25.53	10	27.78
>6months	18	38.30	4	11.11
Total	47	100.00	36	100.00

Annex 5 Types of livestock products produced

Livestock Products	Bachhauli		Meghauli	
	Frequency	%	Frequency	%
Milk	19	27.14	23	32.9
Meat	2	2.86	2	2.9
Eggs	9	12.86	3	4.3
Milk+ meat	2	2.86	5	7.1
Milk+ butter	5	7.14	5	7.1
Milk+ eggs	3	4.29	1	1.4
Meat+ eggs	2	2.86	0	0
Milk+ butter+ egg	3	4.29	1	1.4
None	25	35.71	30	42.9
Total	70	100.00	70	100.0

Annex 6 Unit Conversions by Crop Types

Crop Type	Local Unit (Muri)	Standard Unit (Kg)
Paddy	1	50
Maize	1	60
Wheat	1	69
Oil Seed	1	57

Source: Nepal & Weber, 1993

Annex 7 Livestock Units Conversion Factor

Livestock	Units
Buffalos	0.81
Cattle (Cows/Ox)	0.65
Goat/ Sheep	0.18

Source: Sharma, 2000

Annex 8 Farm Size Conservation Factor

Farm Size	Conservation Factor
1 Bigha(20 Kattha)	=0.6 ha
1 Kattha	=0.03 ha

Source: Nepal & Weber, 1993

Annex 9 Questionnaire

Questionnaire for the socio-economic analysis of Buffer Zone community of Chitwan National Park (2012)

Name of Data Collector: ..... Date: .....

A. General Information

Household head: ……GPS Position: .....

Caste/Ethnic Group: .....Sex: ……..

Age: ..... Education: ……..

Occupation: ..... Address (VDC/Ward): ……

Residence period: .....Distance from park……

- If moved from other place

Place of origin……Reason for migration……

(1=availability of land, 2=employment, 3=family, marriage, 4=conflicts, 5=others, specify)

- Family structure ○ Nuclear ○ Joint
- Family Members

HH Members	Relation to Respondent	Sex	Age (yrs)	Marital Status (M/U)	Occupation			Education
					Main	Secondary	Others	

B. Household assets

- How many house do you own (locally and others)

S.No.	Location	Estimated value (Rs)

- Do you own machinery or other major assets, such as machineries, cars, motorcycles, bicycles? If yes, fill out:

Type of asset		Amount	Total value
Machineries			
Car			
Motorcycle			
Bicycle			
Others			

- Access to loan facilities ○ Yes ○ No
- If yes, what kind of loan…….
- Land Holding information
-

Land Holding Type	**Area**		
	Bigha*	**Kattha***	**Dhur***
Own			
Rented in/out			
Contracted in/out			

- Does your household own any livestock? ○ Yes ○ No
  If yes, what is the inventory of your livestock during the fiscal year 2069/70?

Type of livestock	No. owned	Estimated value (Rs)	Inventory Change in the last year					
			No. Purchased and value	Received	No. Sold and value	Given	Consumed	Died
Ox/bull								
Cow								
Goat								
Sheep								
Poultry								
Others								

C. Income and expenditure status of the household

C. 1 Farm Production

- What type of Crop do you grow?

Crop Type		Area cultivated	Production (Kg)	Consumption (Kg)	Sale (Kg)	Income Rs/yr
Food Crops	**Wheat**					
	Paddy					
	Maize					
Pulses						
Cash Crop	**Vegetables**					
	Oil Seeds					
	Others (specify)					

- If deficit,
  Deficit (kg)……..
  Deficit period (months)……

- How do you manage for the deficit months?

  i) Buy ii) Borrow iii) Barter

  iv) Wage Labour v) others (specify).....

- What are the crop production costs you incurred during production year?

S/No	Type of input	Unit	Price per unit	Quantity	Total Cost
1	Fertilizer				
2	Seed				
3	Pesticide				
4	Labor (hired)				
5	Equipment				
6	Others				

C.2 Income from livestock

Type of livestock products/services	Produced* (kg/lt./no)	Consumed	Sold	Price	Income
Milk					
Meat					
Butter					
Egg					
Others					

*per month

- What were the inputs associated with livestock ownership during the past 12 months

S/No	Description of cost	Cost/month	Estimated cost/year
1	Fodder		
2	Vet service		
3	Labor (hired)		
4	Transportation		
5	Others		

C.3 Off farm activities

- What type of wage labour did members of the household engage in during the last 12 months?

Type of work	**If related to park**	**Period**	**Wage**	**Total Income/week**

- Did the household have income from other businesses during the past 12 months?

Type of business	If related to park	Total income per month

- What were the other sources of income?

Source	Total income per month
Remittance	
Government support	
Others	

D. Attitude towards park and access to services

- Which of these attitudes do you think you have towards the park
  i) Highly positive ii) positive iii) neutral
  iv) Negative v) highly negative

- If negative why,
  i) Restrictions placed by park
  ii) Wildlife damages
  iii) Fines
  iv) Issues related to compensation
  v) others……

- If positive why,
  i) Community development programs
  ii) Wildlife conservation
  iii) Tourism
  iv) Yearly grass cutting program
  v) Others…….

- Do you have any of the following in your home?

Variables	**Access**
Electricity	
Piped drinking water	
Sewage	
Communication (phone, internet)	
Latrine/bathroom	

- What is the distance to the nearest Health post/ hospital/clinic……..
- What is the distance to the nearest
  Primary school……..
  Secondary school……
  Higher Education: Higher Secondary…… University or university degree……
- Nearest urban center……..…….Distance.……Travel time……
- What is the distance to the nearest main road/highway leading to the urban center……
- Nearest market place……...Distance…….Travel time……
- What is the distance to the nearest main road/highway leading to the market……
- Are/were you currently involved in any of the BZ program or BZ management council, UG, UC, Mother Groups?

  ○ Yes ○ No

  If yes, specify

Date	**Program**	**If any other member of family**	**Continuation of Program**

- How many meetings do HH members attend per month? ……..

- Are you involved/ active in any specific programs to increase the individual and institutional capacity of women and other ethnic, marginalized group?

  ○ Yes ○ No

  If yes, what types of programs? ……..

- Is there any improvement in the general awareness and capacity of your household after the commencement of buffer zone?

  ○ Yes ○ No

E. Wildlife Damages

- Have you suffered any losses from wildlife over the last 12 months?

  ○ Yes ○ No

- What kind of problems they bring to you?

E.1 Crop Damage in the last 12 months

Wild Animal	Crop	Area Planted	% of area damaged	Average Yield	% of yield lost	Cost	Compensation

Average yield × area planted × %yield loss = Volume of loss

Volume of loss × value of crop = **Value of crop loss per respondent**

Distance*	Stage of Crop**	Month of damage

*Distance of farm from the national park or nearest forest <1km, 1-3km and >3km

**Mature, immature, ready to harvest, others

E.2 Livestock Loss in the last 12 months

Wild Animal	Livestock	No. of Loss	Place, time &month	Estimated value of loss	Compensation (Rs)

E.3 Human Loss (injured/ killed) from own family in the last 12 months

Wild animals	Date/ Time	Killed	Injured	Place, month and time of attack	Compensation (Rs)

E.4 Loss or damage to property in the last 12 months

Wild animals	Date/ Time	Property	Loss/damage in Rs/yr	Compensation (Rs)

E.5 Compensation

- Did you received any compensation ○ Yes ○ No
- Total value of compensation received (Rs)**……..**
- If compensation received, were compensation measures enough?

○ Yes ○ No

If no, what do you think should be done?

……

- If you didn't received compensation, what do you think are the reasons behind it?

…….

F. Mitigative/Adaptive measures against wildlife damages

F.1 Have you used repellents and other strategies against wildlife damages for the last 12 months and what are the costs involved in these?

S.No	Repellents and other	Usage		Days Used/ month	Cost/year	Target animals	Major crop loss or Livestock prayed	Ranking*
1	Chemical	Yes	No					
2	Setting fire	Yes	No					
3	Exploding fire crackers	Yes	No					
4	Noisemaking	Yes	No					
5	Other strategies	Yes	no					

*Effectiveness of control measures: Rank 1- ineffective to Rank 5- most effective

F.2 Have you invested on any sort of construction for wildlife damage control for the last 12 months?

○ Yes ○ No

If yes……

S.N.	Strategies		Material cost	Target animals	Major crop loss or Livestock prayed	Ranking
1	Fencing					
2	Natural physical barriers(branches, twigs)					
3	Trenches					
4	Watch towers (*machans*)					
5	Scarecrow					
6	Other constructions					

F. 3 Are you or members of your family involved in guarding your crops, livestock against wildlife damages?

○ Yes ○ no

- What are the cost involved in guarding farms and livestock?

S. No.	Guarding	Season	Labor input days or nights /month	Target animals	Major crop loss or Livestock prayed	Ranking
1	Self	Spring				
		Monsoon				
		Autumn				
		Winter				
2	Hiring labor	Spring				
		Monsoon				
		Autumn				
		Winter				

F.4 What actions should be taken by the Park authorities to reduce crop and livestock damages?

…….

F.5 What actions should be taken by the Park authorities to reduce injury and loss of human lives?

…….