Land Use Land Cover Change and its Impact on Human Wildlife Conflicts in Suklaphanta Wildlife Reserve and its Buffer Zone, Nepal

Project Final Report

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Abstract

Land use land cover is a dynamic process and its change pattern and associated impacts of human activities continue to accelerate the rate of conversion of wildlife habitat destruction. These changes are associated with loss of wildlife, habitat destruction, land degradation, human-wildlife conflicts and corridors blockages. Digital methods of change detection were applied in determining the changes associated with land use and land cover properties with reference to geo-registered three LANTSAT TM scenes from 1989-2015. The human wildlife conflict data were collected through participatory tools such as questionnaire survey, key informant interview and focus group discussion. About equal proportionate in gain and loss of land use land cover pattern was noticed over the time period with overall accuracy more than 80 %. This study evidently showed that buffer zone community perceived human-wildlife conflict as a problematic issue and human casualties, livestock depredation, crop damage, house/shelter destruction and store grain destruction were found as five nature of consequences due to wildlife. It is found that more than 85 % respondents found to bear average 29 % crop loss per annum. Two peak season for crop raiding were found at wheat harvesting season and rice harvesting season. Most of the crop damage and property losses were found to be occurred at night. The mean loss of livestock depredation due to wildlife was found to be 0.195 livestock per year per household; the sum of four-year loss is approximately 14.80 % of the total existing livestock. The human wildlife conflict in Suklaphanta wildlife reserve was found to be increased due to the factors such as increase in wildlife population; particularly population increase of wild pig, blue bull and spotted deer, improvement in the condition of community forestry, lack of fencing, reduction in guarding by humans, deforestation and degradation of wildlife habitat and land use land cover change. Burning fire, scare crow, live fence, making noise, wooden fence, clearing bushes, beating drum, guarding by dogs and humans were found to be adopted mitigation measures at the Suklaphanta buffer zone and their effectiveness was measured. The local people showed positive thinking in favor of conservation and participation towards wildlife conservation but some illiterate, poor and wildlife victims have negative attitude towards wildlife conservation.

Key words: LULC, RS, PRA, HWC, Mitigation measures, Perception

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ABBREVIATIONS

AOI : Area of Interest

BZ : Buffer Zone

BZMC : Buffer Zone Management Committee

BZUC : Buffer Zone User Committee

CFUGs : Community Forest User Groups

DNPWC : Department of National Park and Wildlife Conservation

DoF : Department of Forest

ERADAS : Earth Resources Data Analysis System

ETM^{+} : Enhanced Thematic Mapper Plus

FAO : Food and Agriculture Organization

FGD : Focus Group Discussion

GDP : Gross Domestic Products

GIS : Geographical Information System

GPS : Global Positioning System

HWC : Human Wildlife Conflict

IUCN : International Union for Conservation of Nature

LULC : Land Use Land Cover

MDGs : Millennium Development Goals

MFSC : Ministry of Forest and Soil Conservation

NBS : Nepal Biodiversity Strategy

NGOs : National Government Organization

PA : Producer Accuracy

PAs : Protected Area

RS : Remote Sensing

SPSS : Statistical Packages for the Social Sciences

SWR : Suklaphanta Wildlife Reserve

TAL : Terai Arc Landscape

TM : Thematic Mapper

UA : User Accuracy

USGS : United States Geological Survey

UTM : Universal Transverse Mercator

VDC : Village Development Committee

WGS : World Geodetic System

WWF : World Wildlife Fund for Nature

CHAPTER-I

INTRODUCTION

INTRODUCTION

1.1 Background

The mountainous country, Nepal, covers a region of immense natural beauty and has a high level of cultural and biological diversity. Recognizing the importance of these resources for the betterment of human kind at global and national levels, Nepal has established 20 protected areas of different categories, which provide protection to at least 67.8 % of the country's ecosystems (NBS, 2002). At present, protected areas in Nepal cover 23.23 % of the country's land area (NBS, 2014). Nepal covers only 0.1 % of the total land area of the world and about 0.3 % of the total land area of Asia. However, Nepal ranks 11th and 25th position in Asia and the world, respectively, in terms of biodiversity richness. Similarly, Nepal's rank from the point view of the protected area management is in 2nd and 20th position in Asia and globe respectively (NBS, 2014). Protected areas are established with the primary objective to conserve the wild endangered flora and fauna. Protected areas play a vital role in the conservation of wild endangered flora and fauna. Suklaphanta wildlife reserve is located in the far-western development region of Nepal. It was officially gazetted as a wildlife reserve in 1976 to protect Nepal's last remaining herd of Swamp deer *(Cervus duvaucelli duvaucelli)*. It was extended to its current size of 305 km^2 incorporating grassland, wetland and mixed forest that create a mosaic of wildlife habitats supporting many wildlife species, including many wild ungulate species, namely- swamp deer (*Cervus duvauceli duvaucelli*), spotted deer (*Axis axis*), hog deer (*Axis porcinus*), barking deer (*Muntiacus muntjak*), sambar deer (*Cervus unicolor*), blue bull (*Boselaphus tragocamelus*), wild pig (*Sus scrofa*), rhino (*Rhinoceros unicornis*) and elephant (*Elephas maximus*) and also good number of tigers (17 individuals according to DNPWC, 2013).

Despite the massive conservation efforts backed by significant international support, changes in land use patterns and associated impacts of human activities continue to accelerate the rate of conversion of wildlife habitat destruction in SWR and its BZ. The threat to wildlife populations is, therefore, an eminent one for SWR. The impacts of land use change on human-wildlife conflict in SWR have not yet been fully appreciated. Information on their manifestation and intensity is inadequate despite its importance in formulating mitigation measures. This has made it difficult to mitigate wildlife habitats, and their losses as well as their conservation in SWR. Digital methods of change detection help in determining the changes associated with land use and land cover properties with reference to geo-registered

multi-temporal remote sensing data. The collaboration of remotely sensed data and field observations can accomplish land cover classification and change detection, faster and cheaper than either alone. This study involved classifying the LULC of SWR and its BZ, in three Landsat TM scenes from 1989 to 2015, and assessing the changes that have occurred between these time period and determining the changing land use patterns in SWR and its BZ from 1989 to 2015 and thereafter its impact on human-life conflict.

1.2 Statement of problem

The protected areas are considered as the major strategy for biodiversity conservation established with the primary objective of conservation of wild endangered flora and fauna. But, nowadays, LULC changes have been transforming land cover into agricultural lands, grazing lands and human settlements at the expense of wildlife habitat. Thus, the wildlife habitats and their population are declining in area and numbers globally, regionally and locally. Despite the massive conservation efforts backed by significant international support, these changes are associated with loss of wildlife, habitat destruction, land degradation, human-wildlife conflicts and corridors blockages (Maitima *et al*., 2009). Many of the park areas in the developing countries are surrounded by the agricultural lands and human settlements. The people living in and around such national parks have interacted with them in a multifarious way. Some of them have built an ecological relationship with the park, where as in certain areas the existence of the national park has been questioned because of the growing conflict over land use rights and practices (Nepal & Weber, 1992). The protected areas are surrounded by the rural settlements and agricultural lands, especially in Terai region of country. With increasing urbanization and demand of resources, the rising serious problems, the conflicts between park and people, becomes more pronounced and thus become major obstacles in meeting the objectives of the establishment of the protected areas. Before the establishment of the PAs, local people were free to use forest resources. With the declaration of the parks and reserves in such areas many people were legally restricted from utilizing their traditional rights to these resources. As a result, illegal activities such as poaching, illegal collection of fire wood have intensified. The wild animals of PAs have caused losses of crops and depredation on livestock, which has further aggravated the problems (Regmi, 2006). Thus, human-wildlife conflict is a present major threat to survival of many wildlife in different parts of the world. At the same time, it has also become a significant threat to local people. The appropriate solutions to minimize such conflicts are necessary; otherwise local support for conservation may decline in the near future.

1.3 Rational of the study

Protected areas are established with the primary objective to conserve the wild endangered flora and fauna. Till date, there are altogether 20 protected areas which cover 23.23 % of the total land area of the country. Nepal covers only 0.1 % of the total land area of the world and about 0.3 % of the total land area of Asia. However, Nepal ranks 11th and 25th in Asia and the World, respectively, in terms of biodiversity richness. Similarly, Nepal's rank from the point view of the protected area management is in 2nd and 20th positions in Asia and Globe respectively (NBS, 2014). Thus, protected areas play an important role in the conservation of wild endangered flora and fauna. But, nowadays, the wildlife habitats and their population are declining in area and numbers globally, regionally and locally. This has been attributed to land use changes, human encroachment into wildlife habitats, human-wildlife conflicts, recurrent droughts, poaching and other anthropogenic activities. (Sala *et al*., 2000). The study aims to determine the human wildlife conflict; impacts, and management measures. Assessment of present study is important to develop effective management plan with appropriate actions to manage the wildlife with respect to its ecological, economic and cultural resources and to reduce human-wildlife conflict through mitigation measures and create harmony and ensure human - wildlife co-existence. Information of this study will be useful for governmental and non-governmental authorities from the aspect of more effective and efficient management. Thus, these kinds of information are needed for appropriate policy formulation and environment problem reduction and information of the study can be used as baseline information for the protected area manager, foresters, researchers and BZ users, to reform and re-plan the management plan of core protected area as well as BZ. In view of this, this study was purposed.

1.4 Objectives of the study

The research put forward the following hypothesis and objectives to contribute the local support and participation in sustainable protected area management with maintaining harmony and ensure human-wildlife co-existence.

Hypothesis:

(a) H_o: There has been significant increase in land use changes in SWR from 1989 to 2015.
(b) H_o: Changes in land use patterns in SWR have significant effects on the human-wildlife conflict and wildlife habitat.

(c) H_o: Existing mitigation measures adopted by the local people have significant impact in reducing human wildlife conflicts SWR and its BZ.

(d) H_o: Understanding local people attitude and tolerance level towards HWC basis for improving the wildlife habitat as well as reducing the HWC.

Specific objectives:

1. To analyze the rate of change of LULC and its impacts on wildlife habitat in SWR and its BZ using RS and GIS techniques between 1989-2001 and 2001-2015.
2. To assess the nature, intensity and trends of visible and hidden impacts of human-wildlife conflicts and map out the human-wildlife interface using RS and GIS in SWR and its BZ.
3. To determine the causes of LULC change and find out existing mitigation measures in order to reduce human-wildlife conflicts in SWR and its BZ.
4. To understand the attitude of local people and park authority toward HWC and make local people aware on the policy provisions of wildlife damage relief support guideline-2015 through awareness programs.

1.5 Structure of the thesis

This dissertation report consists of seven chapters. Chapter I provides a general introduction to the dissertation work. It includes background information, problem of the research work, justification of the research work, hypothesis and objectives of the study. Chapter II presents the literature review. It includes the literature review focusing on LULC dynamics and its impact on wildlife, human wildlife conflicts, causes and consequences of human wildlife conflict and human wildlife conflict management. Chapter III presents the general overview of study area focusing on the general description of the study area including geographic location, features and map of the study area. Chapter IV presents methodology of the research work. It includes description of the methodology regarding the land use land cover change and participatory rural appraisal tools for primary data collection such as questionnaire survey, key informant interview, consultant meeting and focus group discussion. Chapter V presents the results. It includes an analysis of the secondary data, land use land cover change, crop damages, livestock depredation, human casualties, adopted mitigation measures and their effectiveness and finally, local people perception and tolerance level towards human wildlife

conflict. Chapter VI presents the discussion of the results with the relevant published articles related to the LULC change and human wildlife conflict. It includes the comparison of the findings with other related nationally and internationally relevant published land use land cover change and human wildlife conflict related relevant articles and reasons behind this. Chapter VII presents the conclusion and recommendation of the research work. It concludes the findings of the research work. It concludes the summary of the land use land cover change, crop damage, livestock depredation, human casualties, adopted mitigation measures and their effectiveness and finally, perception and tolerance level of the buffer zone community towards human wildlife conflict and has been recommended some suggestions in order to mitigate human wildlife conflict.

CHAPTER-II

LITRATURE REVIEW

LITERATURE REVIEW

2.1 LULC change dynamics and its impact: human-wildlife conflict

Land Use is defined as the arrangement, activities and inputs that people undertake on certain land cover type whereas Land cover is defined as the observed bio-physical cover on the earth' surface (FAO 2000). LULC are distinct yet closely linked characteristics of the earth's surface. The term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as human structures, soil types, biodiversity, surface and ground water (Meyer, 1995). Land cover categories could be cropland, forest, wetland, pasture, roads, and urban areas among many others. Among concerns about global environmental change, some issues related to LULC and its change over time are becoming increasingly recognized (Lambin *et al*., 2003; Pielke 2005). Globally, land cover today is altered principally through direct human use, by agriculture and livestock raising, forest harvesting and management and urban and suburban construction and development (Brondizio *et al* 1996, MacCracken *et al* 1999). LULC can be altered by forces other than anthropogenic. Natural events such as weather, flooding, fire, climate fluctuation, and ecosystem dynamics may also initiate modification of land cover (Meyer, 1995). Land use is one of the main factors through which humans influence the environment. Changes on LULC have important consequences for natural resources through their impacts on soil and water quality, biodiversity and global climatic systems (Awasthi *et al* 2002). Studies have shown that there remain only few landscapes on the earth that are still in their natural state. Anthropogenic activities have altered the earth's surface significantly and are associated with profound effect upon the natural environment. This has resulted in observable pattern of change in context of LULC over time. Many studies found connection between species loss and the quality (size, composition, and structure) of forest. Gascon *et al* (1999) and Jha *et al* (2005) reported strong negative correlation between forest size, density, structure, and quality to the number of species using it. Hoare (1995), Kiiru (1995) and Naughton *et al*, (1999) described human population growth, land use transformation, species and their habitat loss, fragmentation, development, ecotourism, increasing livestock population, competitive exclusion of wild herbivores, abundance and distribution of wild prey and increasing wildlife population as sources of conflicts. In Nepal, more than 60% of the tourists used to visit the protected areas of the country (DNPWC, 2014).

The decline in wildlife numbers globally, regionally, and locally has been attributed to land use changes, human encroachment into wildlife habitats, recurrent droughts, poaching, and other anthropogenic activities (Loibooki *et al*, 2002). Land use changes affect key aspects of the earth's functioning, including a direct impact on global biodiversity (Sala *et al*, 2000). These changes are associated with wildlife losses, habitat destruction, land degradation, and blockage of wildlife corridors (Gordon *et al*, 2009). Increase in human population is rapidly leading to encroachment into wildlife habitats leading to the reduction of wildlife space and blockage of wildlife corridors (Okello *et al*, 2011). If protected areas have no wildlife corridors, genetic drift and inbreeding may occur, thus leading to population instability, loss of ecological integrity, and possibly local extinction and increase in human-wildlife conflict. Such conflicts create frustration and animosity towards wildlife and may result in retaliatory killings (Okello *et al*; 2005). Muruthi (2005) highlighted conflicts between humans and wildlife today as undoubtedly ranking amongst the main threats to conservation of biodiversity.

2.2 Human-wildlife conflict

Human wildlife conflict is, generally, the interaction between human and wild animals with its consequential negative impact on people, their resources and wild animals. Conflict is a competition for same resources. The IUCN (2003) defined conflict as the needs and behavior of wildlife have negative impacts of human goals or vice versa. The Human-Wildlife Conflict has recently become one of the fundamental aspects of wildlife management as it represents the most widespread and complex challenge currently being faced by the conservationist around the world (Shrestha *et a*l; 2007). Human and wildlife conflict is much debated in recent times as it poses a major threat to survival of many wild species in different parts of the world. At the same time, it has also become a significant threat to local human populations. It affects both wild animal and human being and also in economy. People lose their crops, livestock, property and sometimes their lives. Animals, which are already endangered or threatened, are often killed by the people (Bhatta, 2003). Conflicts arise when the activities of wild animals coincide with those of people (Treves 2007). Human-wildlife conflict is a universal problem and it vary according to geography, land use patterns, human behavior, and the habitat and behavior of wildlife species or individual animals within the species (WWF, 2006). The nature of HWC in buffer zone area and corridors of the Terai Arc is both historical and recent. What seems inevitable is that human wildlife conflicts incidences will continue to occur in the present context of wildlife habitat instability and growing human population's

activity in and around the park and reserves (Shrestha & Paudyal, 2007). The studies around the world show that HWC is more intense in the developing countries where livestock holdings and agriculture are an important part of rural livelihoods. In these regions, competition between local communities and wild animals, for the use of natural resources, is particularly intense and direct and resident human populations are very vulnerable (Distefano, 2010).

As we know, the most important objective of the protected areas is to protect and conserve the biodiversity including, wild animals in their natural state and at the same time to contribute the living standard of the local community. Protected areas are the milestone for conservation of biodiversity. These are recognized as the effective means of in-situ conservation. PAs in Nepal has played significant role in the conservation of biodiversity but restrictions of PAs in using park resources created resource conflict and wildlife induced damage in the form of human harassment or killings, crop damage and livestock depredation has brought negative sentiments towards it (Shrestha, 1996; Allendorf *et al.*, 2007). Livelihood of the local people is threatened due to the existence of park when there is low chance of gaining benefits from parks or reserves. Local people are also the core stakeholder in participatory management and conservation of PAs, which is recently realized in Nepal. Conflicts in Nepalese PAs are inevitable as the park finite resources are used by the local people whereas park authorities impose ban on access, as these resources are also required for the natural maintenance of ecosystems and for wildlife.

All the protected areas have more or less problem of human-wildlife conflict and that is not only in our country but also exists in the world. The degree and the magnitude of the problem are different in the different protected areas. Some protected areas need the remedial measures where the study is conducted and the problem has found significant and in high degree. Mitigation measures has not required where the problem was not significant. The significance and the degree of the problem have not known for all the protected areas of our country because the study has not been conducted widely in all the protected areas. The status of the problem is given as follows in term of global, national and local level. This problem is also found in developed countries but the problem has been minimized in a great extent. The population and the dependency of the people on the natural resources are very less and the local people are aware about the conservation and protection of their green resources. Thus the status of the protected areas is in managed way in these countries. The problem is found significant in developing and under developed countries where the people are fully dependent on the natural resources for fulfillment of their daily needs and the conduction of their

livelihood. The educational, economical and awareness status of the people is also very low in these countries. Therefore, there is a threat to conserve and protect.

2.3 Causes and consequences of the human-wildlife conflicts

All natural ecosystems are extensively being used by humans to fulfill their basic needs. Around 70% of PAs globally have human populations residing in them (in 1997) and 20% of the world's populations live within the 25 biodiversity hotspots. Human–wildlife conflicts have traditionally been viewed to occur 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 (Madden, 2004). Nowadays, the role of PAs in reducing poverty, providing livelihood and food security, maintaining ecological sustainability in light of MDGs is becoming critical. Most of the studies have been emphasized visible impacts of human–wildlife conflict, i.e. crop and livestock loss, injury and fatality. For instance, in low-income countries such as in India and Nepal, elephants kill more than one person every day (Rangarajan *et al*., 2010). In both Asia and Africa, communities may lose up to 10–15% of their total agricultural output to elephants (Lamarque *et al.,* 2009; Madhusudan and Sankaran, 2010). Such losses may seem insignificant at a national level, but they give rise to exponentially high costs for the affected individuals and families, many of whom are amongst the least privileged people in the world. Besides visible impacts, human–wildlife conflict has a range of poorly-documented indirect or 'hidden' impacts on the poor in low-income nations.

These impacts include opportunity and trans-action costs that occur as a result of conflict (Ogra, 2008), as well as health impacts that impair people's physical and mental wellbeing (Chowdhury *et al*., 2008; Dixon *et al.*, 2009). The effects of such impacts penetrate far deeper than immediate threats from wildlife. However, most attempts to examine human–wildlife conflict and policies to mitigate it gravitate toward visible aspects of the issue (Sangay and Vernes, 2008; Treves, 2009; Treves *et al.*, 2006; Vidya and Thuppil, 2010; Woodroffe *et al.*, 2005c).

Visible impacts of human–wildlife conflict, i.e. injury and fatality, crop and livestock loss, are its best-documented consequences. Studies suggest that in Tanzania, between 1990 and 2004 lion attacks led to injury or death of over 800 people (Packer *et al.*,2005). In India documented loss of human life to elephant attack averages over 400 people annually (Rangarajan *et al.,* 2010). People killed in such conflict are generally from weaker socio-economic sections of society (Das and Chattopadhyay, 2011). Crop damage is the most

prevalent form of human–wildlife conflict in both Asia and Africa, with large-bodied animals such as elephants being identified as the greatest threat by farmers (Parker *et al*., 2007). Elephants damage crops worth up to 3 million US$, and break 10,000–15,000 houses annually in India (Bist, 2006). In several African countries such loss may amount to 10% of the total agricultural output (Lamarque *et al*., 2009). Livestock depredation is another adverse impact of human–wildlife conflict, particularly in Africa where lions lift cattle from farms and ranches (Hazzah *et al*., 2009; Kissui, 2008). Hidden impacts of human–wildlife conflict may be defined as costs characterized as uncompensated, temporally delayed, psychological or social in nature (Ogra, 2008). The term 'hidden', synonymous with 'indirect' or 'secondary' impacts (Hunter *et al*.,1990), is deployed here as it encapsulates many causes and antecedents that slip critical inquiry when the focus is on visible impacts of human–wildlife conflict. Further, the term has come into use in the human–wildlife conflict literature (Chhangani *et al*.,2008; DeMotts and Hoon, 2012; Ogra, 2008). Hidden impacts include diminished states of psycho-social wellbeing resulting from injury or fatality, disruption of family, livelihoods and food security through crop or livestock loss. It also includes opportunity costs, poor health and nutritional status, and transaction costs incurred when pursuing compensation. Such impacts are generally temporally delayed, their effects on individuals or communities becoming pronounced well after the occurrence of a conflict event. Visible impacts may also have hidden consequences; hence, hidden and visible impacts interlace with each other (Fig.1). The degree and severity of psychosocial effects of conflict may be shaped by a range of precedent factors that compound vulnerability for many social groups. These include poverty, poor access to resources and social capital, ethnic and political marginalization. For instance, the death or injury to the principal bread-earner, generally a male member of the family in most low-income country contexts, transfers the responsibility onto women or children. They may have to find paid employment in addition to carrying out household activities.

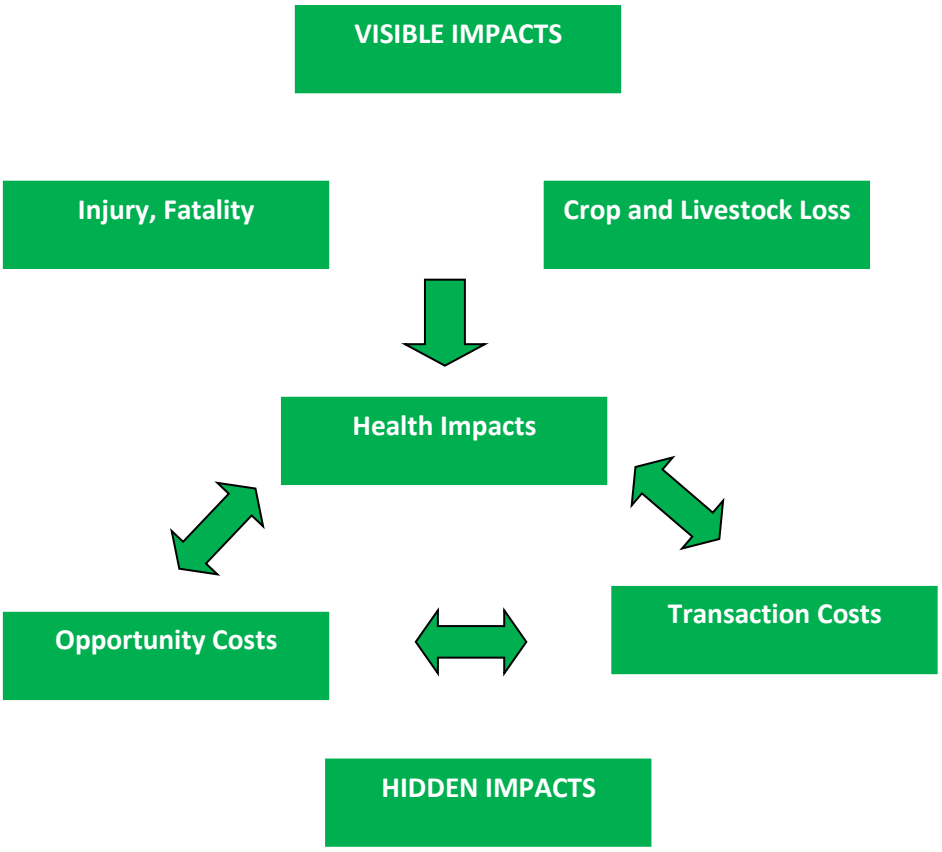


Figure 1:Visible and Hidden Impacts of Human Wildlife Conflicts and Respective Relationship.

IMPACT ON CONSTITUENTS OF WELL BEING

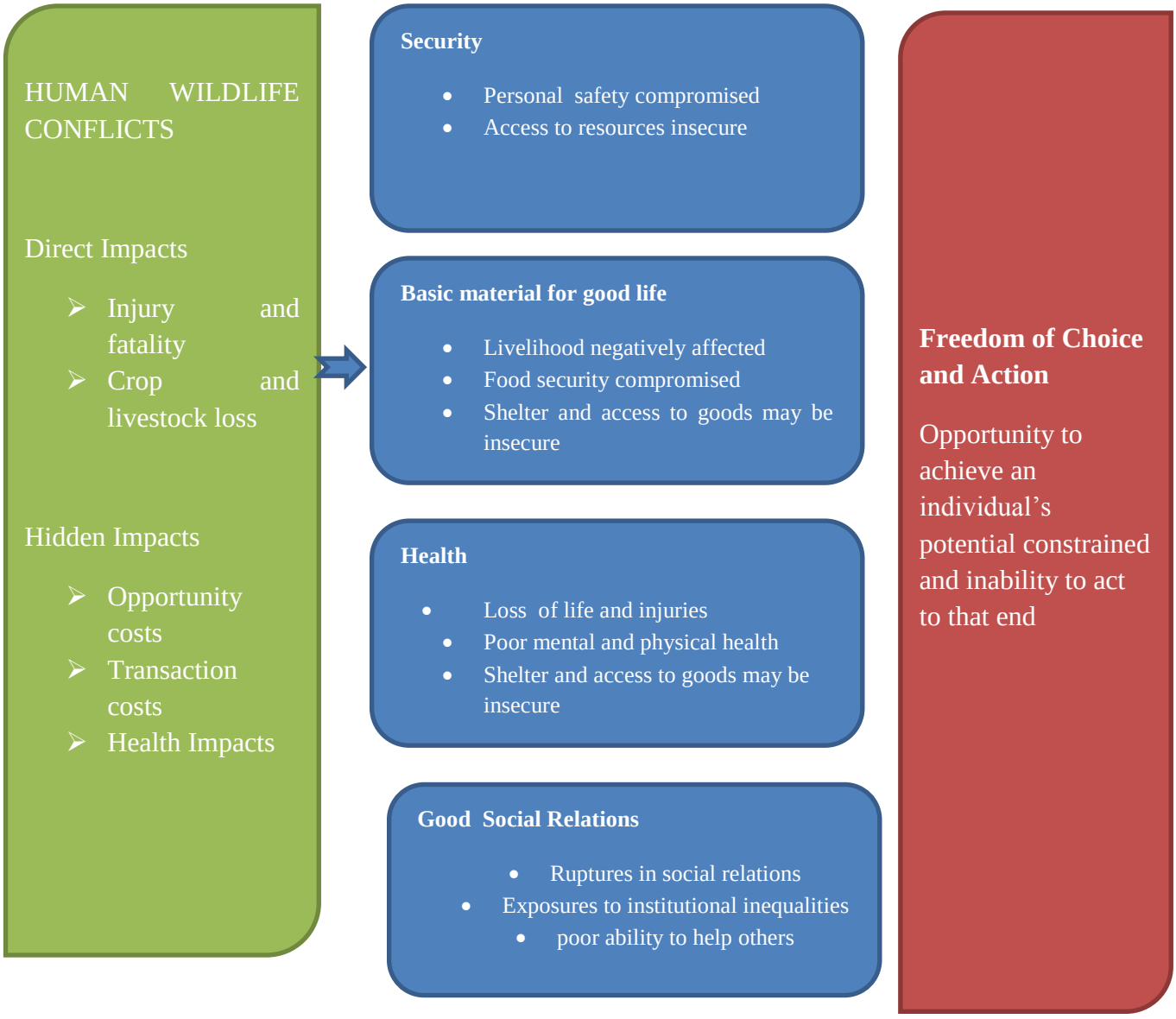


Figure 2:Human Wildlife Conflicts and its adverse impacts on components of human well being identified by Millennium Ecosystem Services.

2.4 Human-wildlife conflicts management:

Wildlife damage affects 90% of the households in five PAs, across India and Nepal (Karanth and Nepal, 2012) and crop damage and livestock loss found to be between 12% and 30% (Madhusudan, 2003 and Butler, 2000). Crop-guarding and herding of livestock are frequently deployed, the onus of which often falls upon affected communities or individuals. Studies have dissected the different methods through which crop-guarding and herding can be made more effective (Davies et al., 2011; Hedges and Gunaryadi, 2010), but the opportunity costs these activities generate are seldom discussed (Hill, 2000; Walker, 2012).

Guarding herds and taking steps to actively defend them are essential features of animal husbandry. Where herdsmen are present, the rate of depredation is generally lower than in free-ranging herds (Kaczensky, 1996; Ogada *et al.*, 2003; Breitenmoser *et al.*, 2005). Watchtowers providing good vantage points, built around cultivated fields, can increase the farmers' chances of being alerted to the presence of potentially harmful wildlife before damage has occurred. Guard animals provide an alternative to a herder monitoring a flock, which is labor intensive, time-consuming and costly. Reducing dependence on forest resources in protected area borderlands is another recommended solution for decreasing fatal encounters with wildlife, especially when people venture into forest habitat (Ogra, 2009; Tamang and Baral, 2008). Others argue that separating people from wildlife through relocation and resettlement of communities may be a more effective conflict-reduction strategy where alternative land and incentives might be available (Karanth and Madhusudan, 2002). However, providing alternatives for forest-based livelihood resources or relocation are by no means easy. Practices of relocation could actually aggravate dispossession instead of ameliorating conflict (Adams and Hutton, 2007).

Compensation payments for livestock lost to predators or crops raided by ungulates are a widespread mitigation strategy used to reduce economic impacts. They are broadly viewed as efforts to increase community tolerance of problem species (Madhusudan, 2003; Naughton-Treves *et al*., 2003; Schwerdtner and Gruber, 2007). However, compensation schemes often have unforeseen effects. They may lead to a neglect of preventive measures (Nyhus *et al*., 2005), or make people dependent on payment (Bulte and Rondeau, 2005). More importantly, bureaucratic inadequacies and practical barriers in filing complaints lead to additional transaction costs for the rural poor (Ogra and Badola, 2008). Alternative compensation systems rely on giving out licenses to exploit natural resources, through tourism, hunting or collecting fuel-wood, timber, mushrooms, fodder, etc. This type of compensation scheme,

also known as the “settlement of rights” to use natural resources, appears to be a more practical solution than monetary payment. Indeed, the benefits derived from the legitimate use of natural resources influence the attitudes and perceptions of rural residents (Sekhar, 1998). Generating income and redistributing revenues earned through ecotourism is often promoted as an alternative. However, its efficacy and scope in conflict mitigation has been questioned (Kiss, 2004; Walpole and Thouless, 2005). Benefits from ecotourism are unevenly shared whilst the costs of human–wildlife conflict are widespread. The insurance scheme is an innovative compensation approach where farmers pay a premium for cover against a defined risk, such as livestock depredation. The premium can be set at the true market rate or be subject to subsidy provided by conservation organizations (Muruthi, 2005). Awareness raising can be carried out in the community at different levels, for instance in schools or in adult education arenas such as farmer field schools. Educating children, coupled with awareness raising among adults through the traditional authority of chiefs and headmen, would certainly be highly cost-effective means of managing conflict. The payment of compensation in the event of loss is usually confined to a specific category of loss, such as human death or livestock killed by predators or elephants.

If fences are properly designed, constructed and maintained, fences can be almost completely effective in preventing conflict between people and wild animals. Fences are used to protect crops and to protect people and livestock. Fences constructed using strong material such as galvanized steel wires protect crops successfully against many mammals. The major factor limiting the wider use of wildlife fences is their cost, which varies depending on many factors such as topography, type of fence and the species it is designed to contain. The high maintenance cost of fencing is another limiting factor, which explains why fences are effective when managed by commercial farmers for high-value crops such as sugar cane or citrus. This option is beyond the means of emerging farmers or subsistence growers. Electric fencing is a more sophisticated and efficient solution. It is more durable, due to the reduced physical pressure from animals; it deters a wider range of species; and it is more aesthetically appealing. However, the cost of installation and maintenance is higher than for simple fences (Hoare, 1992). Although the introduction of fencing is a good way to manage human-wildlife conflict, it also brings a number of environmental and economic disadvantages and is never hundred percent efficient. Plant hedges have the advantage of being a low-cost solution, effective against both carnivores and ungulates.

Little research exists on wildlife preferences for particular crops, but some crops are less palatable to wildlife. There are some crops that elephants appear not to eat. Agricultural practices such as changing the time a crop is planted or harvested can also result in a decrease in crop-raiding. This can be done by using special varieties such as open pollinated maize varieties which can be harvested earlier than other food crops and consequently are less vulnerable to crop. Livestock raids can be minimized through good husbandry practices, such as herding during the day, keeping livestock in a predator-proof enclosure at night. Land-use planning is a basic human-wildlife conflict management strategy which offers possibly the best chance of overall and long-term success. Unlike strategies of protection and mitigation, it tackles the root of the problem. It is therefore a preventive approach designed to alleviate human-wildlife conflict by creating landscapes in which people and wildlife can co-exist and have as little negative impact on each other as possible (Muruthi, 2005). Land-use planning is typically a long-term process that requires government support, legislation and policy changes. (Muruthi, 2005).

CHAPTER-III

STUDY AREA

3.1 Study area

Suklaphanta Wildlife Reserve is located in the Terai Arc Landscape of Nepal with geographical location of longitude (80.229^0E) and latitude (28.8402^0N). It is located at an altitude of 174 to 1386 meters. It was officially gazetted as a wildlife reserve in 1976 to protect Nepal's last remaining herd of swamp deer *(Cervus duvaucelli duvaucelli)*. It was extended to its current size of core area (305 km^2) and buffer zone (243.5 km^2) incorporating grassland, wetland and mixed forest that create a mosaic of wildlife habitats. A small part of the reserve extends north of the east-west to create a corridor for seasonal migration of wildlife into the siwalik hills. The Syali river forms the eastern boundary southward to the international border with India which demarcates the reserve's southern and western boundary. The Kishanpur Wildlife Sanctuary is contiguous in the south. The park has three season. From October through early April the weather is dry. The days are warm and pleasant, and the nights are cool. From April to June, the temperature warms up to 37^0C and average temperature in cool season drops to 7^0C in January.

The reserve is the richest terai protected area in terms of floral diversity. It promotes more than 665 species of plants. Sal *(Shorea robusta)* is predominant species in the reserve. The habitat can be categorized into three main types namely-forest, grassland and aquatic habitat. The riverine forest is composed of sissoo *(Dalbergia sissoo)* and khayer *(Acacia catechu).* Marsh vegetation dominates the wetland areas. The main grass species of the phantas include *Imperata cylindrica* and *Heteropogan contortus,* which are used for thatching. The reserve is equally rich in faunal diversity. It is supporting more than 43 species of mammals among which Swamp deer *(Cervus duvauceli duvauceli)* is prominent species. The SWR is the home for a large number of endangered (IUCN Red List) and nationally protected (National Park and Wildlife Conservation Act-1973) wild fauna supporting 2170 population of swamp deer (*Cervus duvauceli duvauceli*), 25-30 wild elephants (*Elephas maximus*), 8 one horned rhinoceros *(Rhinoceros unicornis*), 17 royal bengal tigers *(Panthera tigris tigris)* and many wild ungulates such as spotted deer (*Axis axis*), hog deer (*Axis porcinus*), barking deer (*Muntiacus muntjak*), wild boar (*Sus scorfa*), blue bull (*Boselaphus tragocamelus*) (DNPWC, 2013). Swamp deer populations are now restricted to few isolated pockets mainly due to habitat alternation, habitat fragmentation and their illegal hunting. Swamp Deer inhabit the

swampy flat grassland and usually avoid thick-forested area. Today, an estimated number of 5,000 individuals remain in the wild, mostly in protected areas of Nepal and India (Wemmer, 1998). The reserve is also home to Goldern monitor lizard (*Varanus flavescens*), Hispid Hare, Langur (*Presbytis entellus*), and Rhesus monkey (*Maccaca mulatta*) and different species of mammals. The reserve provides habitat for about 424 species of birds, including the highest population of Bengal florican in Nepal. The reserve provides habitat for 21 species of fishes including Mahaseer, Rohu and Tenger. The reserve also houses a diverse population of reptiles like marsh mugger crocodile, cobra and python. Although Suklaphanta grass land is the prime habitat for wild ungulates, they are also found in other grasslands like Haraya phanta in very less numbers within the reserve.

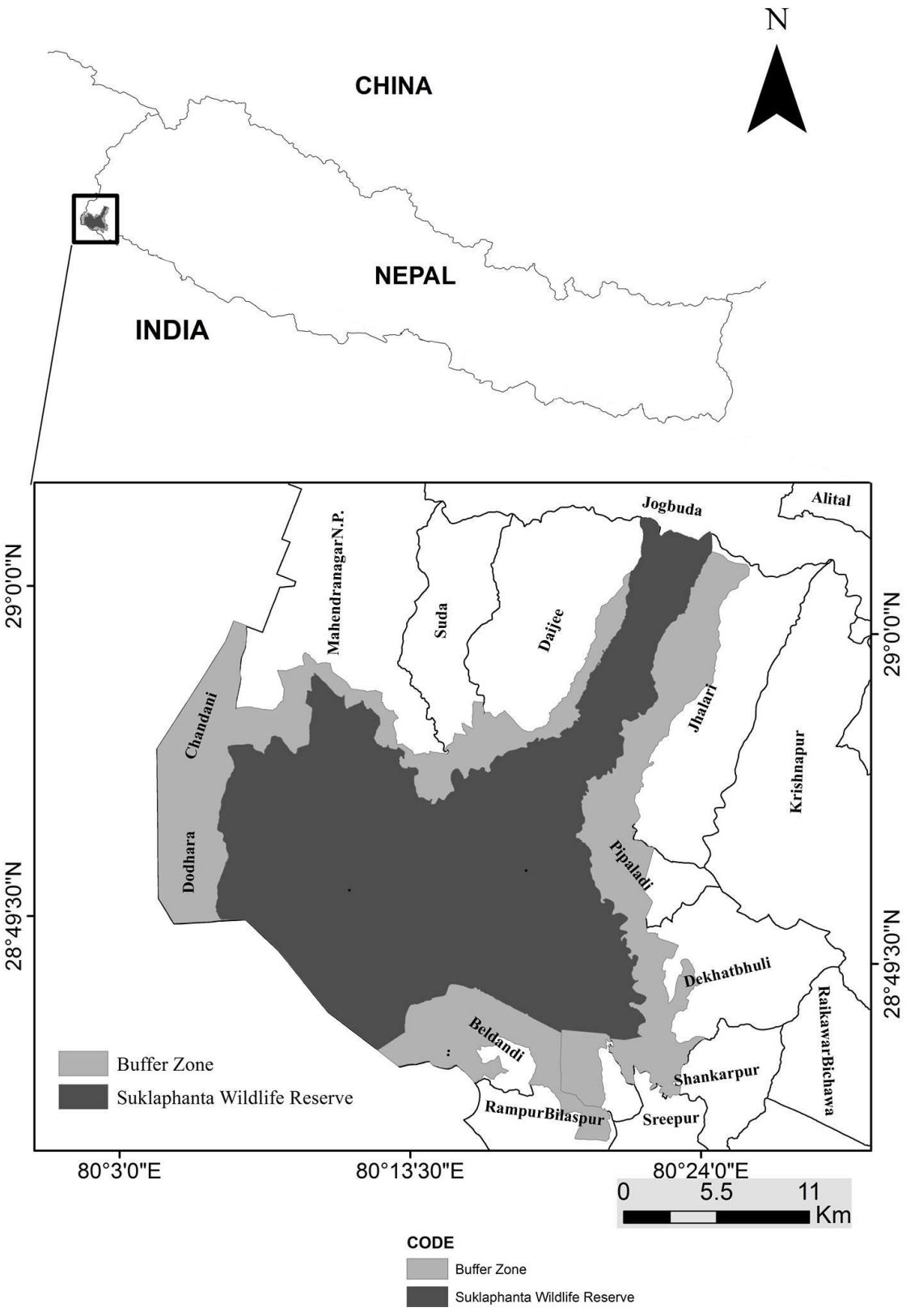


Figure 3:Map showing Suklaphanta wildlife reserve and its BZ.

CHAPTER-III

METHODOLOGY

4.1 LULC Change detection

Three satellite images namely Landsat 5, Landsat 7 ETM + and Landsat 8 for year 1989, 2001 and 2015 respectively were obtained from the United Nations Geological Survey (USGS) Earth Resources Observation and Science Data Centre (http://www.usgs.gov). The images were geo-referenced and fit to the Universal Transverse Mercator (UTM) projection system (zone 45, datum WGS-84). These images were acquired with relatively clear sky (cloud coverage less than 10 %). Sub-setting of these images were done based on area of interest (AOI) of study area and then supervised classification was carried out into 7 land-use types by using Arc GIS 10.3 and ERDAS software 2014. The land use land cover classes were namely forest, shrub land, grassland, agricultural land, sandy area, water bodies and others were considered for LULC classification for research purpose. The classified maps will be overlaid each other to detect the change and area by using raster calculator. Then, the rate of change was predicted by using the following formula:

$$\text{Rate of change (\%)} = [(a_2/a_1)^{1/n}-1] *100$$

Where, a_1 = base year data

a_2 = end of time

n = no. of years

Table 1:Satellite data specification.

S.N.	Scene ID	Sensor Type	Date of Acquisition	Cloud coverage
1	LT51440401989101ISP00	Landsat 5	1989	< 10%
2	LE71440402001270SGS00	Landsat 7 ETM+	2001	<10%
3	LC81440402015317LGN00	Landsat 8	2015	<10%

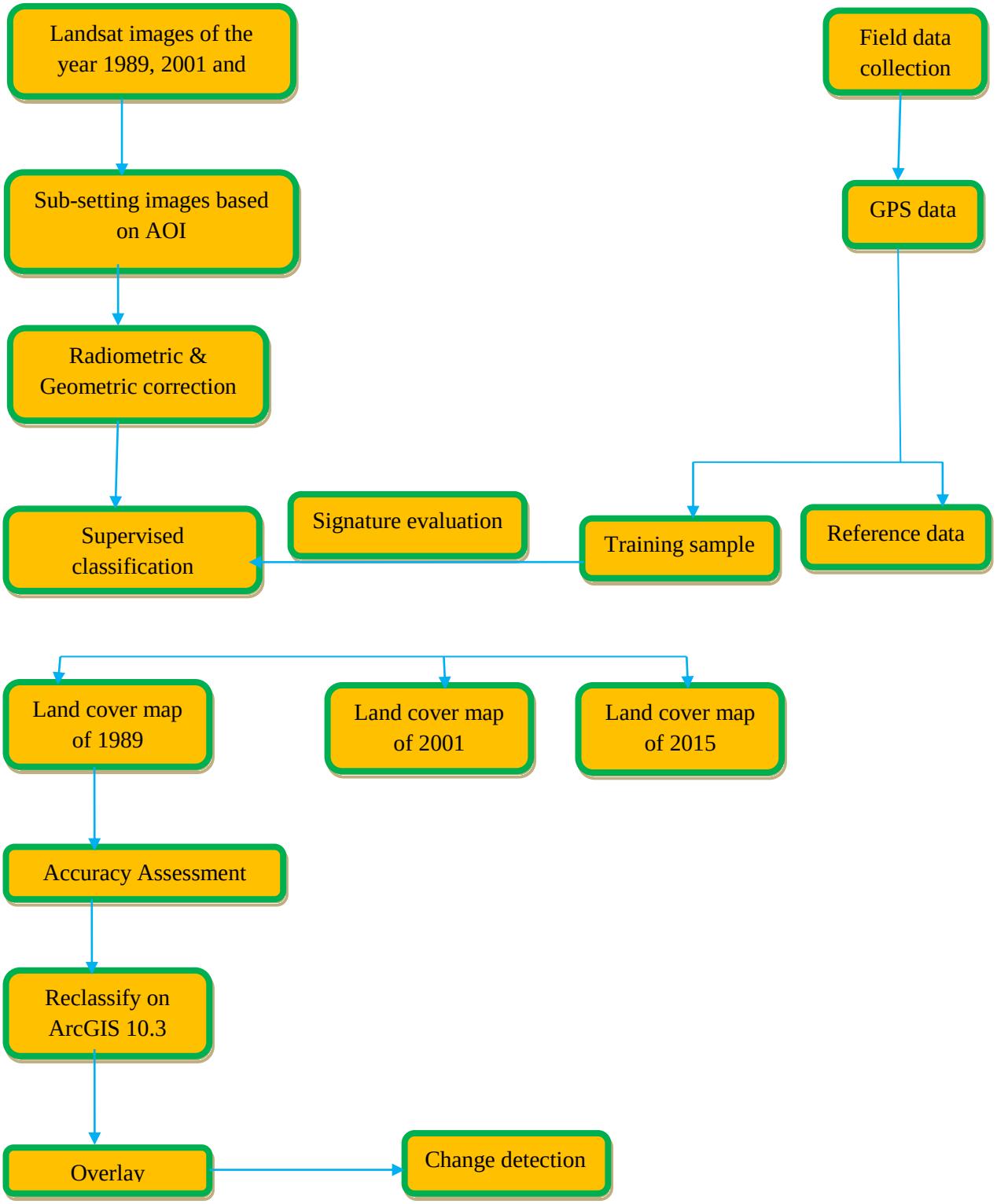


Figure 4:Methodology for LULC change detection.

In order to fulfill the objectives of the research, two types of field GPS data were collected from the field; training samples were used during supervised classification and references data were used during accuracy assessment. The total ground sample points were randomly divided into two groups allocating 60 % of samples as training data for classification, and remaining 40 % as testing data for accuracy of classified maps. The selection of ground truth sample points for the LULC classification was based on a stratified random sampling method as LULC sample points were selected based on each land use land cover classes. In total 320 sample points were collected from field. In the field, the geographical coordinates of each sample plot was recorded using hand-held GPS and other information was collected in data sheet. The detailed step followed for LULC classification is outlined in fig.4.

4.1.1 Accuracy assessment of classified maps

In this study, the accuracy assessment of classified maps was carried out using confusion/error matrix and kappa coefficient (Cohen, 1960). According to Jiang & Lin (2011), overall accuracy, producer's accuracy and user's accuracy should be used for the accuracy assessment as they directly interpretable as probabilities of correct classification. The confusion matrix is the only way to effectively compare two maps quantitatively (Congalton, 2007). Cohen (1960) has described kappa coefficient is the proportion of agreement obtained after removing the proportion of agreement that could occur by chance. It lies on a scale between 0 and 1 where 1 represents a complete agreement (Cohen, 1960). Congalton (1991) had used kappa statistics to statistically compare classification accuracies of maps. According to Yang (2007), the kappa values greater than or equal to 0.75 is excellent agreement beyond chance, values below 0.49 or equal is poor agreement and values between 0.40 and 0.75 is fair to good agreement beyond chance.

GPS data collection on different LULC for classification and accuracy assessment.

1. Grassland

2. Flowing waterbodies

3: Wetland

4: Waterbodies inside the park.

5: Forest

6: Sandy area

4.2 Questionnaire survey

The study was carried out in buffer zone user committees of six VDCs and four municipalities of SWR. The BZUC is in general formed at VDC level. The studied BZUCs were namely Sagarmatha, Himalaya, Suklaphanta, Trisakti, Betkot, Sundevei, Kalikich, Bagesori and Shovatal covering an area of 243 km^2 around the reserve. I used a structured self-administered questionnaire survey (Punch, 2006) to collect data on human wildlife conflicts and land use land cover change of the SWR and its BZ. All questions were close ended for simplicity in quantitative analysis. Before initiating the questionnaire survey, pilot surveys were taken with the Suklaphanta BZUGS, fifteen households were selected randomly for the pilot survey, after which necessary improvements were made in the questionnaire. The pilot questionnaire was not considered in the result analysis. The questionnaire survey was carried out in time with the help of three local level field assistances who were able to understand both the Tharu and Nepali languages and had graduated in sociology. The three field assistants were trained before they stated the job and jointly participated with me during pilot surveys. The advantages of hiring local people was that they understood local languages and were able to determine if the respondent might be giving false data. Verification by cross checking was done when there was doubt as to the validity of the data being provided.

4.3 Key informant survey

The key informants consisted primarily of interviewing representatives from the buffer zone management committee (BZMC), community forest user groups (CFUGs), buffer zone user groups (BZUGs), local leaders who were involved at the decision making level. These interviews were conducted to know the cause of human wildlife conflicts, land use land cover change, adopted mitigation measure and its effectiveness. In addition, I had conducted interview with the protected area managers and representatives from NGOs. Protected area managers were asked in order to understand human wildlife conflicts management strategy, the compensation scheme of the government, problem wildlife management, illegal poaching, livestock pressure, forest resources pressure. Eight interviews who are working for managing the protected area of different levels included chief warden, the wildlife reserve ranger, forestry staffs, game scouts, and representatives from conservation NGOs were interviewed in this group of PA managers.

4.4 Focus group discussion

The Focus Group Discussion (FGD) is also called as a group interview where a researcher conducts a form of in-depth interview with research participations (Kitzinger, 1995; Robinson, 1999; Theobald et al, 2011; Webb & Kevern, 2001). It is conducted with a small group of people who share their ideas, insights and expectations on a specific topic selected by a researcher (Kitzinger, 1995; Kumar, 1987; Morgan, 1984, Powell & Single, 1996; Robinson, 1999). Considering availability of time and geographical remoteness, six FGDs were conducted in this research with different buffer zone user groups at different research locations. The participations of FGDs and their locations were purposively selected to represent different settings of study area ensuring representation of different caste, class, ethnicity and gender dimensions. As suggested by many authors (Khan & Manderson, 1992; Kumar, 1987; Powell & Single, 1996; Robinson, 1999; Jayasekara, 2012), the member of participations in FGD ranged from 4 to 10 depending upon the depth of issues to be discussed and interest of research participants. In this research, the researcher facilitated the FGDs and the objective and purpose of the research was shared and prior consent on note taking were obtained prior to discussions as suggested by many authors (Kumar, 1987; Powell & Single, 1996). The FGDs were guided by a list of questions as checklist (Appendix III). The information generated from FGDs were noted by the researcher, analyzed it according to the need of research questions, and presented as bar diagrams and interpreted in sentences as required. The trend of human wildlife conflict, land use land cover change pattern and adopted mitigation measures and their effectiveness in the last 25 years were discussed and relevant information was collected. FGD participants were also interviewed about ongoing socio-economic and environment changes and its implications and push factors of land use land cover change.

Household survey: Photos 7,8,9, 10, 11 &12.






Key informant interview

13: Interview with game scouts.

14: Interview with students.

15. Interview with BZUC president.

16: Interview with School teacher.

17. Interview with park chief warden.

18. Interview with BZMC president.

Focus group discussion with different stakeholders.

Photo 19: FGDs with BZUC members

20. FGDs with Local leaders

21. FGDs with students

22. FGDs with local farmers

23. FGDs with BZUC & CBAPU members

24. FGDs with CFUGs.

4.5 Secondary data collection

Secondary data was collected from different relevant sources like wildlife reserve office, BZUCs, BZUGs, VDCs, DNPWC, DFO, regional forest directorate and various published and unpublished literature. The data were collected particularly related to the human casualties i.e. death and injury, livestock depredation, house/store grain destruction and crop damages by wildlife in and around the reserve and were verified through key informant interview with the park warden, president of buffer zone management committee and other buffer zone representatives.

4.5 Data analysis

All quantitative data were analyzed using the statistical software SPSS (Statistical Package for Social Science) version 22.0. The pre-tested questionnaire was directly entered into variable view of the SPSS and then collected responses of each question were entered into the data view of the SPSS. Then, data was analyzed using descriptive statistics (mean, standard deviation, percentage, frequency, minimum and maximum, standard error and range). The result obtained through analysis process was compared to see whether difference in the mean of LULC change differs significantly or not in that time period. Chi-square test was applied to analyze the perception and educational level, and perception and gender SPSS 22.0 software at 10% level of significance. Similarly, the LULC change detection was analyzed using the ERADAS IMAGINE 2014 and Arc GIS 10.3 through three time periods satellite images.

CHAPTER-V

RESULT

5.1 Analysis of social data

Suklaphanta buffer zone committee was declared on 22, May, 2004 under the NPWC Act 1973 covering 243 km^2 area around the Suklaphanta wildlife reserve. The buffer zone management committee was formed through representation from nine buffer zone user committee through election process. There are altogether nine buffer zone user committees under the Suklaphanta buffer zone management committee covering six VDCs and four municipalities around the reserve. The socio-economic data of the buffer zone user committees of the Suklaphanta wildlife reserve like demographic features, wealth ranking and status of community forestry were analyzed before analyzing the data collected through household survey. These features have direct or indirect relationships in the process of involvement and participation of local people in conservation programs and management of buffer zone community forest.

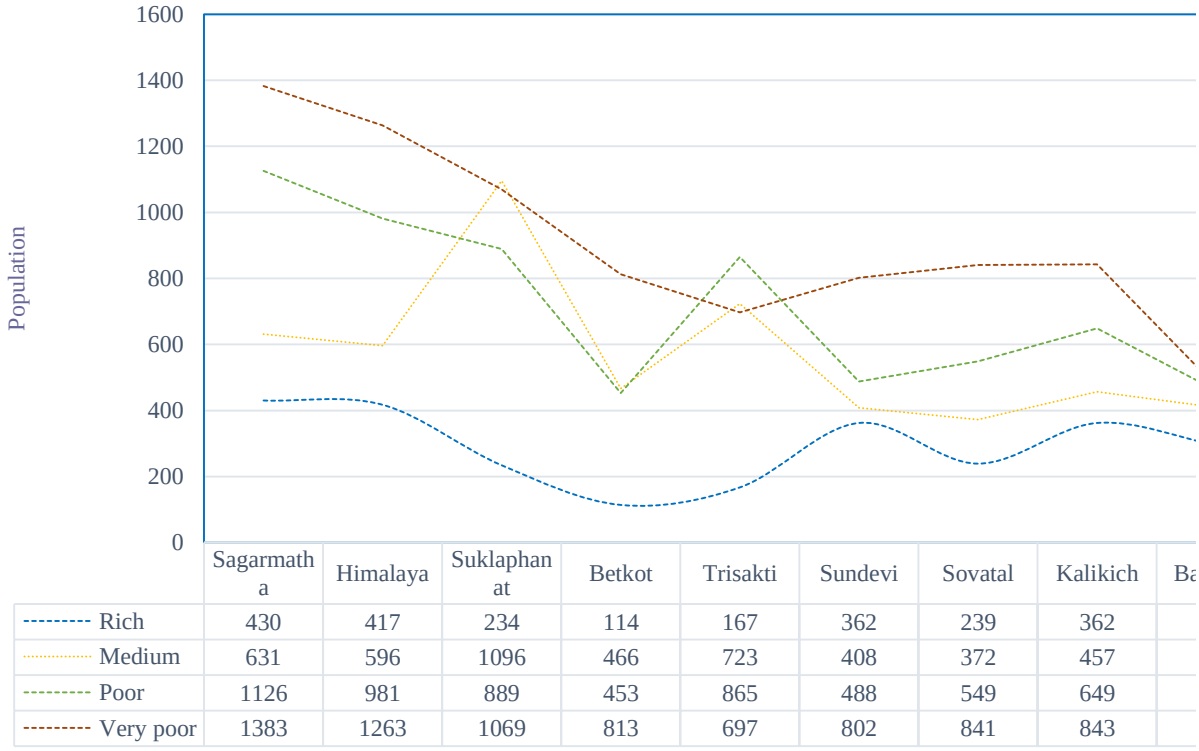
5.1.1 Wealth ranking

The BZUGs users were categorized into four classes viz. very poor, poor, medium and rich. The wealth ranking of Suklaphanta wildlife reserve was done on the basis of following five criteria.

Table 2: Wealth being ranking criteria.

Criteria\Ranking	Rich	Medium	Poor	Very Poor
Land holding	>1 Bigha	10 katta-1Bigha	5-10 Katta	<5 Katta
Industry Business status	Industry or business owner	Industry or business owner	-	-
Employer status	Government/NGOs employer	Government/NGOs employer	Daily wage labour	Daily wage labour
Type of house	Permanent with concret roof	Permanent with tiles/slate roof	Temporary house with straw/thatch roof	Temporary house with straw/thatch roof
Food grown	Sufficient production from	Sufficient production from	Production from their land to	Sufficient production from

their land to provide subsistence for whole a year	their land to provide subsistence for whole a year	provide subsistence for 3 to 6 months a year	their land to provide subsistence for whole a year	



	Sagarmatha	Himalaya	Suklaphanat	Betkot	Trisakti	Sundevi	Sovatal	Kalikich	Ba
Rich	430	417	234	114	167	362	239	362	
Medium	631	596	1096	466	723	408	372	457	
Poor	1126	981	889	453	865	488	549	649	
Very poor	1383	1263	1069	813	697	802	841	843	

Figure 5:Wealth being ranking of the Suklaphanta BZMC users.

*(Source: Western Terai Arc Landscape Development Project**;** 2065)*

5.1.2 Population status suklaphanta buffer zone management committee

There are altogether 22,413 households with 73,423 male and 69,913 female. The Sagarmatha buffer zone user committee have the highest population i.e. 21,994, follwed by 21,255 by Himalaya, 20,874 by Suklaphanta, 16,075 by Trisakti, 14,379 by Kalikich, 14,342 by Sundevi, 13,308 by Shovatal, 11,909 by betkot and 8,926 by Bagesori. The population status of nine buffer zone user committees has been presented as fallows.

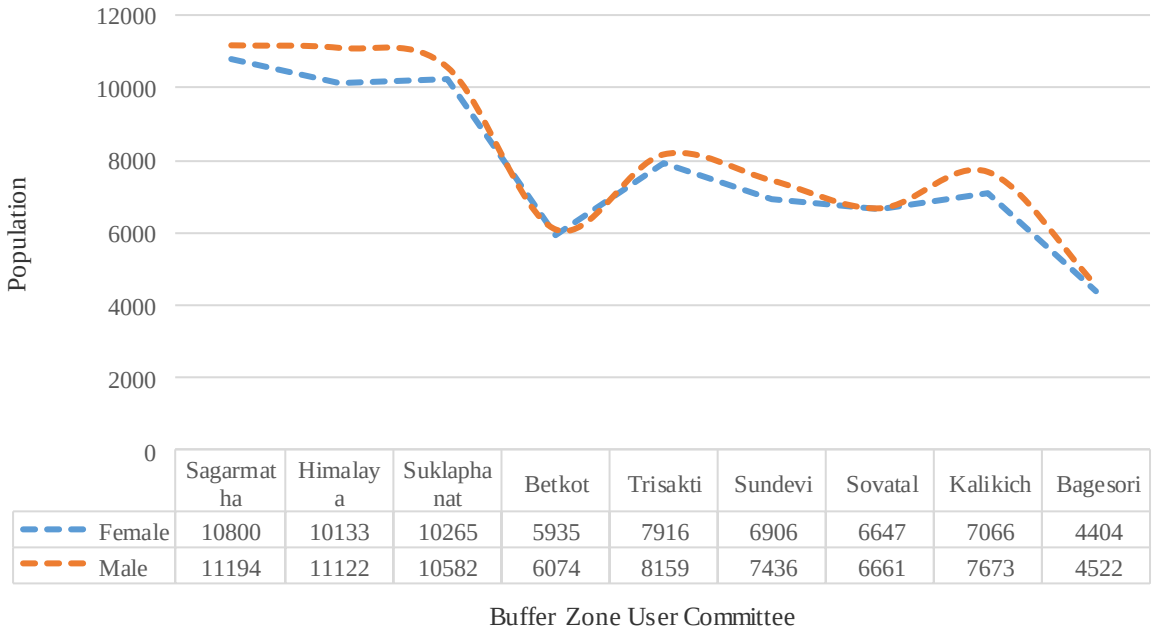


Figure 6:Population status of buffer zone user groups.

(Source; Western Terai Arc Landscape Development Project; 2065)

5.1.3 Status of community forestry in suklaphanta buffer zone management committee

The buffer zone community forests have been directly or indirectly linked with the human wildlife conflicts as the restored and improved buffer zone community forests have been providing habitats to many wildlife. There is a provision that buffer zone government managed forest can be handed over to the local community for the purpose of conservation, management and utilization of forest resources as buffer zone community forest. There are altogether 46 buffer zone community forests; of which 39 buffer zone community forests have been already handed over with approved constitution and working plan and remaining 7 buffer zone community forests are in the process of handing over to the buffer zone community. Out of total, there are altogether 12 buffer zone community forests under the Sagarmatha buffer zone user group, followed by 11 under Himalaya BZUG, 5 under Trisakti BZUG, 4 under Kalikich BZUG, 4 under Shovatal BZUG, 3 under Sundevi BZUG, 3 under Betkot BZUG, 2 under Bagesori BZUG and 2 under Suklaphanta buffer zone user group. The areas of these buffer zone forests have been shown as fallows.

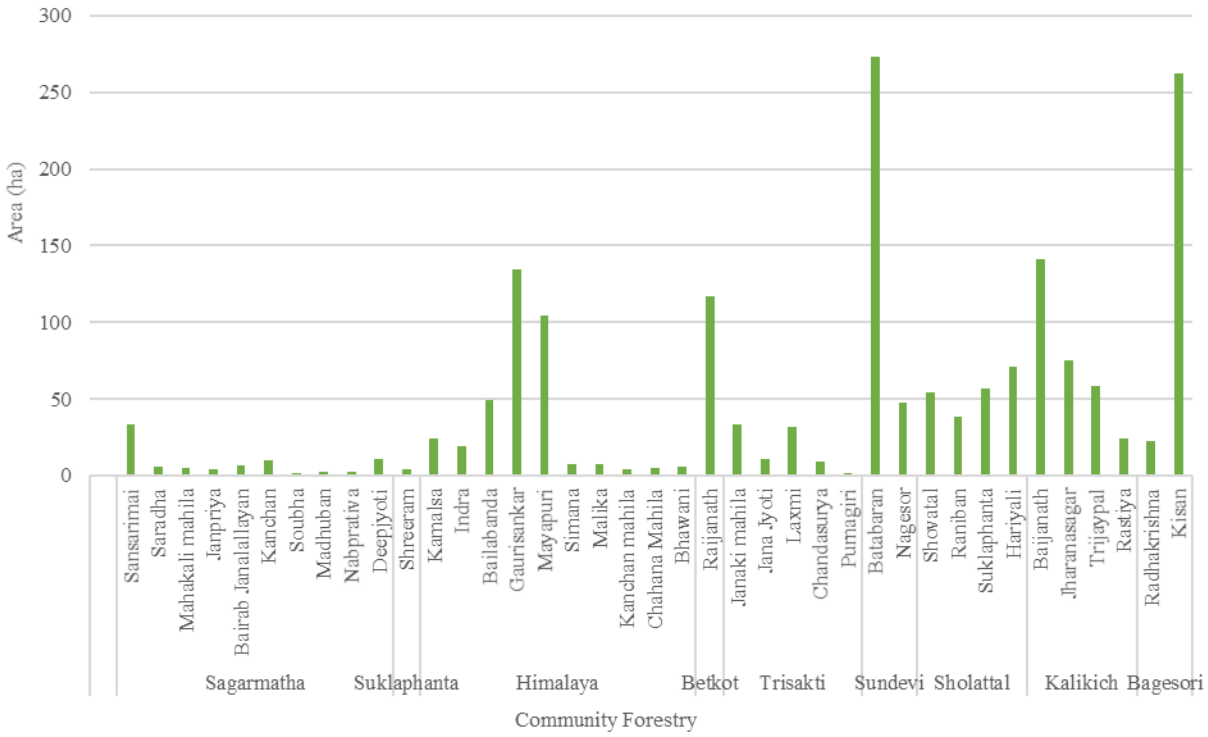


Figure 7:Status of Buffer Zone Community Forests.

(Source; Suklaphanta Buffer Zone Management Committee;2015)

5.1.4 Socio-economic background of the respondents

The socio-economic status of the respondents such as gender, age class, ethnic group and educational level were collected during household survey. Out of the total 225 respondents, about two third of respondents were male (66.7 %) and about one third of respondents were female (33.3 %). The highest percentage of age class group (41.8 %) were between 30-45 years age class group, followed by 30.7 % of 45-60 years, 14.7 % of 15- 30 years and finally, 12.9 % respondents were above the sixty years old class group. Majority of the respondents were Chhetri (49.9 %), followed by 20.4 % Brahmin, 13.3 % Dalit, 7.7 % Tharu and finally, 9.3 % others. Similarly, regarding the education level of the participants; about 80 % respondents were literate and 20 % were illiterate. Finally, 66% respondents were farmers, followed by 14.2 % government employer, 13.8 % foreign employer, 10.7 % business, 4 % wage labor, 2.2 % students and finally, 1.8 % other than these mentioned employer.

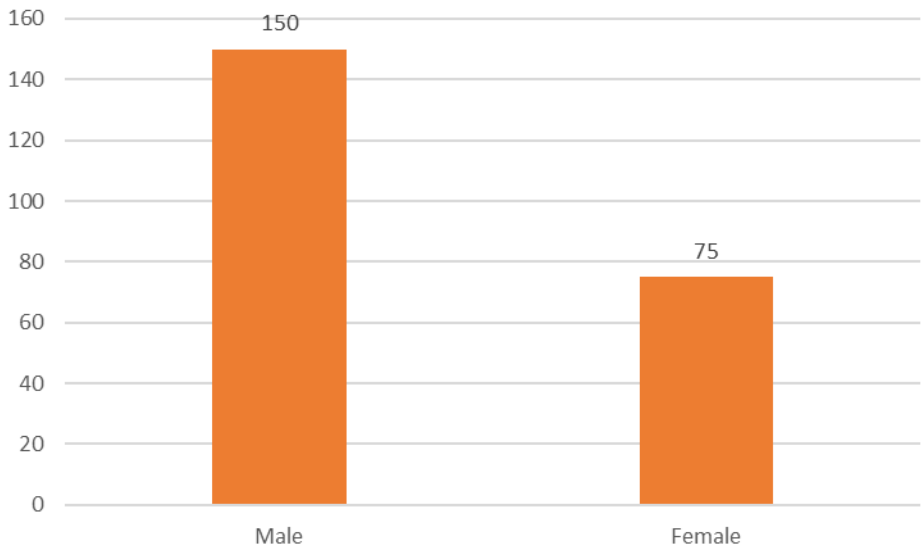


Figure 8:Gender of the respondents

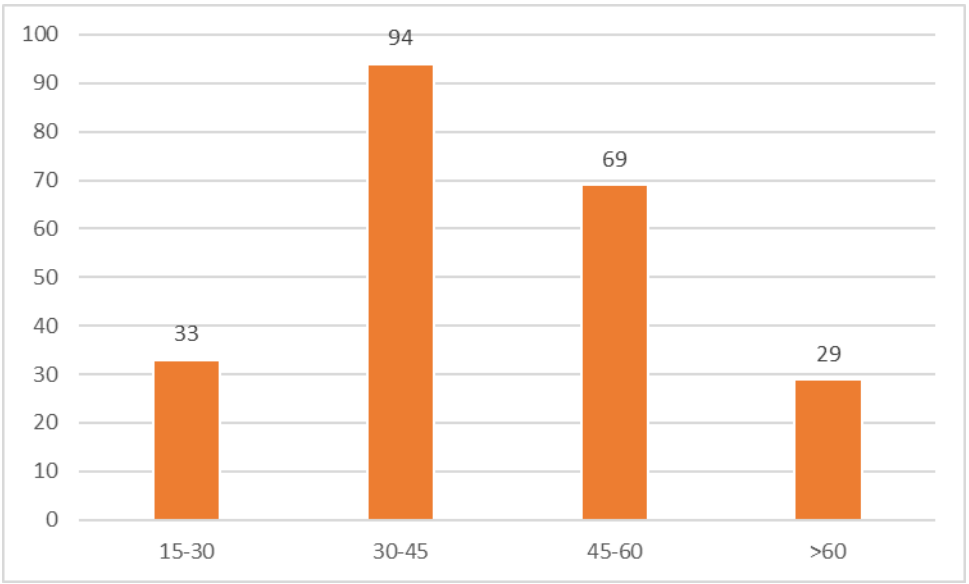


Figure 9:Age class of the respondents.

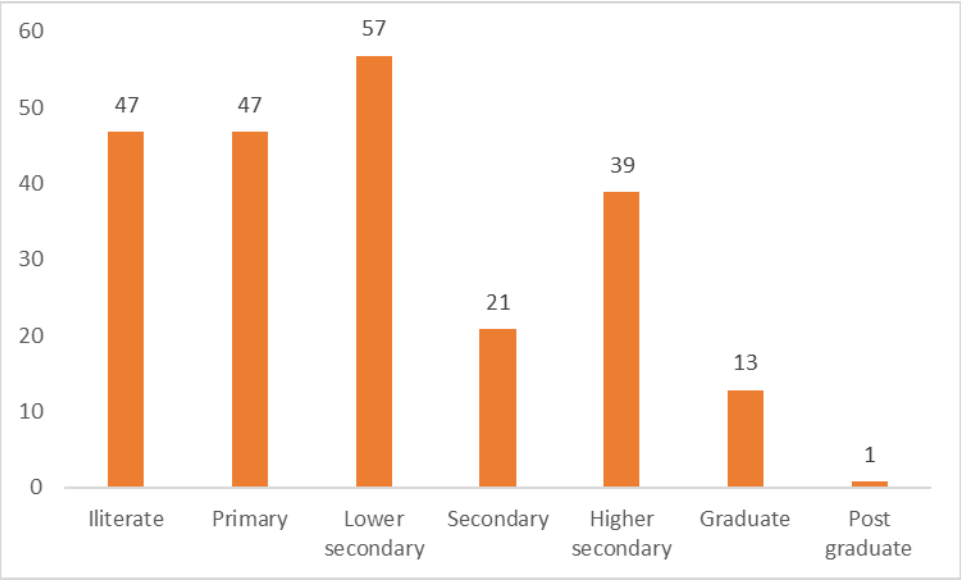


Figure 10:Educational level of the respondents

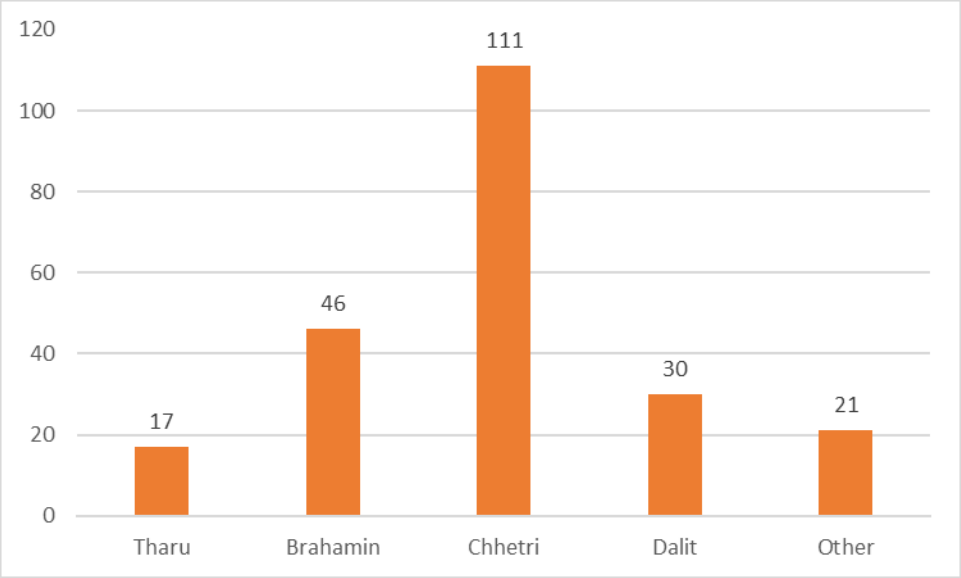


Figure 11:Ethnic background of the respondents.

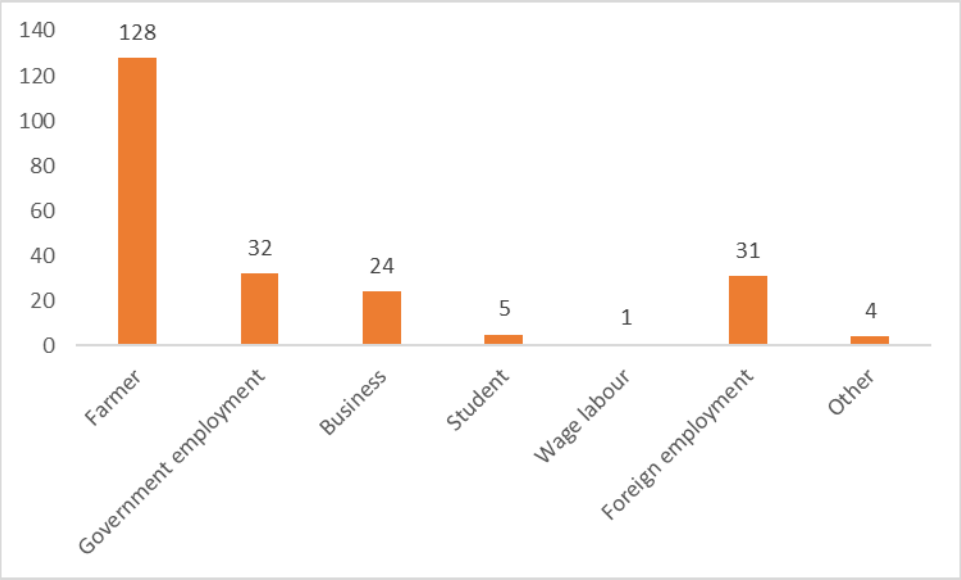


Figure 12: Occupation of the respondents.

5.2 Land-use land cover

5.2.1 Status of land use/land cover at different time periods

Land-use Land cover pattern 1989: Seven land use/ land cover classes were classified in this period. The land-use patterns included forest, cultivation land, grassland, shrub land, sand, water and other land (Table 3). Forest land covered 30137.58 ha which was 48.13 % of the total area. Cultivation land covered 16787.43 ha which was 26.81 % of the total area. Grass land covered 8846.73 ha which was 14.13 % of the total area. Shrub land covered 2101.05 ha which was 3.36 % of the total area. Sandy area covered 3385.26 ha which was 5.41 % of the total area. Waterbodies covered 1230.21 ha which was 1.96 % of the total area. Other land covered 133.29 ha which was 0.21 % of the total area.

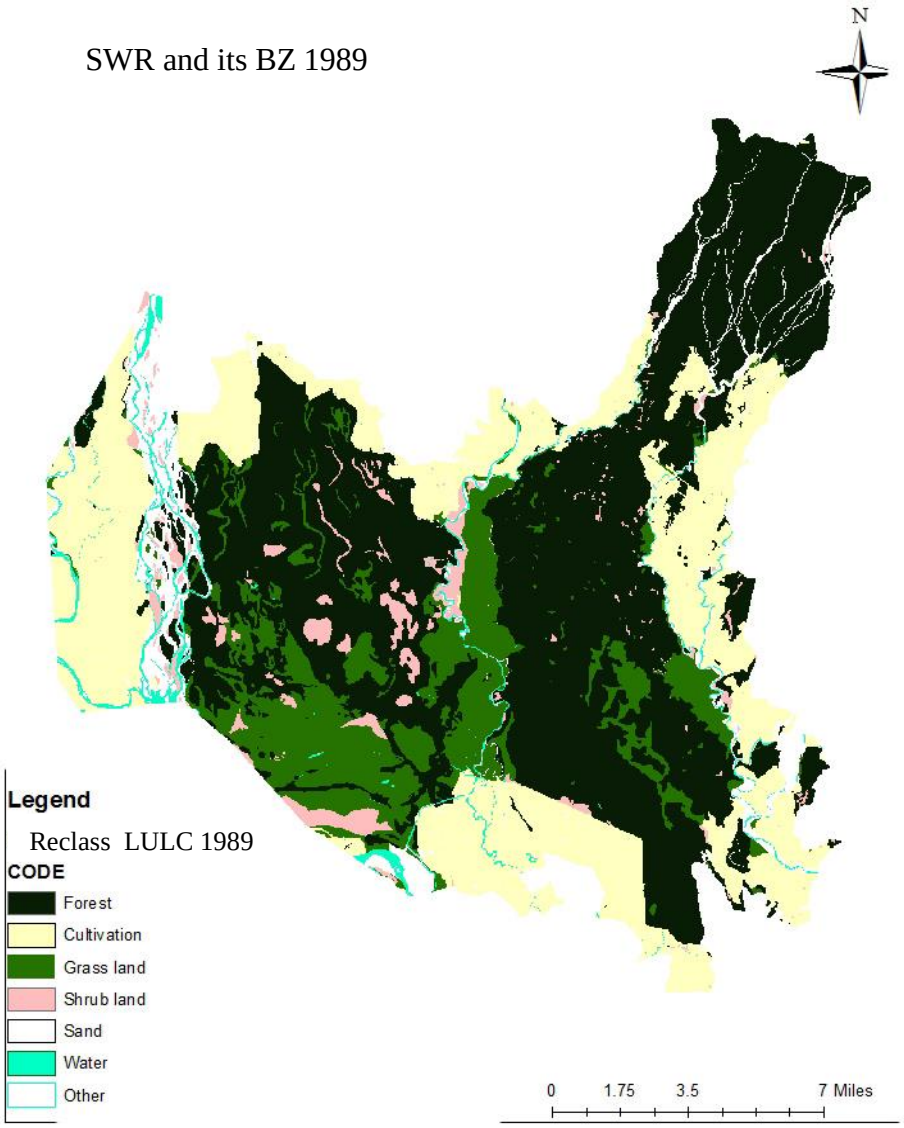
Land-use pattern 2001: Similarly, seven land use/land cover classes were classified in this period. The land-use patterns included forest, cultivation land, grassland, shrub land, sand, water and other land (Table 3). Forest land covered 29713.1 ha which was 47.45 % of the total area. Cultivation land covered 16670.6 ha which was 26.62 % of the total area. Grass land covered 9191.5 ha which was 14.68 % of the total area. Shrub land covered 2081.3 ha which was 3.32 of the total area. Sand covered 3452.5 ha which was 5.51 % of the total area. Waterbodies covered 1234.6 ha which was 1.97 % of the total area. Other land covered 278.2 ha which was 0.44 % of the total area.

Land-use pattern 2015: Seven land use/land cover classes were classified in this period. The land-use patterns included forest, cultivation land, grassland, shrub land, sand, water and other

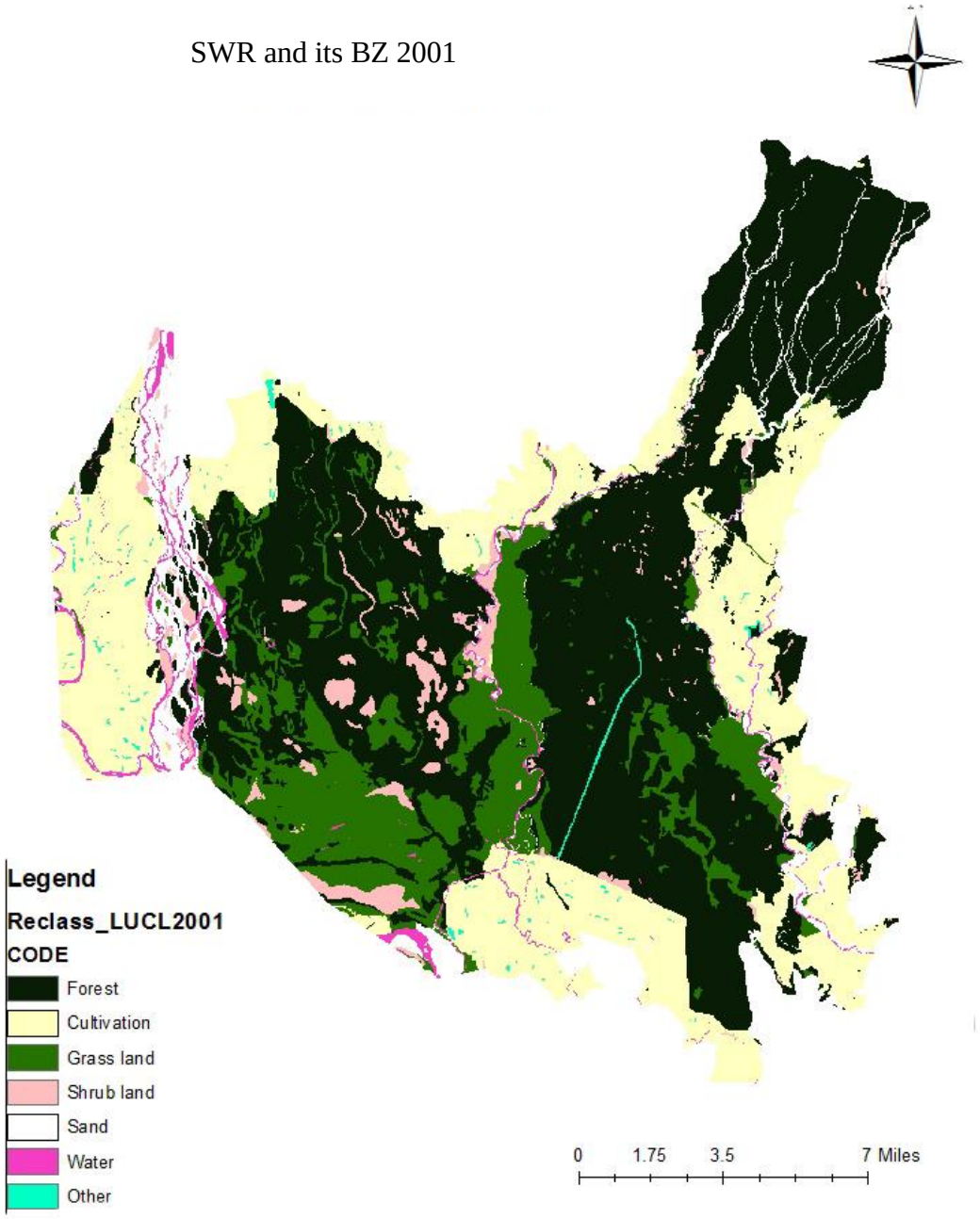
land (Table 3). Forest land covered 29710.17 ha which was 47.44% % of the total area. Cultivation land covered 16783.20 which was 26.80 % of the total area. Grass land covered 8945.91 ha which was 14.28% of the total area. Shrub land covered 1981.35 ha which was 3.16% of the total area. Sand covered 3429.54 ha which was 5.48 % of the total area. Waterbodies covered 1416.15 ha which was 2.26 % of the total area. Other land covered 359.28 ha which was 0.57 % of the total area.

Table 3:Land Use/Land Cover classes and areas in hectares.

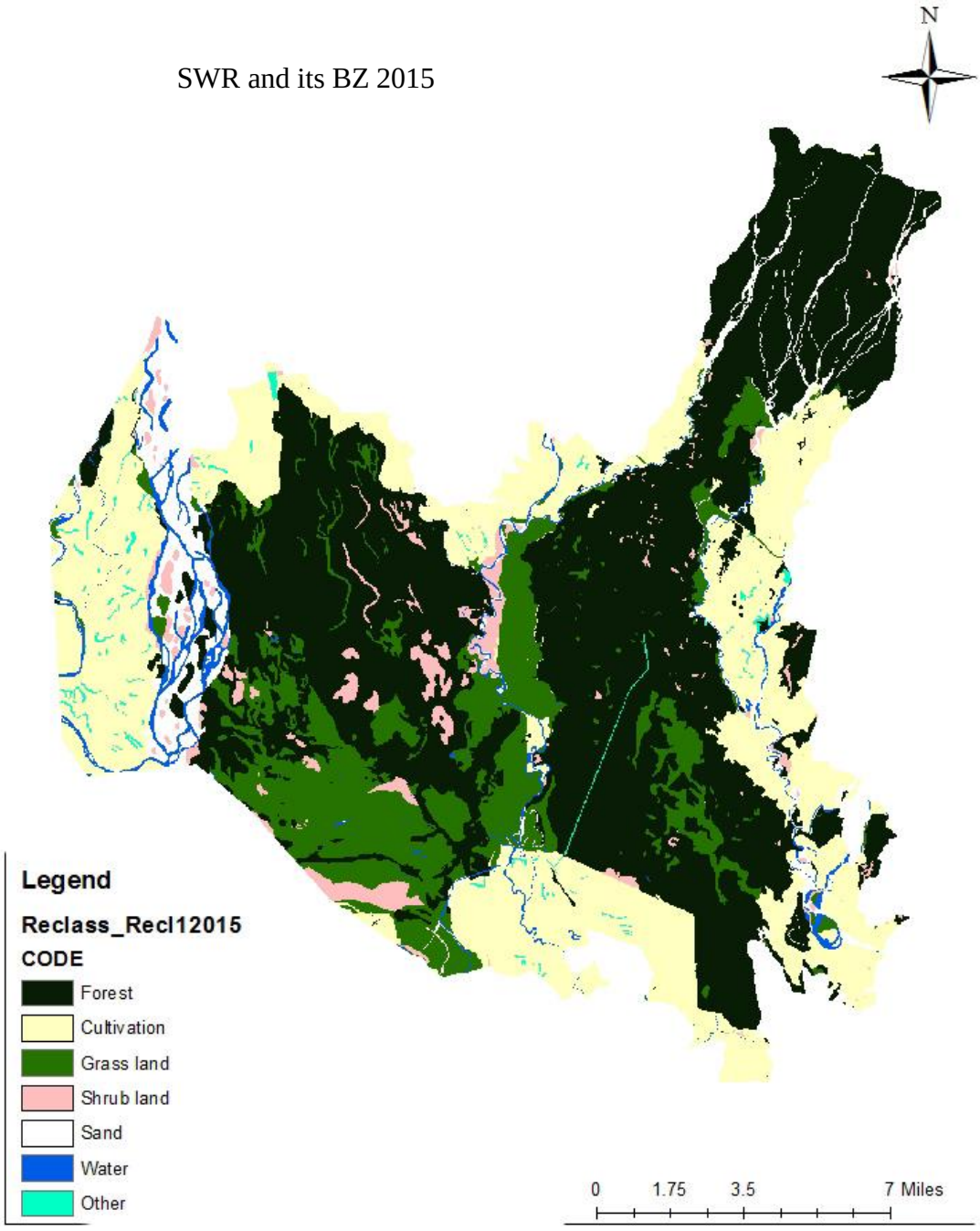
LULC Classes	1989		2001		2015	
	Area	**%**	**Area**	**%**	**Area**	**%**
Forest	30137.58	48.13	29713.1	47.45%	29710.17	47.44%
Cultivation land	16787.43	26.81	16670.6	26.62%	16783.20	26.80%
Grass land	8846.73	14.13	9191.5	14.68%	8945.91	14.28%
Shrub land	2101.05	3.36	2081.3	3.32%	1981.35	3.16%
Sand	3385.26	5.41	3452.5	5.51%	3429.54	5.48%
Water	1230.21	1.96	1234.6	1.97%	1416.15	2.26%
Other	133.29	0.21	278.2	0.44%	359.28	0.57%



Map1: Map showing LULC of SWR and its BZ at 1989



Map 2:Map showing LULC of SWR and its BZ at 2001



Map 3:Map showing LULC of SWR and its BZ at 2015.

5.2.2 Land use/land cover change

An overall land-use change that occurred from 1989 to 2015 was obtained from LANSAT 5 and LANDSAT 8. During this period, there was net gain in area of grassland, sand, waterbodies and other land were found 99.72 ha, 44.73 ha, 185.94 ha and 225.99 ha respectively. And there was net loss in area of forest, cultivated land, shrub land was found -426. 96 ha, -3.87 ha and -119.7 ha respectively. The results are shown in Table 4 and map 4. During this period, about 29038.05 ha forest was found to be remained unchanged whereas 167.04 ha, 322.38 ha, 110.16 ha, 306.00 ha, 153.18 ha and 40.32 ha of forest land was found to be converted into cultivated land, shrub land, sand, water and other land respectively. At the same time, 64.44 ha, 334.44, 179.28, 81.99 ha, 11.16 ha and 0.27 ha of cultivation land, grassland, shrub land, sand, water and other land respectively found to be converted into forest and total forest at 2015 was found to be 29709.63 ha. Similarly, about 15771.78 ha of cultivation land was found to be remained unchanged whereas 1015.29 ha of cultivated land was converted into 64.44 ha, 412.56 ha, 14.22 ha, 162. 45 ha, 106.38 ha, 255. 24 ha of forest, grassland, shrub land, sand, water and other land respectively. About 7772.92 ha of grassland was found to be remained unchanged whereas 1073.25 ha of grassland was found to be converted into other six land cover and 1241.55 ha of other land cover was found to be converted into grassland during the period 1989-2015. About 1640.97 ha of shrub land was found to be remained unchanged whereas 460.08 ha of shrub land was found to be converted into other six land cover and 340.02 ha of other land cover was found to be converted into shrub land during the period 1989-2015. About 2430.72 ha of sandy area was found to be remained unchanged whereas 954.09 ha of sandy area was found to be converted into other six land cover and 994.68 ha of other land cover was found to be converted into sandy area during the period 1989-2015. About 694.80 ha of waterbodies was found to be remained unchanged whereas 535.09 ha of waterbodies was found to be converted into other six land cover and 720.99 ha of other land cover was found to be converted into waterbodies during the period 1989-2015. About 63.64 ha of other land was found to be remained unchanged whereas 69.65 ha of other land was found to be converted into other six land cover and 295.64 ha of other six land cover was found to be converted into other land during the period 1989-2015. Similarly, the LULC changes between the time periods 1989-2001 and 2001-2015 were given in table 5 & map 5 and table 6 & map 5 respectively. The rate of change of LULC between these periods was predicted and shown in table 7.

Table 4:Cross tabulations of land cover classes between 1989 and 2015.

	Forest	Cultivation	Grass	Shrub	Sand	Water	Other	1989
Forest	29038.05	167.04	322.38	110.16	306.00	153.18	40.32	**30137.13**
Cultivation	64.44	15771.78	412.56	14.22	162.45	106.38	255.24	**16787.07**
Grass land	334.44	637.83	7772.94	8.28	39.96	52.74	0.00	**8846.19**
Shrub land	179.28	20.25	50.04	1640.97	146.43	64.08	0.00	**2101.05**
Sand	81.99	58.77	297.45	171.90	2430.72	343.98	0.00	**3384.81**
Water	11.16	58.50	90.27	35.46	339.84	694.80	0.18	**1230.21**
Other	0.27	0.00	68.85	0.00	0.00	0.63	63.54	**133.29**
2015	**29709.63**	**16714.17**	**9014.49**	**1980.99**	**3425.40**	**1415.79**	**359.28**	

Table 5:Cross tabulations of land cover classes between 1989 and 2001.

LULC Classes	Forest	Cultivation	Grass	Shrub	Sand	Water	Other	1989
Forest	29631.87		349.65	11.7	24.3	31.86	88.2	**30137.58**
Cultivation	25.02	16664.31	12.33	7.47	13.95	0.45	63	**16786.53**
Grass land	13.86		8825.58	7.29				**8846.73**
Shrub land	42.21		3.96	2054.88				**2101.05**
Sand					3385.26			**3385.26**
Water					27.9	1202.31		**1230.21**
Other		6.3					126.99	**133.29**
2001	**29712.96**	**16670.61**	**9191.52**	**2081.34**	**3451.41**	**1234.62**	**278.19**	**62620.65**

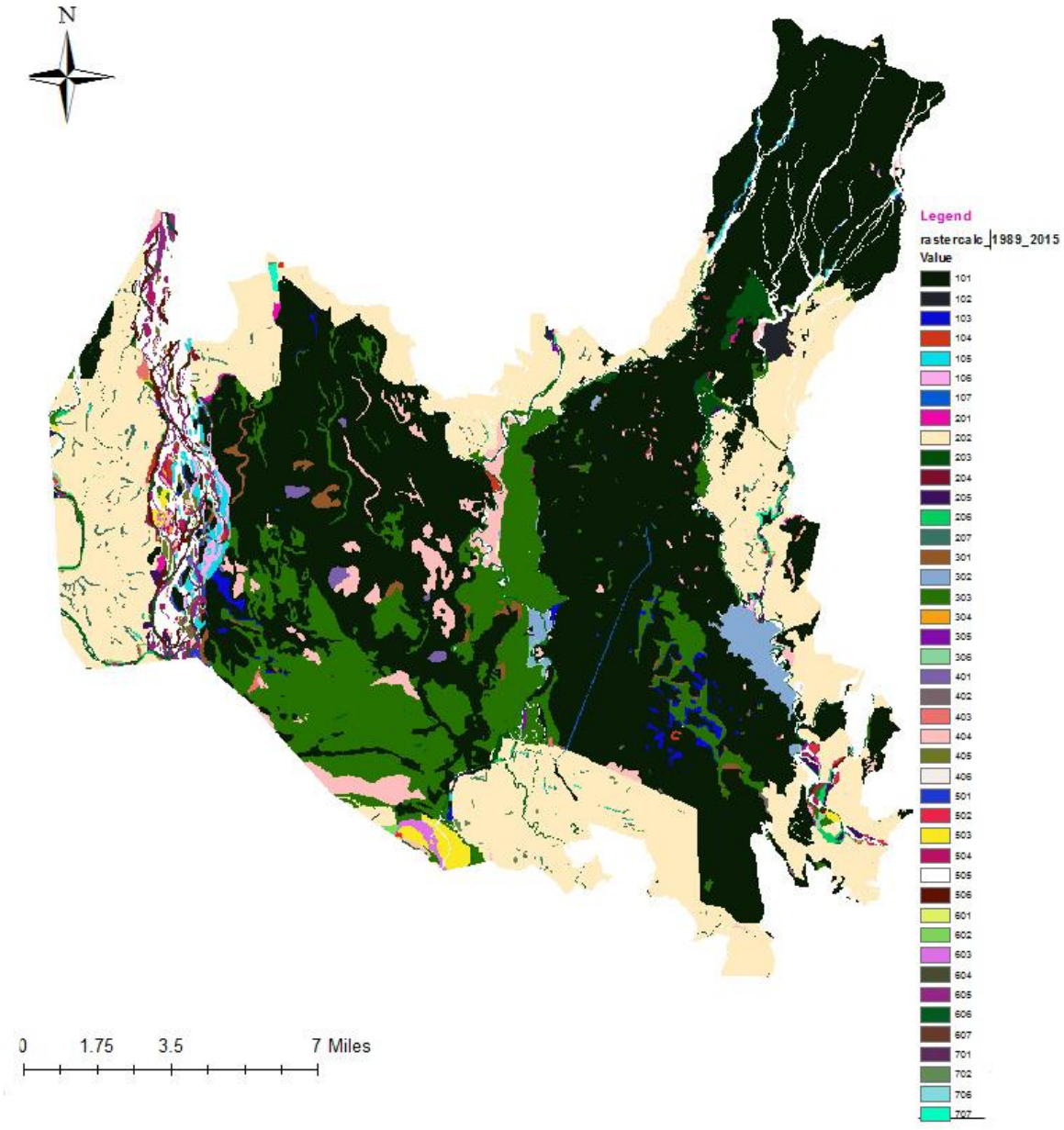
Table 6:Cross tabulations of land cover classes between 2001 and 2015.

LULC Classes	Forest	Cultivation	Grass	Shrub	Sand	Water	Other	2001
Forest	28674	179.82	311.49	151.11	266.67	128.07	1.44	**29712.6**
Cultivation	52.02	15696	400.23	14.22	162.45	106.38	238.95	**16670.25**
Grass land	653.76	638.91	7788.87	8.28	39.96	61.2		**9190.98**
Shrub land	187.02	26.46	57.33	1600.02	146.43	64.08		**2081.34**
Sand	82.62	72.72	297.45	174.42	2463.57	361.26		**3452.04**
Water	10.71	58.95	90.27	32.94	347.22	694.35	0.18	**1234.62**
Other	49.59	109.26				0.63	118.71	**278.19**
2015	**29709.72**	**16782.12**	**8945.64**	**1980.99**	**3426.3**	**1415.97**	**359.28**	**62620.02**

Table 7:The rate of change of LUL cover the different time periods.

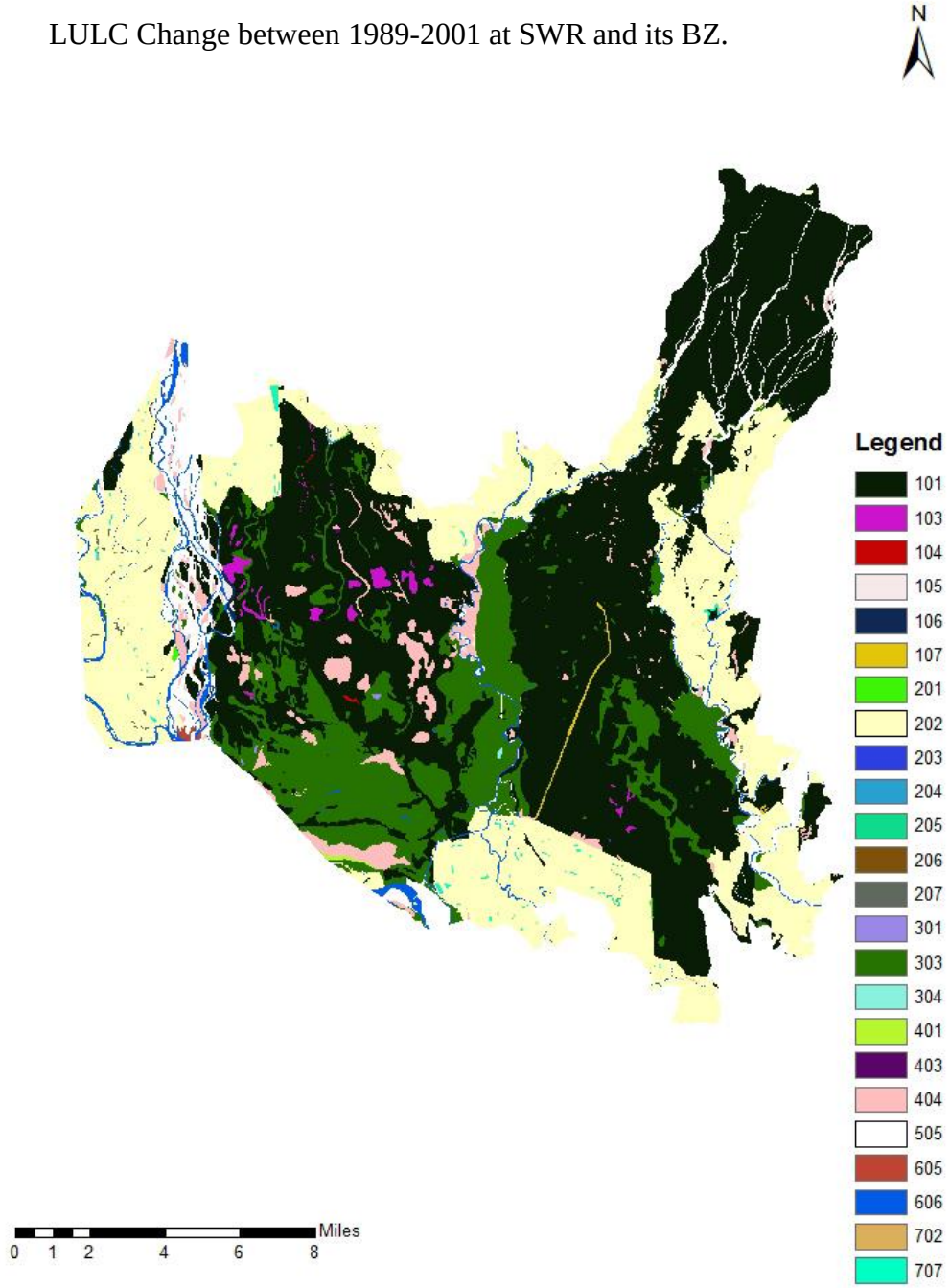
LULC Classes	Rate of change		
	1989-2001	**2001-2015**	**1989-2015**
Forest	-0.1182	-0.001	0.054921
Cultivation	-0.0582	0.048	-0.000969
Grass land	0.3191	-0.193	0.0428882
Shrub land	-0.0785	-0.351	-0.225356
Sand	0.1640	-0.048	0.0499949
Water	0.0298	0.985	0.5428413
Other	6.3234	1.844	3.8874061

LULC Change between 1989-2015 at SWR and its BZ



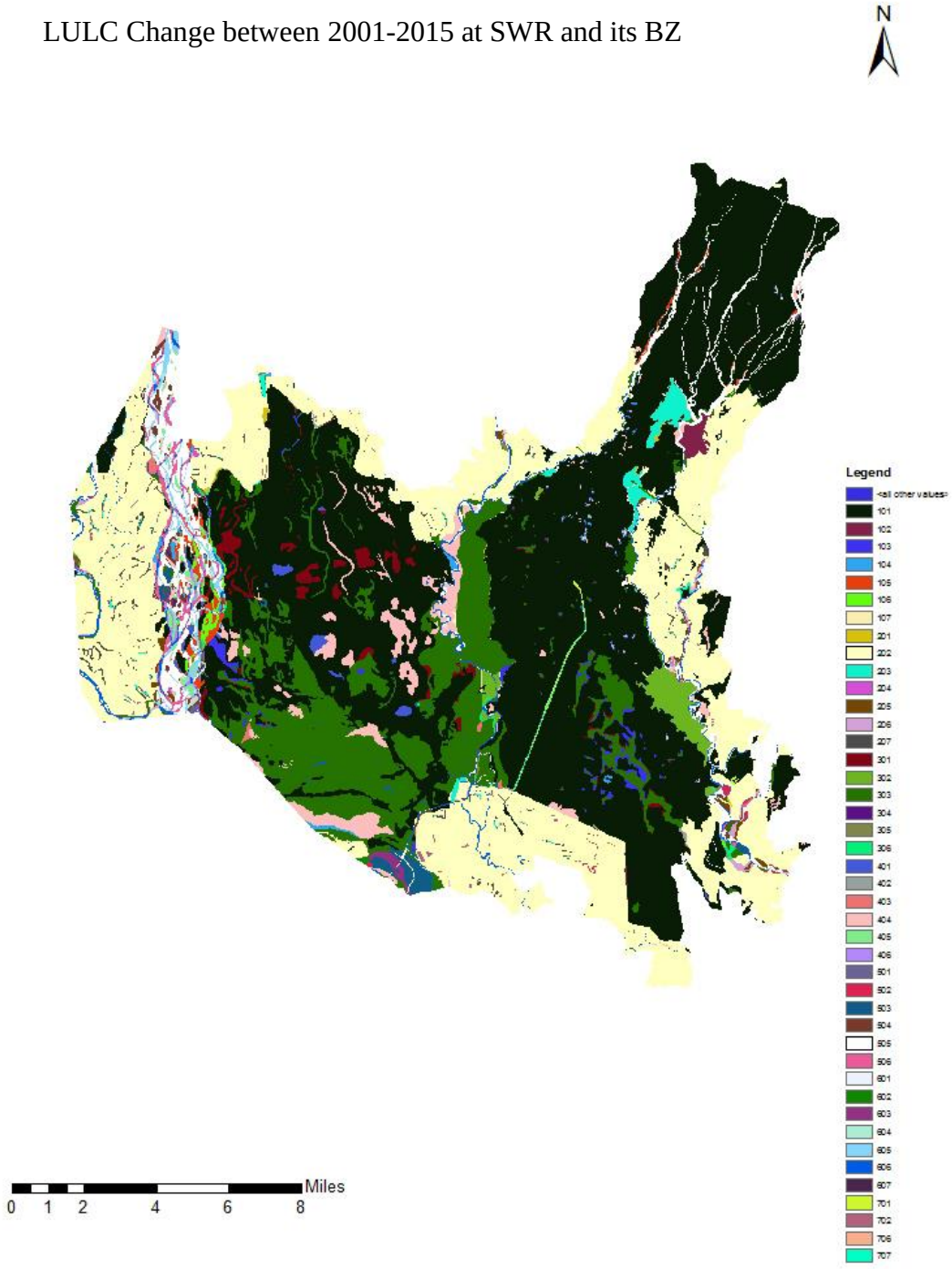
Map 4:Map showing LULC change of SWR and its BZ between 1989-2015.

LULC Change between 1989-2001 at SWR and its BZ.



Map 5: Map showing LULC change of SWR and its BZ between 1989-2001.

LULC Change between 2001-2015 at SWR and its BZ



Map 6: Map showing LULC change of SWR and its BZ between 2001-2015

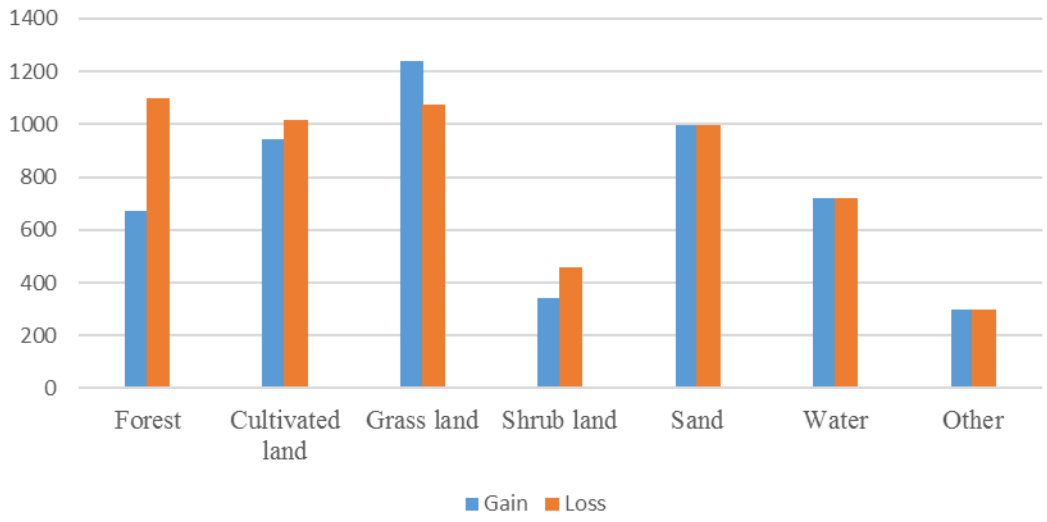


Figure 13:Gain and loss in land use/land cover between 1989-2015.

5.2.3 Accuracy assessment

Confusion matrix presents the overall classification accuracy of three classified maps of 1989, 2001 and 2015.(Table 5, 6 & 7). The table shows the highest accuracy was obtained with an overall accuracy of (80.83 %) on 2015 followe by 80.00 % and 76.67 % on 1989 and 2001 respectively. The change in accuracies of the classified maps is due to real change LULC of study area and comparsion can be made between two diffeent classified maps. The clssified image of 2015 shows a highest kappa value 0.7673 (Table 6). Since, the calculated kappa values of the two classified maps are greater than 0.75. its is the excellent agreement beyond chance i.e. the results meet the accuracy assessment but the map of 1989 is less than 0.75 and it indicates the moderate classificatoin performance.

Table 8:Confusion matrices for 1989 Landsat images using different types land cover/use.

LULC maps	**LULC classes**	**Ground truth data**								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**Total**	**UA (%)**
1989	**1**	**25**	5	3	1	0	0	0	**34**	73.53
	2	2	**19**	2	0	0	0	0	**23**	82.61
	3	1	1	**14**	1	0	0	0	**17**	82.35
	4	0	0	1	**11**	0	0	0	**12**	91.61
	5	0	0	0	0	**10**	0	3	**13**	72.92
	6	0	1	0	1	0	**9**	0	**11**	81.82
	7	0	0	0	0	2	0	**8**	**10**	80.00
	Total	**28**	**26**	**20**	**14**	**12**	**9**	**11**	**OA**= 80.00 %	
	PA (%)	89.29	73.08	70.00	78.57	83.33	100	72.73	**Overall Kappa Statistics** = 0.7595	

Table 9:Confusion matrix for 2001 Landsat images using different types land cover/use.

LULC maps	LULC classes	Ground truth data							Total	UA (%)
	1	**29**	4	1	0	0	0	0	**34**	85.29
	2	2	**17**	5	0	0	0	0	**24**	70.83
	3	2	2	**11**	2	0	0	0	**17**	64.71
2001	**4**	0	0	3	**8**	0	0	0	**11**	72.73
	5	0	0	0	0	**9**	0	4	**13**	69.23
	6	0	0	0	0	0	**9**	2	**11**	81.82
	7	0	0	0	1	0	0	**9**	**10**	90.00
	Total	**33**	**23**	**20**	**11**	**9**	**9**	**15**	**OA**= 76.67 %	
	PA(%)	87.88	73.91	55.00	72.73	100	100	60.0	**Overall Kappa Statistics** = 0.7176	

Table 10:Confusion matrix for 2015 Landsat images using different types land cover/use

LULC maps	LULC classes	Ground truth data							Total	UA (%)
	1	**28**	4	2	0	0	0	0	**34**	82.35
	2	1	**21**	2	0	0	0	0	**24**	87.50
	3	3	0	**13**	1	0	0	0	**17**	76.47
2015	**4**	0	1	1	**9**	0	0	0	**11**	81.82
	5	0	0	0	0	**13**	0	0	**13**	100.00
	6	0	1	1	0	0	**6**	3	**11**	54.55
	7	0	0	0	1	2	0	**7**	**10**	70.00
	Total	**32**	**27**	**19**	**11**	**15**	**6**	**10**	**OA**= 80.83 %	
	PA(%)	87.50	77.78	68.42	81.82	86.67	100.00	70.00	**Overall Kappa Statistics** = 0.7673	

5.3 Nature of problem

Out of total sampled households (n=225), 89.33 % households reported that they had a wildlife problem (n=201) and 10.67 % households (n=24) only reported that they didn't have wildlife problem (SD=0.309 & SE= 0.021). Out of 201 respondents, more than 57 % respondents reported that they had been facing crop damage problem by wildlife (n=116), followed by 21.4 % crop and livestock damage (n=43), 10.9 % crop, shelter and store grain

destruction (n=22), crop, livestock, store grain and house destruction (n=11), 4 % human casualties (n=8), and finally, house and store grain destruction (n=1).

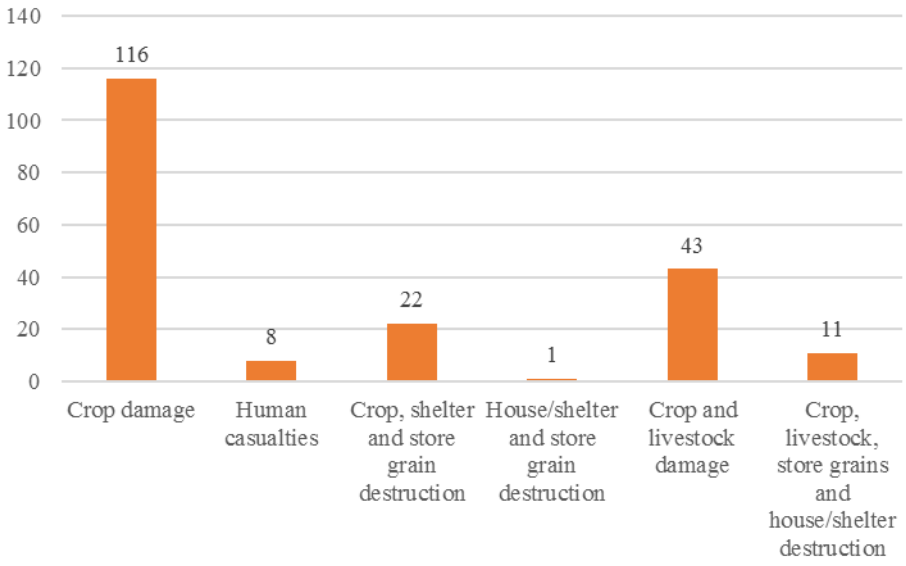


Figure 14:Nature of problem.

5.3.1 Crop damage

Most of the Suklaphanta buffer zone community is growing paddy, wheat, maize, lentils and cash crops for their livelihood and the crop damage is found to be the most common and severe problem of the Suklaphanta wildlife reserve buffer zone community i.e. more than 85 % respondents found to bear crop damage losses caused by wildlife. It is found that they had lost their grown crop due to damages caused by wildlife ranging approximately 5 % to 90 % of total estimated harvested quantity from their agricultural field. The average percentage of crop loss per household per annum was found to be 29 % (SD=17.08 & SE=1.20); the detail descriptive statistics of crop loss percentage of every household is given in Annex-2. Similarly, the average cost of crop loss caused by wildlife was found to be NRS. 9483.33 per household per annum which vary from NRS. 1000 to 60,800. The total crop loss per annum was found to be NRS. 19,06,150.00 (SD=10768.42 & SE=759.54); the detail descriptive statistics of cost of crop loss of every household is given in Annex-2.

I had a question, “Which wildlife is major responsible to damage crops?” to them who have been facing wildlife problem. The result showed that 30 % of the respondents (n=57) stated that wild pig was the major responsible wild animal to cause the crop damage at Suklaphanta buffer zone, followed by 19.8 % spotted deer (n=38), 17.7 % blue bull, 13.5 % elephant, 4.7 % rhino, 1.6 % porcupine and finally 1.6 % by peacock. Thus, mainly wild pig, spotted deer,

swamp deer, blue bull, monkey, rhino, porcupine and peacock were found responsible to cause crop damage.

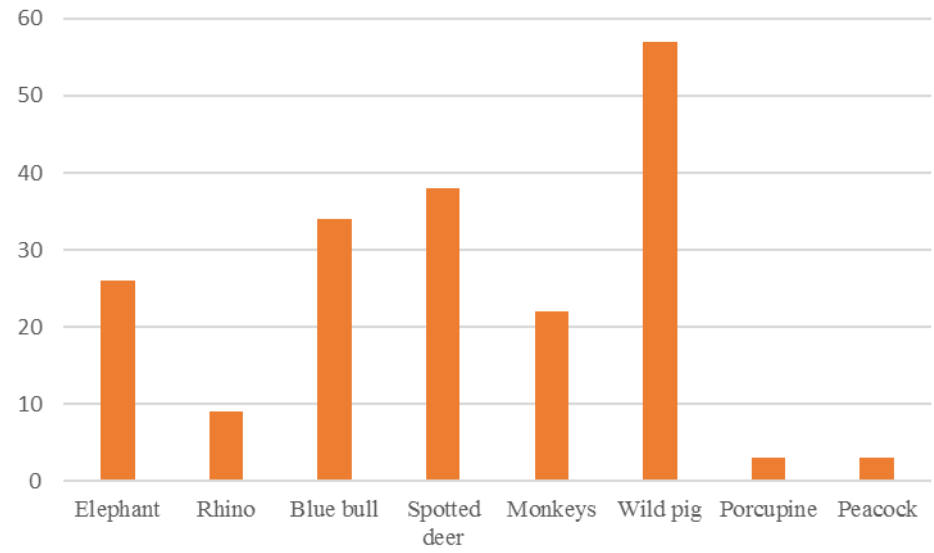


Figure 15:Which wildlife is responsible for crop damage?

"At what time does mostly wildlife come to damage?". The result showed that about 75 % (n=152) respondents stated that wildlife used to come at night in order to cause damage to them and their property, followed by 10.4 % at early morning (n=21), 6.5 % at daytime (n=13), 6.5 % at any time (n=13) and finally 1 % at evening (n=2).

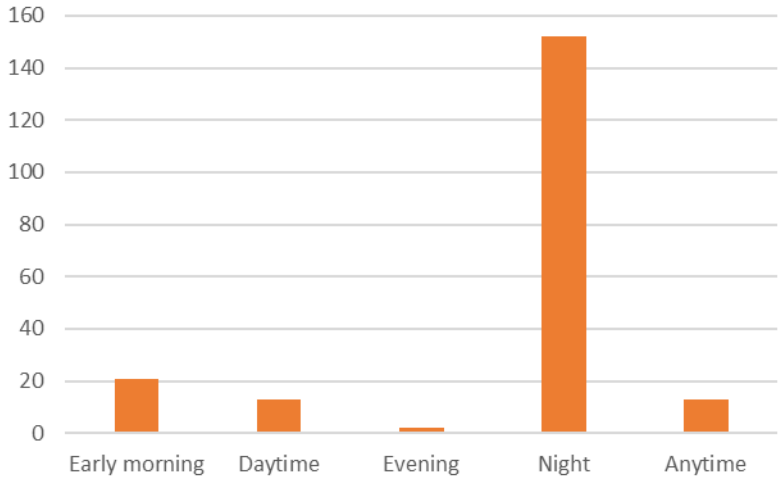


Figure 16:At what time does mostly wildlife come to damage?

5.3.1.1 Trend of crop damage

I asked the question, "What do you think about trend of crop damage due to wildlife?" to them who have been facing crop damage problem. The result showed that 76 % of the respondents felt that the trend of crop damage due to wildlife is increasing from year to year, followed by 13.3 % no change; it means that they have crop damage problems but it is almost same these days as it was before and finally, 9.3 % decreasing trend.

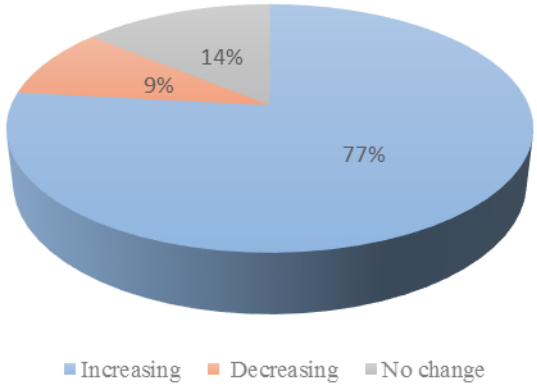


Figure 17:Trend of crop damage.

I had asked the question, "What could be the possible cause of increase in crops damage?" to them who had felt that crop damage is increasing from year to year. The result showed that 40 % respondents felt that lack of fencing might be the possible cause of increase in crop damage, followed 25.5 % by community forestry, 24.8 % by increase in wildlife population and finally, 9.7 % by reduction in guarding by humans.

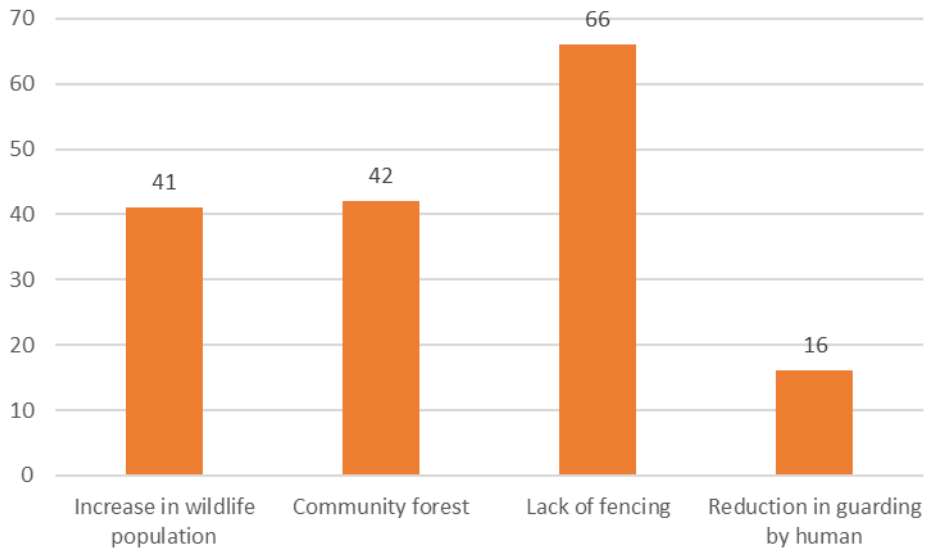


Figure 18:Cause of crop damage.

5.3.2 Livestock depredation

Out of 225 households, only 2.22 % households didn't keep livestock and other every household had kept one to nineteen livestock in order to sustain their farming system. The total number of livestock in sampled households (n=225) were 1189 and an average livestock per household was found to be 5.28 (SD=3.501 & SE=0.233) (Fig.20 and Annex-1). Out of 225 households, 12 households reported a total loss of 14 cows as a result of wild predator in last four years (Mean=0.06, SD=0.277 & SE=0.018). Similarly, 3 households reported a total loss of 4 buffaloes (Mean=0.02, SD=0.163 & SE=0.011), 40 households reported a total loss of 138 goats and sheep (Mean=0.61, SD=0.938 & SE=0.016), 6 households reported a total loss of 8 oxen (Mean=0.04, SD=0.247 and SE=0.011), and 7 households reported a total loss of 12 dogs (Mean=0.05, SD=0.309 and SE=0.021) in the same period. The result showed that an average livestock depredation due to wild predator was found to be 0.195 per year which was about 14.80 % of total existing livestock.

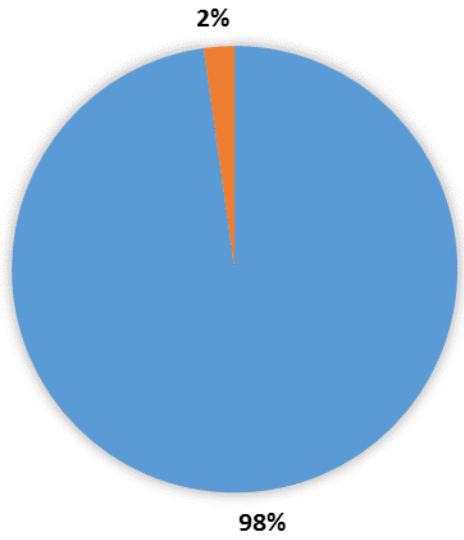


Figure 19:Do you keep livestock?

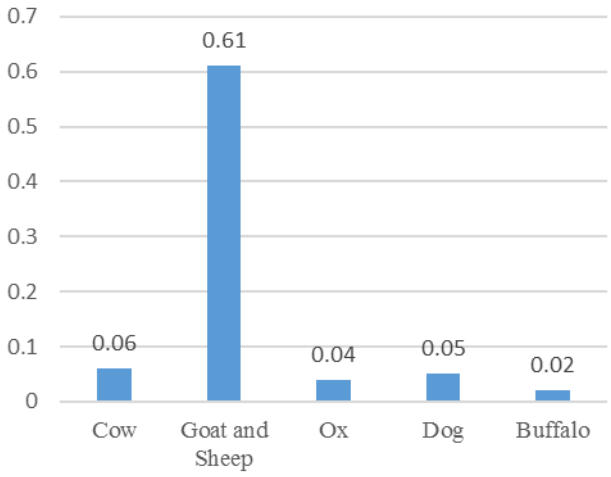


Figure 20:Mean livestock depredation.

I asked the question, “Which wildlife is mainly responsible for livestock depredation?”. The result showed that 63 % respondents stated that leopard was mainly responsible to cause the livestock depredation followed by 37 % livestock depredation by tiger.

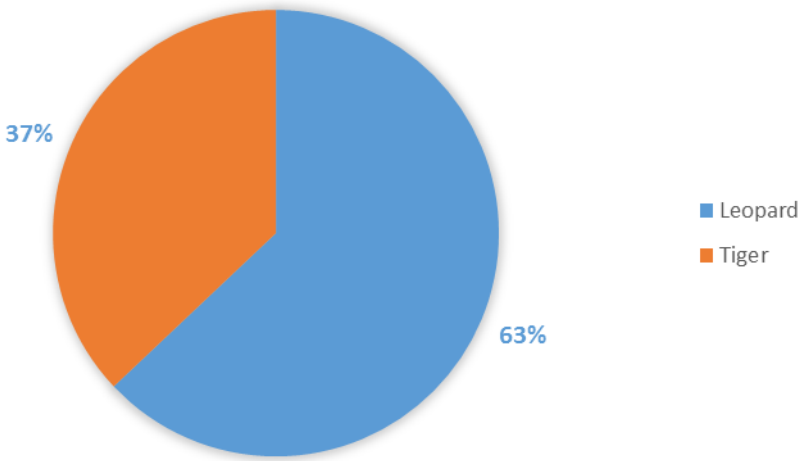


Figure 21:Which wildlife is responsible for livestock depredation?

5.3.2.1 Livestock management system

About two third of the households (65.5 %, n=147) feed livestock from their agriculture field, followed by 15.1 % (n=34) households graze their livestock in the wildlife reserve, 10.2 % (n=23) households collect their livestock feed from buffer zone community forest, 3.1 % (n=7) households brought their feed from market, and 2 % (n=9) households graze in communal land.

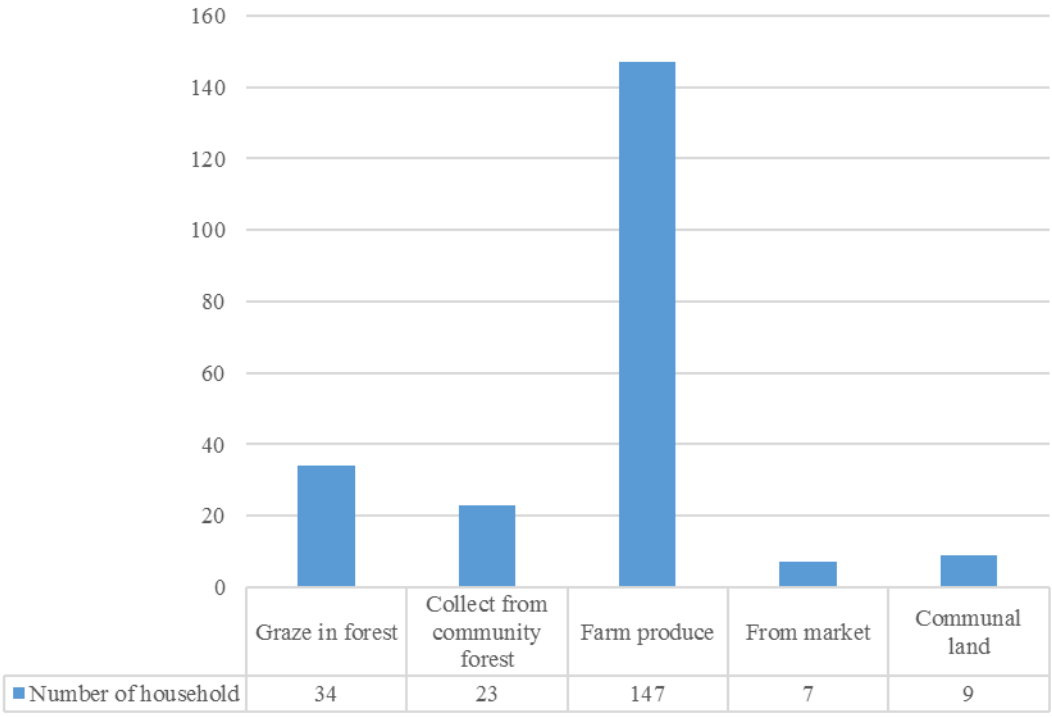


Figure 22:Main source of feed for respondent's livestock.

5.3.2.2 Trend of livestock depredation

I had asked the question, "What do you think about the trend of livestock depredation due to wildlife?" (n=201) particularly to them who have been facing wildlife problem. The result showed that about 62 % respondents felt that there is decreasing trend in livestock depredation due to wildlife, followed by increasing by 19.9 % and no change by 17.4 % respondents.

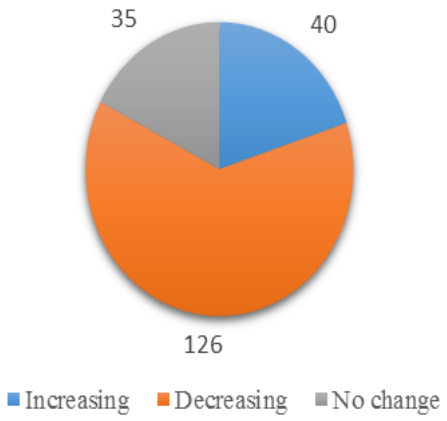


Figure 23:Trend of livestock depredation.

I had asked the question, "What could be the possible cause of increase in livestock depredation due to wildlife?" to them who had felt that livestock depredation is in increasing trend. The result showed that about 35 % respondents felt that degradation and deforestation of existing forest might be the possible cause of increase in livestock depredation, followed by 27.5 % becoming more greenery and dense of community forest, 14.8 % increase in wildlife population and finally, 5 % lack of fencing.

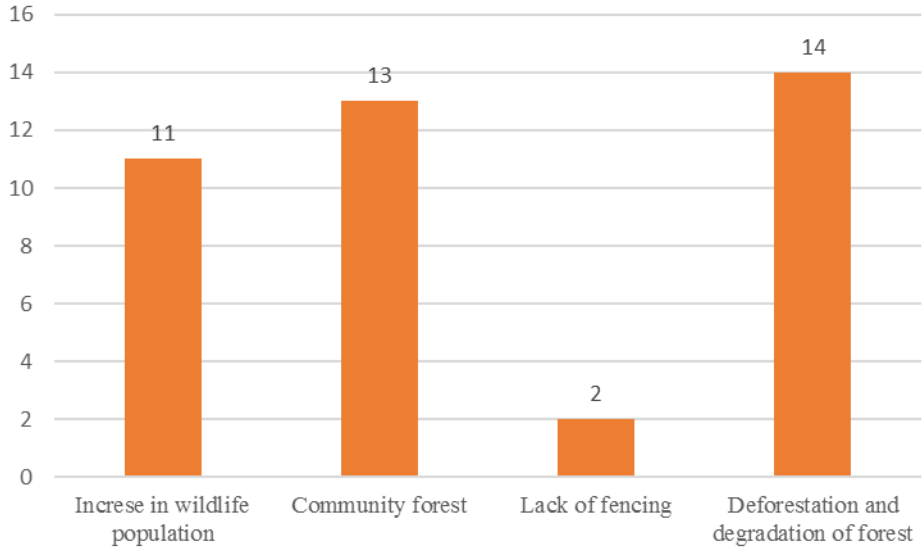


Figure 24:Cause of increase in livestock depredation.

5.3.3 Nature of human casualties

Out of the total households, 8 households were found to have casualties due to wildlife. Out of the total human casualties' households (n=8), 50 % households (n=4) was found to have serious human injury, followed by 37.5 % normal human injury (n=3) and 12.5 % human death (n=1).

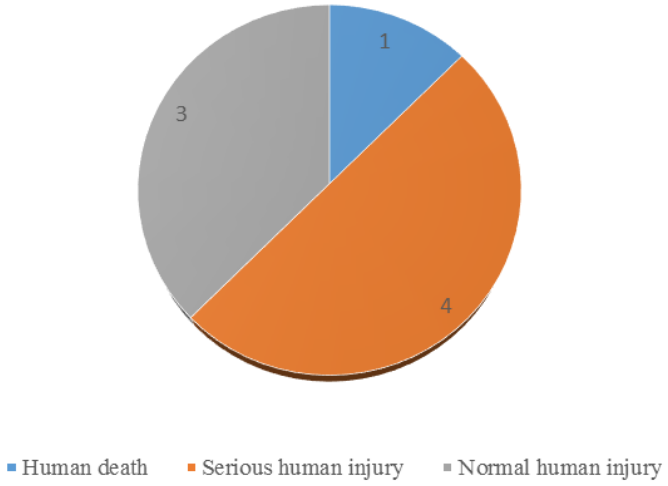


Figure 25:Nature of human casualties.

I asked the question, "Which wildlife is responsible for human casualties?" to them who have got casualties (n=8) caused by wildlife. The result showed that fifty percent human casualties was caused by elephant (n=4), followed by 37.5 % by wild pig (n=3) and 12.5 % by tiger (n=1).

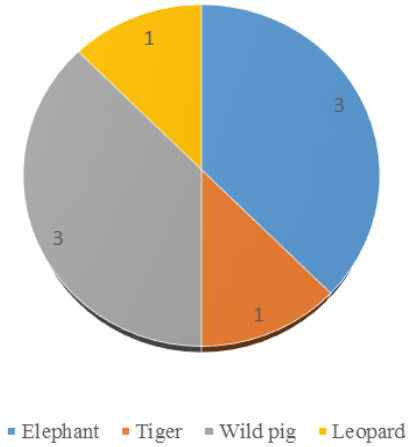


Figure 26:Which wildlife is responsible for human casualties?

5.3.3.1 Trend of human casualties

I had asked the question, "What do you think about the trend of human casualties due to wildlife?" (n=201) particularly to them who have been facing wildlife problem. The result showed that about 60 % respondents felt that there is decrease in human casualties trend due to wildlife, followed by no change by 24.9 % and increasing by 13.4 % respondents.

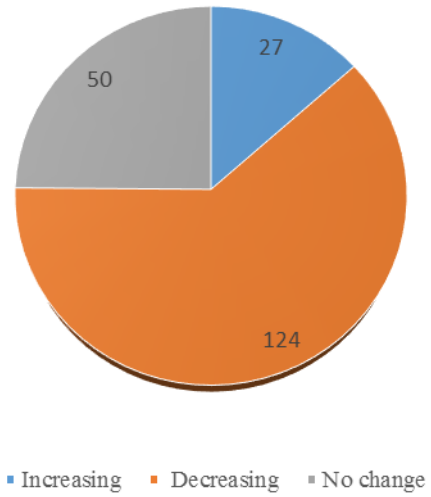


Figure 27:Trend of human casualties.

I had asked the question, "What could be the possible cause of increase in human casualties due to wildlife?" to them who had felt that the trend of human casualties is increasing. The result showed that 55 % respondents felt that improve in condition of community forest might be the possible cause of increase in human casualties, followed 18.5 % by increase in wild population, 14.8 % by deforestation and degradation of existing forest and finally, 11.1 % by lack of fencing.

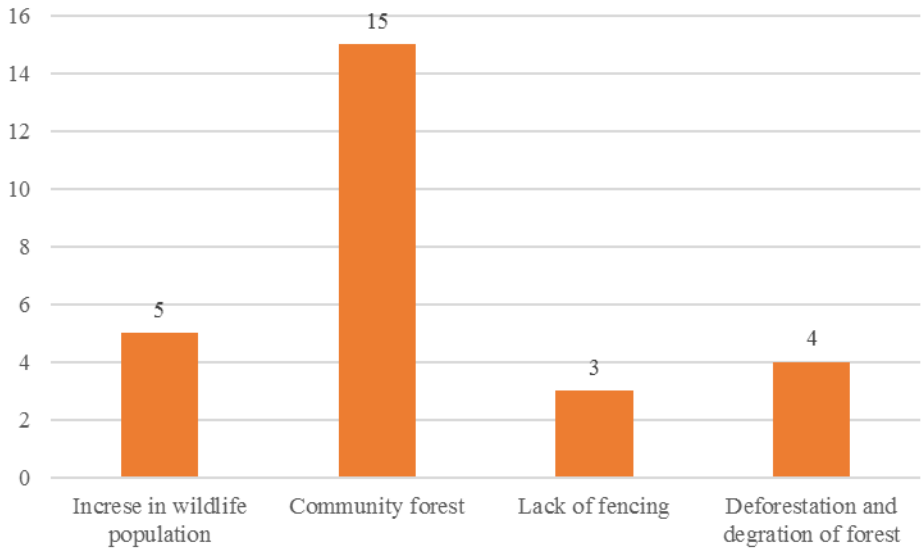


Figure 28:Cause of increase in human casualties.

5.3.4 Shelter/store grain destruction

The shelter/store grain destruction caused by wild elephant is also found to be one of the most common problem of the Suklaphanta wildlife reserve and its buffer zone. Out of the total 201 respondents who have been facing wildlife problem; about 12 % respondents (n=29) found to be affected by the shelter/house and store grain destruction caused by wild elephant. The average quantity of 0.52 quintal store grain were lost (SD=1.39 & SE=0.099) and estimated cost of stored grain destruction was found approximately NRS. 715.5 (SD=1954.29 & SE=138.88) in last five years. Similarly, about 12 % respondents (n=12) were found to be affected by shelter/house destruction caused by wild elephant. The respondents had lost one or two shelter/house with bearing cost of approximately NRS. 4000 to maximum 15,000 (SD=2509.9 & SE=176.99).

5.3.4.1 Trend of shelter/house and store grain destruction

I had asked the question, "What do you think about the trend of house/shelter and store grain destruction due to wildlife?" (n=201) particularly to them who are facing wildlife problem. The result showed that about 57.7 % respondents felt that there is decreasing trend of house/shelter and store grain destruction due to wildlife, followed by increasing trend by 29.4 % and no change by 12.9 %.

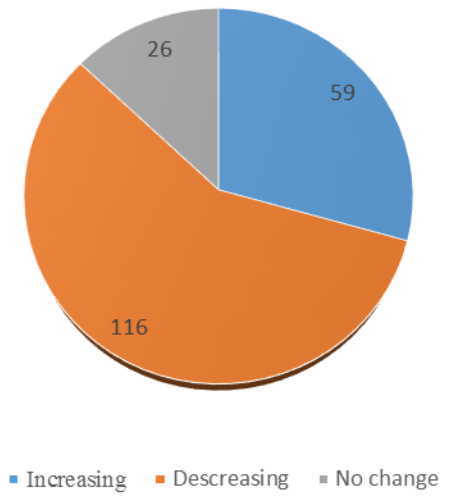


Figure 29:Trend of house and store grain destruction.

I had asked the question, "What could be the possible cause of increase in trend of house/shelter and store grain destruction due to wildlife?" to them who had felt that the trend of house/shelter and store grain destruction is increasing. The result showed that about 40 %

respondents felt that land use land cover changes on routes of elephant might be the possible cause of increase in house/shelter and store grain destruction, followed by smell of local materials used in alcohol making by 27.5 %, more greenery and dense community forest by 27.1 % % and finally, increase in frequency of wild population visits in the human settlement area by 3.4 %.

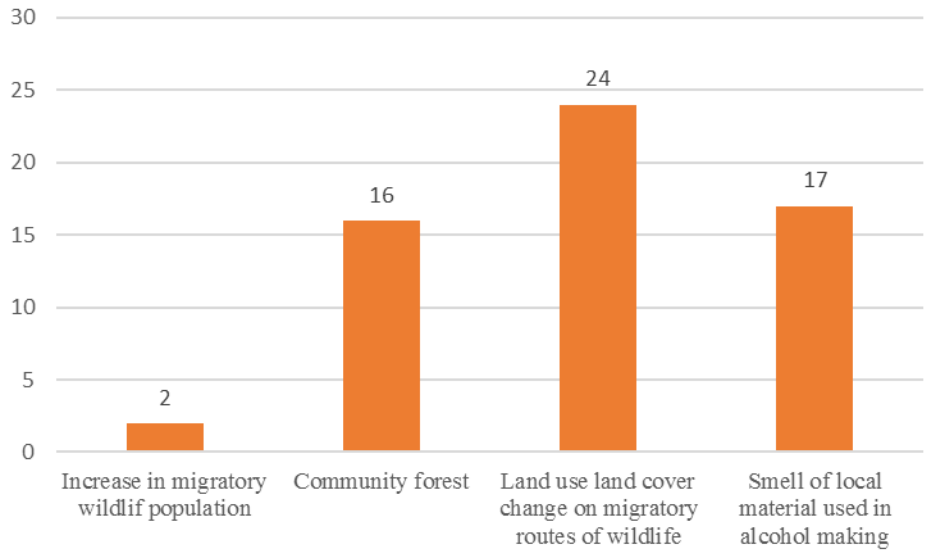


Figure 30:Cause of increase in house and store grain destruction.

5.3.5 Time, season and place of the damages taken place

Which year did the problem start?

I had the question, “Which year did the problem stat?” to them who have been facing wildlife problem. The result showed that 43 % respondents reported that the problem had started since more than 5 to 10 years before, followed by 10-20 years before by 23.4 %, 1-5 years before by 21.4 % and 20 years ago by 11.9 %.

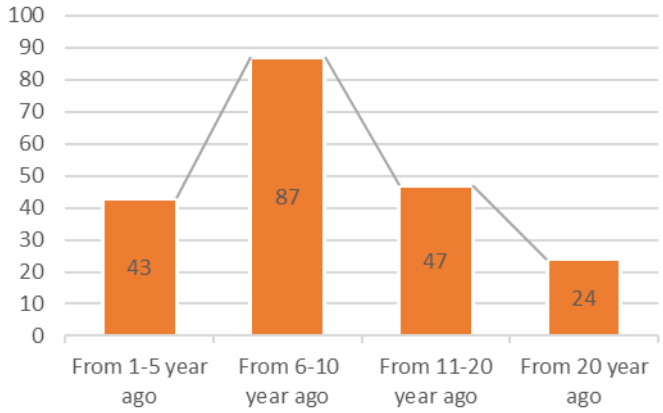


Figure 31:Which year did the problem start?

Number of incidence per year

I had asked the question, "How much is the frequency of incidence per year?" to them who have been facing wildlife problem. The result showed that 42 % respondents reported that incidence used to take place twice per year, followed by thrice, more than three times and once by 33.3 %, 19.4 % and 4.5 % respondents respectively.

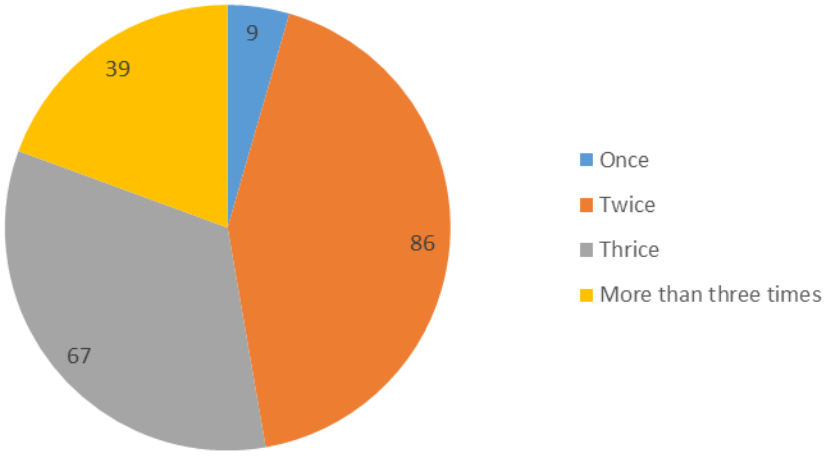


Figure 32:Number of incidences per year.

Period of year

I had asked the question, "When was the problem used to become severe?" to them who have been facing wildlife problem. The result showed that 30 % respondents reported that the problem used to take place at the month of April, followed by October, November, March,

September, May, February, December, January, August, June and July by 29.9 %, 10.9 %, 6 %, 5 %, 5%, 3.5 %, 3.5 %, 2.5 %, 1.5 %, 1 % and 1 % respondents respectively.

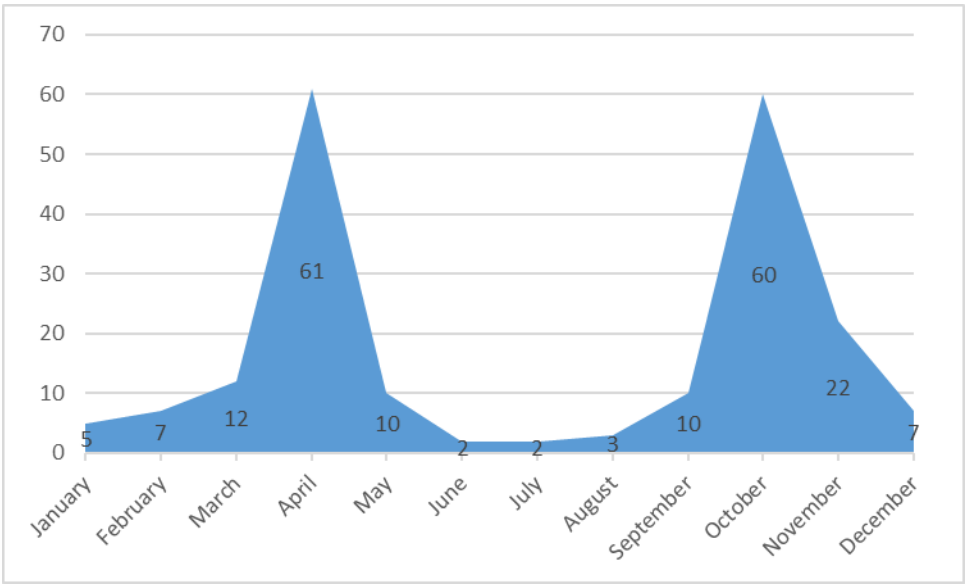


Figure 33:Period of year.

I had asked the question, "Where was the problem generally taken place?" to them who have been facing wildlife problem. The result showed that about 48 % respondent had reported that the problem was taken place at their farm land, followed by human settlement area by 24.4 %, buffer zone community forest by 10.9 %, wildlife reserve by 10 % and finally, other area of the buffer zone by 6 %.

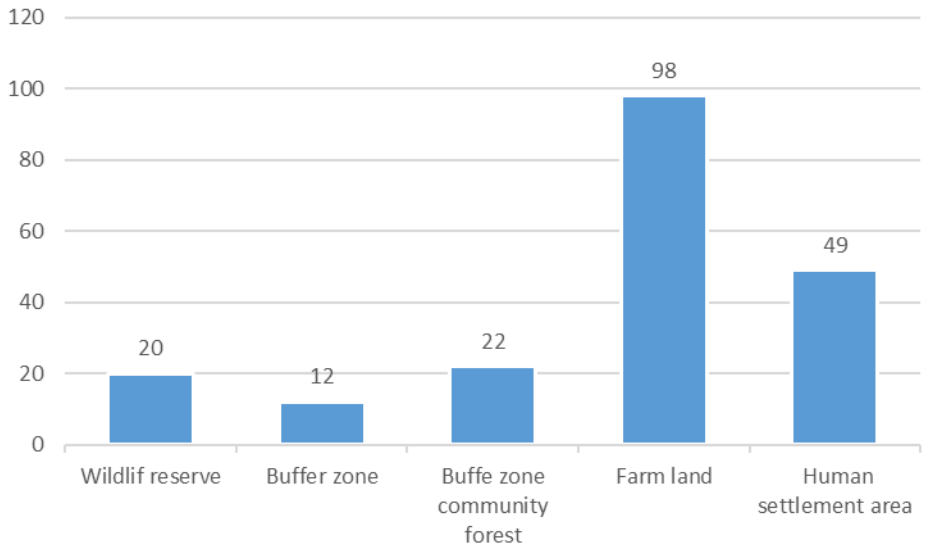


Figure 34:Where was the problem taken place?

5.3.6 Hidden impacts of human wildlife conflicts

I had asked a question. "What are the consequences of crop-livestock and property damage?" to the respondents. The result showed that 64 % respondents stated that they have experienced that the crop-livestock and property damage results reduction in overall food supply to family, followed by 20 % poor family wealth, 10 % shifts to alternative means of income and 6 % others.

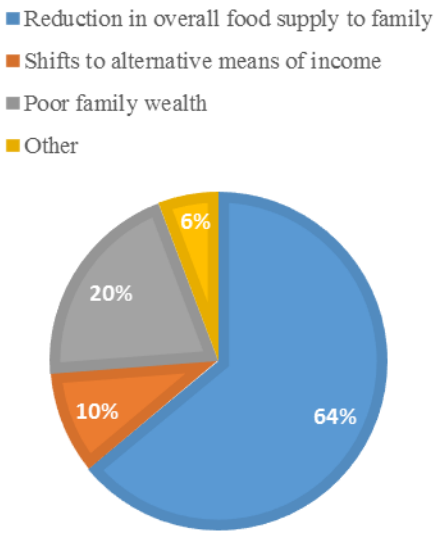


Figure 35: Consequences of crop-livestock and property damage.

Similarly, I had asked a question, "What problems are you facing while guarding crops and livestock?" to the respondents. The result showed that 35 % respondent stated that they feel fair to travel, followed by 31 % mental health morbidity due to lack of sleep at night, 21 % disease due to malaria, 8 % children's poor school attendance and performance and 5 % low possibility of future employment opportunities.

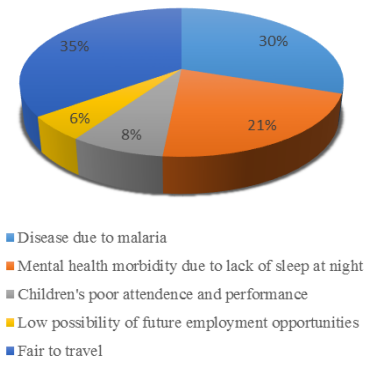


Figure 36: Consequences of crops and livestock guarding.

I had asked a question, "What are the consequences of death or injury to the principle earner or women?" to the respondents. The result showed that 45 % of the respondents stated that aggravated pre-existing poverty was the consequence due to the death or injury to the principle earner or women, followed by 25 % poor child development, 11 % loss of school child attendance, 10 % family depth due to paid employment, 6 % others and 4 % distortion of children parent relationship.

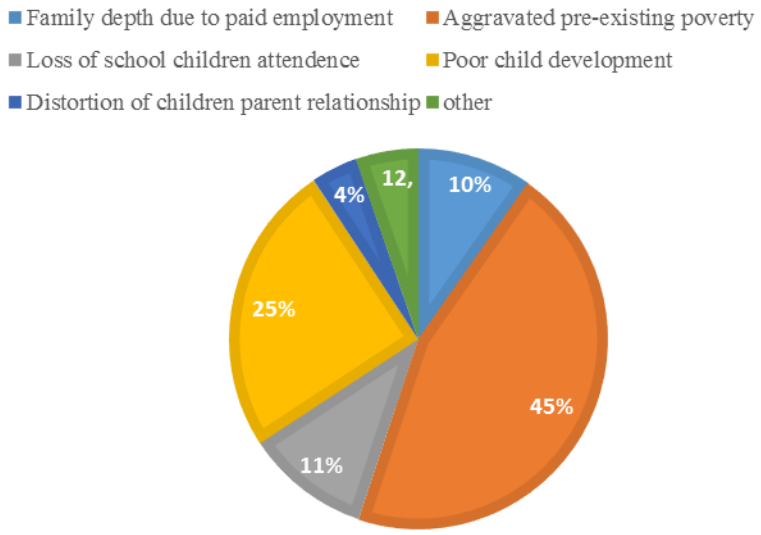


Figure 37: Consequences of death or injury.

5.3 Factors responsible to cause LULC change

I had asked a question, "What could be the possible cause of land use land cover change of SWR and its BZ?" to the respondents. The result showed that 20 % of the respondents stated that population growth was the responsible factor to cause land use land cover change, followed by 17 % encroachment, 16 % agricultural expansion, 11 % infrastructure development, 9 % infrastructure development, 7 % resettlement by reserve and 6% riverbank cutting.

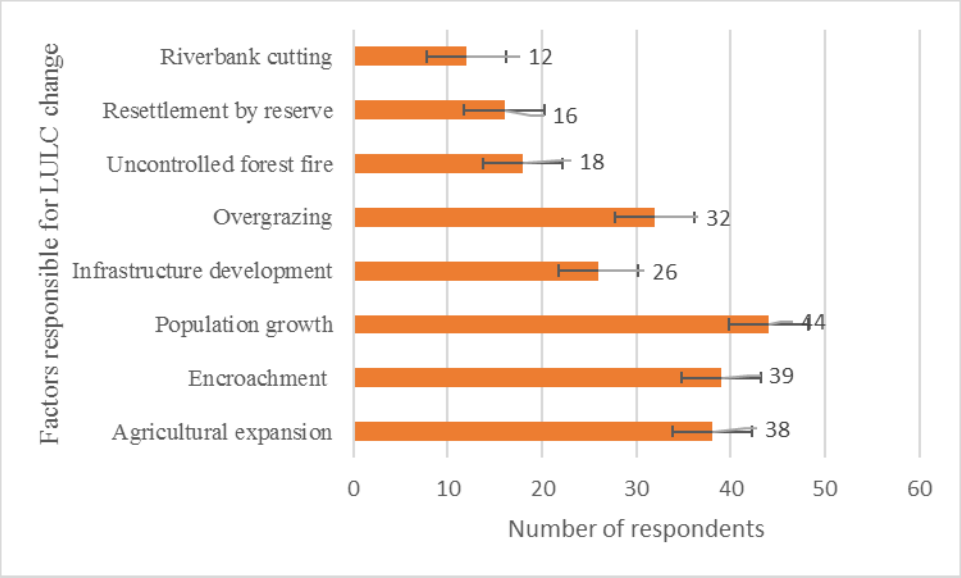


Figure 38: Factors responsible to cause LULC change.

5.4 Mitigation measures

5.4.1 Buffer zone community adopted mitigation measures

I had asked a question, "Do you use any mitigation measures to prevent damage due to wildlife?" to them who have been facing wildlife problem. The result showed that 95 % respondents (n=191) found to be adopted one or more than one mitigation measures to prevent damage caused by wildlife. Only 5 % respondents (n=10) hadn't used mitigation measures (r=162.990, df=1, p=.ooo). Out of 191 respondents, majority of the respondents (n=180, r=149.534, df=1, p=.ooo) have been using making noise in and around their field and human settlement area in order to escape the wildlife, followed by scare crow (n=177, r=139.105, df=1, p=.ooo), guarding by humans (n=173, r=125.785, df=1, p=.ooo), beating drum (n=161, r=89.848, df=1, p=.ooo), making fire using their cow dungs and agriculture (n=150, r=62.204, df=1, p=.ooo), guarding by dogs (n=114, r=7.168, df=1, p=.oo7), clearing bushes (n=94, r=0.047, df=1, p=.828), live fence (n=39, r=66.853, df=1, p=.ooo) and wooden fence (n=39, r=84.445, df=1, p=.ooo).

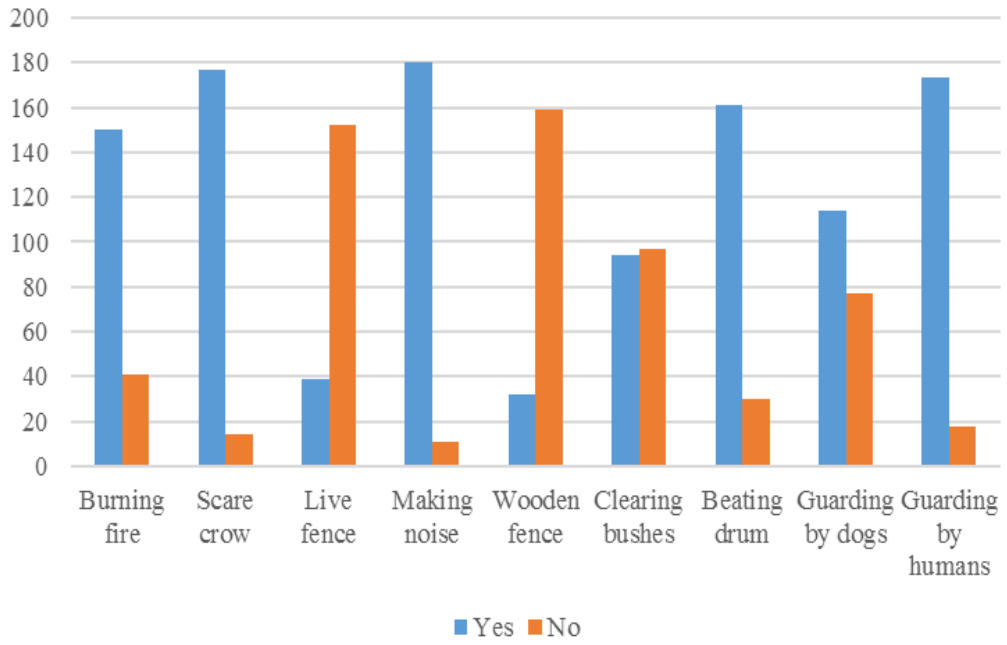


Figure 39:Respondents response on adopted mitigation measures.

5.4.2 Effectiveness of adopted mitigation measures by buffer zone community

The respondents found to be adopted one or more than one mitigation measures in order to escape the wildlife from their agricultural field as well as human settlement area. Regarding the effectiveness of adopted mitigation measures, questions were asked against each mitigation measures whether it is highly effective, medium or low, then following responses of the respondents was found against each adopted mitigation measures.

Table 4: Respondent responses on effectiveness of adopted mitigation measures.

Information sought	Responses from respondents	Number of respondents
Effectiveness of burning fire	Low	19
	Medium	36
	High	95
Effectiveness of scare crow	Low	58
	Medium	91
	High	28
Effectiveness of live fence	Low	5
	Medium	24
	High	10
Effectiveness of making noise	Low	12
	Medium	142
	High	126
Effectiveness of wooden fence	Low	4
	Medium	13
	High	15

Effectiveness of clearing bushes	Low	13
	Medium	55
	High	42
Effectiveness of beating drum	Low	12
	Medium	40
	High	108
Effectiveness of guarding by dogs	Low	35
	Medium	39
	High	40
Effectiveness of guarding by humans	Low	7
	Medium	24
	High	142

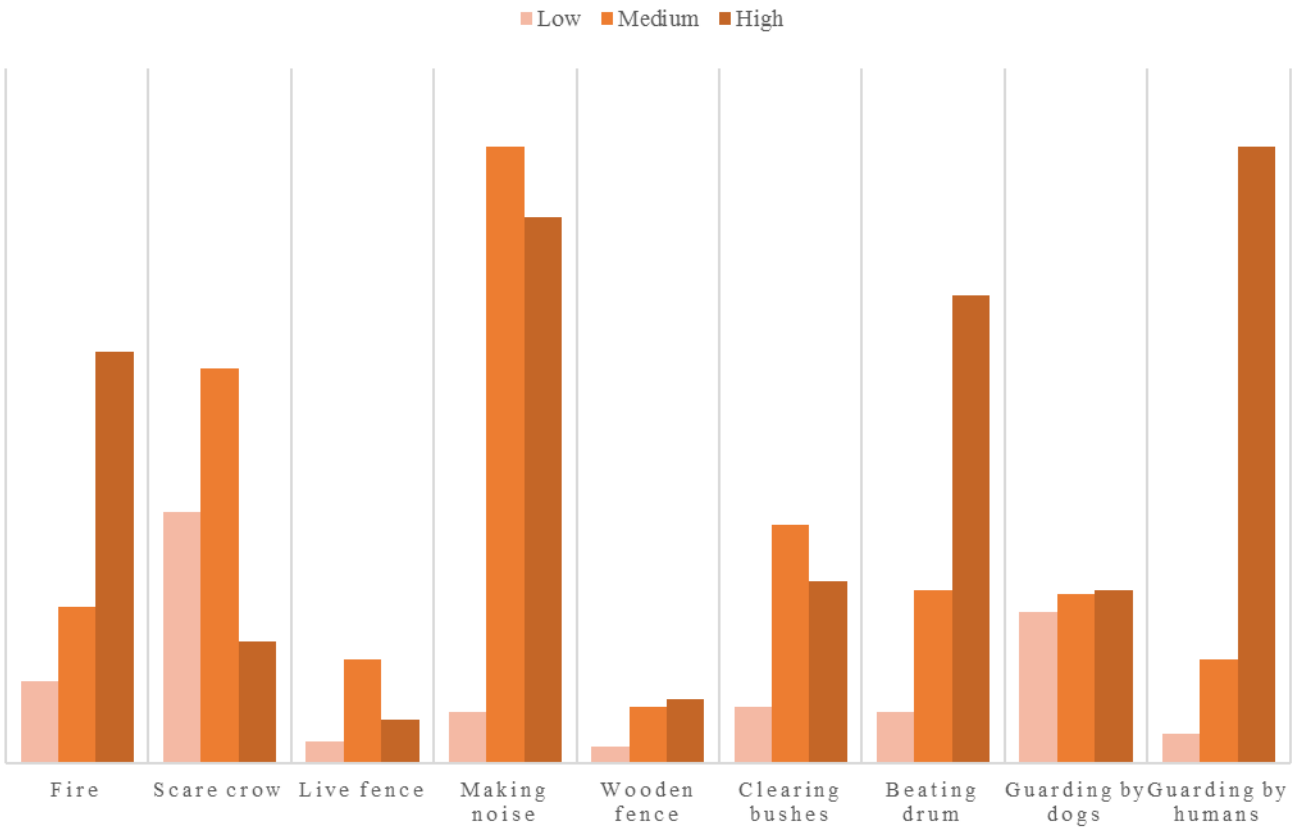


Figure 40:Effectiveness of mitigation measures.

5.4.3 Effectiveness of mitigation measures against wildlife

I asked the question, “For which animal making fire is most effective?” to them (n=150) who are making fire as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the

respondents (34%, n=51) felt that making fire is the most effective control measure for elephant, followed by 22.7 % for wild pig (n=34), 16.7 % for spotted deer (n=25), 4.7 % for blue bull (n=14), 6.7 % for rhino (n=10), 4.7 % for porcupine (n=7), 4.7 % for peacock (n=7), 0.7 % for swamp deer (n=1) and 0.7 % for rabbits (n=1).

Similarly, "For which animal building scare crow is most effective?" to them (n=177) who are building scare crow as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (32.2 %, n=57) felt that building scare crow is the most effective control measure for monkey, followed by 22 % for spotted deer (n=39), 21.5 % for wild pig (n=38), 21.5 % for blue bull (n=38), 2.3 % for peacock (n=4) and 0.6 % for swamp deer (n=1).

"For which animal planting live fence is most effective?" to them (n=39) who are planting live fence as mitigation measure in their farm land in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (43.6 %, n=17) felt that planting live fence is most effective control measure for spotted deer, followed by 38.5 % for blue bull (n=15), 15.4 % for wild pig (n=6) and 2.6 % for monkey (n=1).

"For which animal making noise is most effective?" to them (n=180) who are making noise as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (30.6 %, n=55) felt that making noise is most effective control measure for wild pig, followed by 22.8 % for blue bull (n=41), 18.9 % for spotted deer (n=34), 16.7 % for elephant (n=30), 7.8 % for rhino (n=14), 1.7 % for swamp deer (n=3), 1.1 % for monkey (n=2) and 0.6 % for porcupine (n=1).

"For which animal making wooden fence is most effective?" to them (n=32) who are making wooden fence as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (46.9 %, n=15) felt that making wooden fence is most effective control measure for blue bull, followed by 31.3 % for blue bull (n=10), 18.8 % for spotted deer (n=6) and finally 0.4 % for swamp deer (n=1).

"For which animal clearing bushes is most effective?" to them (n=94) who are clearing bushes as mitigation measure in their farm land in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (46.8 %, n=44) felt that clearing bushes is most effective control measure for peacock, followed by 26.6 % for porcupine

(n=25), 14.9 % for rabbit (n=14), 7.4 % for wild pig (n=7), 2.1 % for spotted deer (n=2), 1.1 % for elephant (n=31) and finally 1.1 % for monkey (n=1).

"For which animal beating drum is most effective?" to them (n=160) who are using beating drum as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (26.9 %, n=43) felt that beating drum is most effective control measure for wild pig, followed by 24.4 % for blue bull (n=39), 23.1 % for spotted deer (n=37), 16.9 % for elephant (n=27), 6.9 % for rhino (n=11) and finally 1.9 % for monkeys (n=3).

"For which animal guarding by dogs is most effective?" to them (n=114) who are guarding by dog as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (33.3 %, n=38) felt that making noise is most effective control measure for wild pig, followed by 24.6 % for blue bull (n=28), 20.2 % for spotted deer (n=23), 8.8 % for elephant (n=10), 4.4 % for monkey (n=5), 3.5 % for swamp deer (n=4), 1.8 % for rhino (n=2), 0.9 % tiger (n=1) and finally 0.9 % for leopard (n=1).

"For which animal guarding by humans is most effective?" to them (n=173) who are guarding by themselves as mitigation measure in their farm land as well as human settlement area in order to minimize their property loss due to wildlife. The result showed that majority of the respondents (34.7 %, n=60) felt that guarding by presence of human is most effective control measure for wild pig, followed by 22 % for spotted deer (n=38), 17.3 % for elephant (n=30), 15.6 % for blue bull (n=27), 5.2 % for rhino (n=9), 3.5 % for monkey (n=5) and finally 1.7 % for porcupine (n=3)

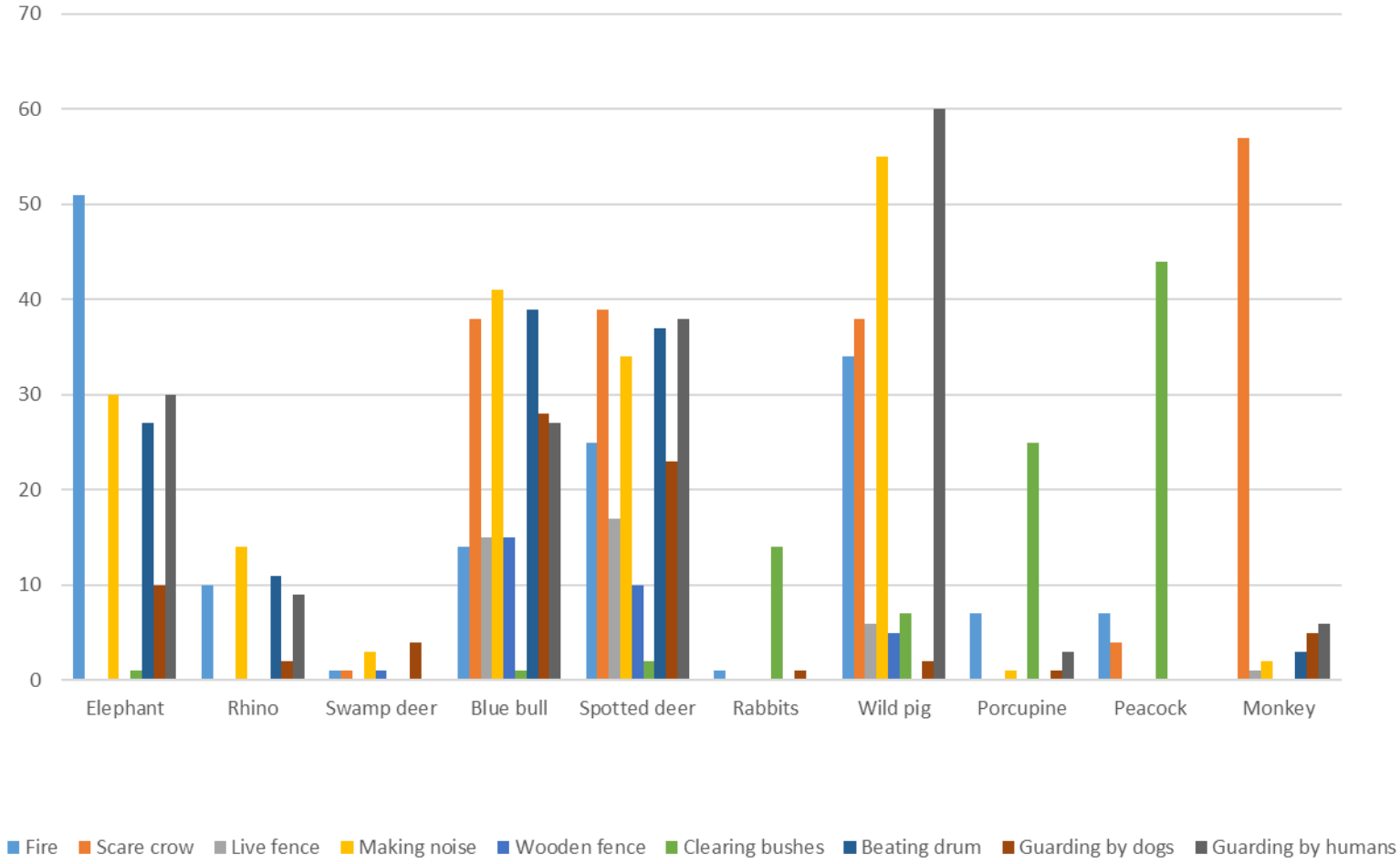


Figure 41::Effectiveness of adopted mitigation measures against wildlife.

5.4.4 Buffer zone community recommendation to SWR

Majority of the respondents i.e. 23.6 % (n=53) voted on use of electric fencing as their first priority order in minimizing wildlife problem, while 21.3 % of them voted on education and awareness (n=48) as their first priority order, 15.1 % of them on insurance and compensation (n=34) as their first priority order, 15.1 % of them on dry stone walls (n=34) as their first priority order, 12.9 % of them on solar fence (n=29) as their first priority order and 12 % on alternative crops (n=27) as their first priority order in their recommendation to Suklaphanta wildlife reserve.

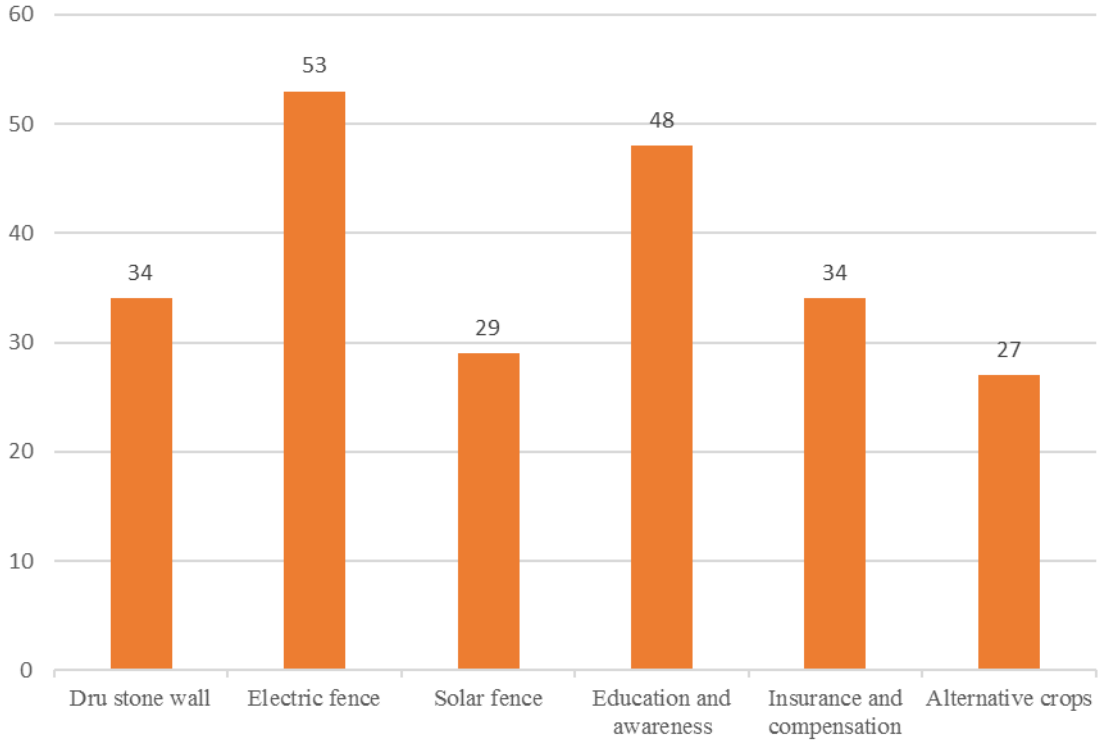


Figure 42:Buffer Zone Community recommendation to SWR .

5.5 Perception and tolerance of local community towards wildlife conservation

5.5.1 Perception of local community on wildlife conservation

About 77 % (n=174) respondents liked wildlife while 23 % (n=51) respondents did not like wildlife. It means they were positive towards wildlife conservation. I had asked the question, “Why do you like wildlife?”. The results showed that they liked wildlife because 21.8 % respondents (n=38) thought that wildlife are beautiful and charismatic species, 17.2 %

endangered and rare species (n=30), 15.5 % part of their life/culture/religion (n=27), 16.7 % maintain eco-system balance (n=29), 8.6 % eco-tourism aspects (n=15), 6.9 % employment (n=6.9) and finally, national heritage by 13.2 % respondents (n=23) & people think that they should conserve wildlife. Out of 51 respondents who didn't like wildlife, 45.1 % of them (n=23) attributed to wildlife damages their crops and properties, hence they don't like wildlife. The rest of the respondents said that wildlife kill/injury/attack livestock (25.5 %, n=13) and human (29.4 %, n=15), hence they don't like wildlife.

I had asked an another question regarding the wildlife conservation, "Do you think wild animals should be conserved?", The respondents showed that positive thinking towards wildlife conservation; 81 % respondents (n=183) thought that wildlife should be conserved while 18.7 % (n=51) respondents think that wildlife shouldn't be conserved. Question regarding the knowledge about wildlife conservation by laws; about 64 % respondents (n=145) found to have knowledge about wildlife conservation by laws while 35.6 % respondents reported that they didn't have knowledge about wildlife conservation by laws.

Perception on wildlife conservation and education level of respondents was found to be significantly associated (Pearson chi-square=8.003, df=6, p<0.005). People who have high education level support wildlife conservation. Similarly, perception and gender showed a significant association (Pearson chi-square=1.027, df=1, p<0.005). Male respondents showed more positive response than female respondents towards wildlife conservation.

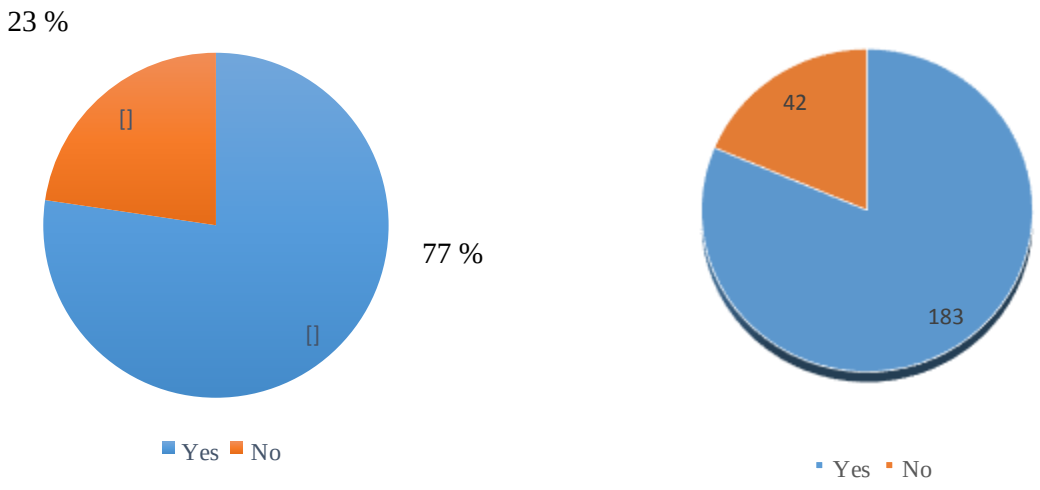


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Figure 43:Do you like wildlife? Figure 44:Do you think wildlife should be conserved?

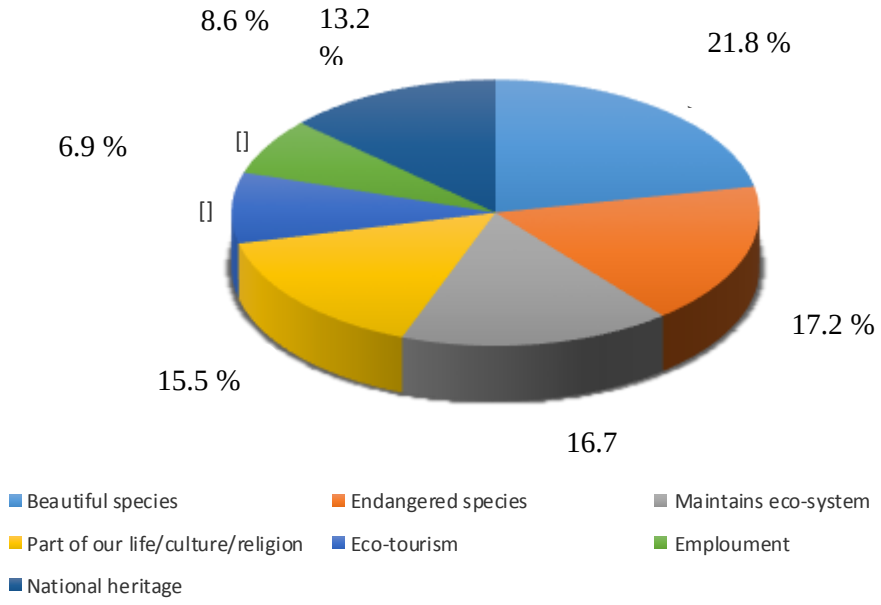

Figure 45:If yes, why do you like wildlife?

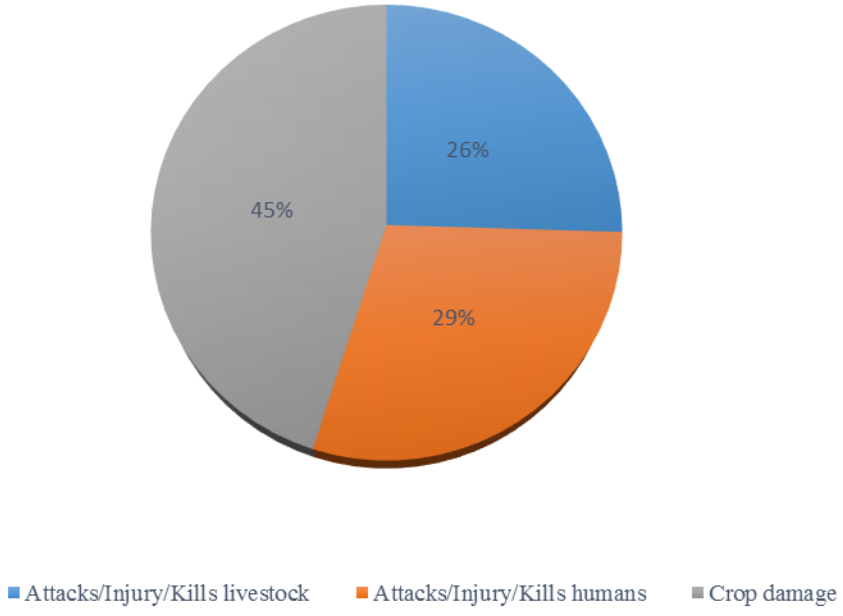

Figure 46:If no, why don't you like?

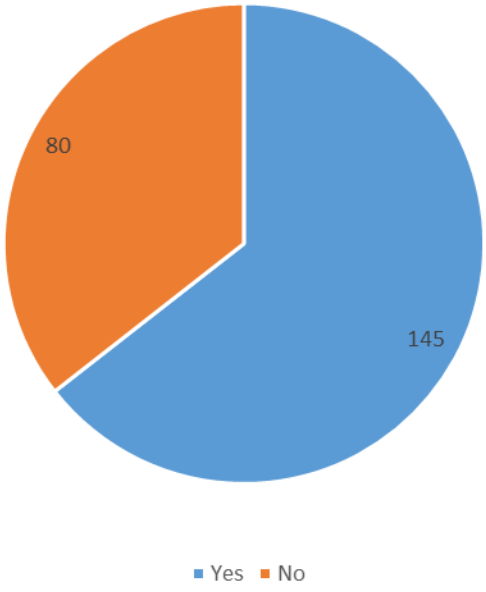

Figure 47:Do you have knowledge about wildlife conservation by laws.

5.5.2 Local people tolerance to losses by wildlife

I had asked three hypothetical questions with responses as to whether they agreed, disagreed or were indifferent in supporting wildlife conservation in order to examine the tolerance level of buffer zone user communities. The results showed that about 51 % (n=116) respondents were agreed that they support wildlife conservation even if their family member is killed. Similarly, 27.6 % (n=62) and 20.9 % (n=47) were found to be neutral and disagree respectively in supporting wildlife conservation even if their one family member is killed by wildlife (Fig.) Similarly, more than 58% (n=119) respondents were agreed that they support wildlife conservation even if their one family member is attacked or injured by wildlife. Similarly, 32 % (n=72) and 15.1 % (n=34) were found to be neutral and disagree respectively in supporting wildlife conservation even if their family member got injured by wildlife (Fig.) Similarly, more than 58 % (n=132) respondents were agreed that they support wildlife conservation even if their properties are damaged by wildlife. Similarly, 25.8 % (n=58) and 15.6 % (n=35) were found to be neutral and disagree respectively in supporting wildlife conservation even if their properties are damaged by wildlife.

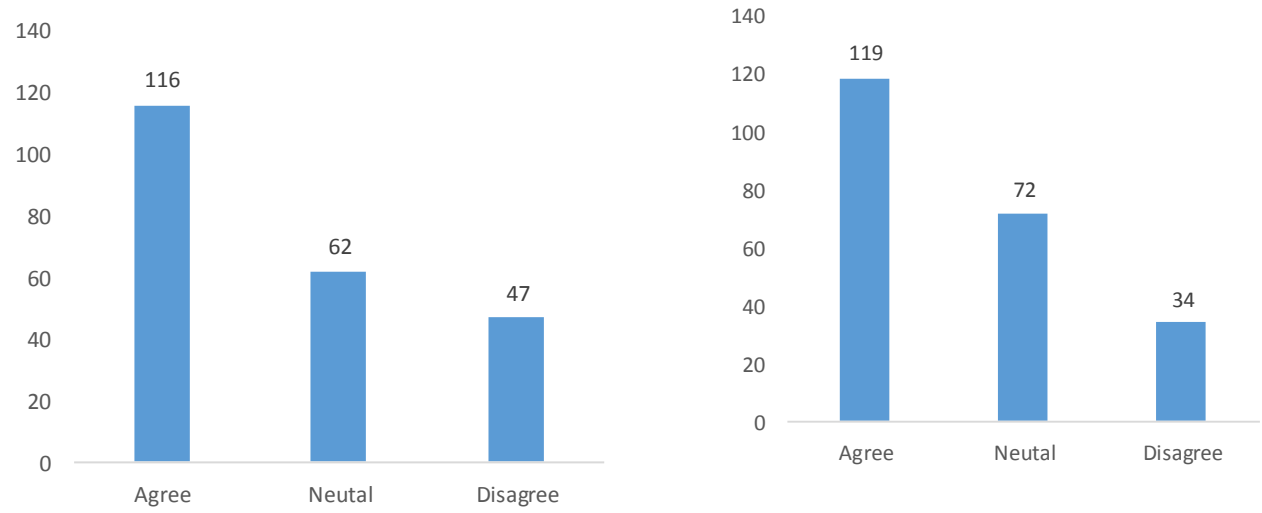

Figure 48:Tolerance level of local community.

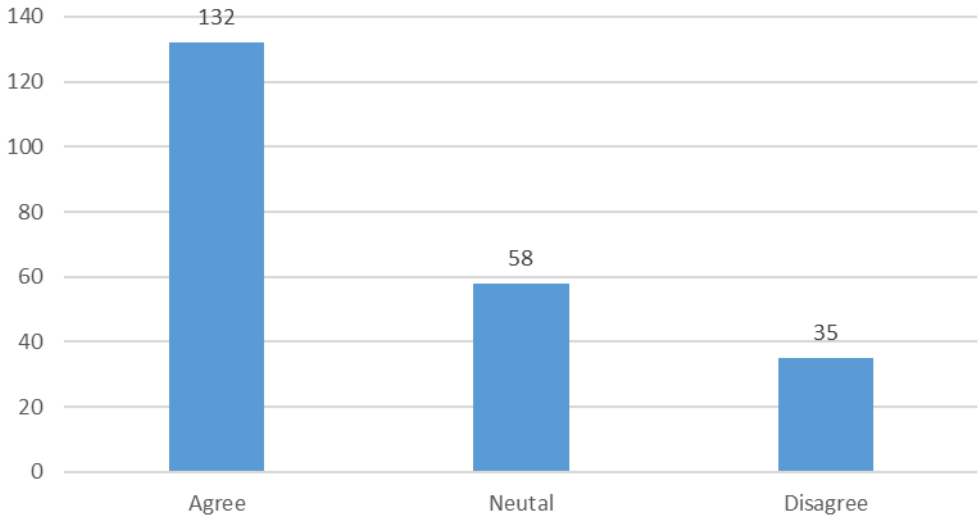

Figure 49:Tolerance level of local community.

CHAPTER-VI

DISCUSSION

DISCUSSION

The socio-economic data of the respondents such as gender, age class, education level and occupation plays a vital role in perception of people towards conservation and tolerance level towards human wildlife conflicts and hence, socio-economic data of the respondents were collected for further analysis. This study evidently showed that local people perceive human-wildlife conflict as a problematic issue. Thus, we can say that there exists a human wildlife conflict in suklaphanta wildlife reserve and its buffer zone and human casualties, livestock depredation, crop damage, house/shelter destruction and store grain destruction were found as five consequences due to wildlife and loss of wildlife due to retaliatory killing or by poaching also exists. All these aspects are discussed in the following topics.

6.1 Land use land cover change

The land use/land cover pattern of Suklaphanta wildlife reserve was found to be changed during the time periods 1989-2015. There seems to be unchanged land use land cover pattern even though there is significantly altered land use land cover pattern. It is due to about equally proportionate in gain and losses of land use/land cover of different classes over the time period. The forest land and shrub land was found to be shrink whereas grassland was found to be increased. National Park and Wildlife Conservation Act-1973 is the ruling policy for the protected areas of Nepal and there is restriction in encroachment, destroy and degrade the forest and wildlife habitat. But, during field visit and questionnaire survey, it was noticed that there were many human settlement as well as their agricultural land were shifted from one place to another over the time period by the park authority. The human settlement as well as their agricultural fields were shifted from one place to another in order to maintain corridor and connectivity between the two suitable wildlife habitat. The existing shrub land or forest land was provided to the local residents and their agricultural land as well as settlement area was converted into wildlife corridor and connectivity in favor of habitat suitability. Thus, there is altered in land use land cover pattern but it seems to be unchanged due to equal proportionate in gain and loss in different land use land cover. In a paper by Pariyar and Singh (1995) a methodology for detecting land-use changes using remote sensing techniques and GIS has been demonstrated. Chitwan district of Nepal was selected for their case study. Analogue maps of 1978/79 on the land utilization, LANSAT TM-5 images of 1990 and aerial photographs of 1992 had been used and five different land-use types viz. cultivated land,

forest land, grazing land, urban land and river bed, were delineated. Their study showed that the agricultural land area in the district had shrunk by about 11% during the period 1978 to 1992. The total area under forest and grazing had remained nearly unchanged. The urban land area in 1992 was almost twice that in 1978; and the area under river bed has increased. From their study in Churiya hills of Nepal Himalaya, Bhuju *et al.* (2007) reported increment of agricultural land by over two-folds at the expense of forest cover, where the forest cover decreased at least by 25%. They noted nearly 400 villages or human settlements in a total study area of about 780 km2. Similarly, Balla *et al.* (2003) reported decline in forested area in their study in two sub-watersheds namely Kali Khola and Andheri. Andheri Khahare of Chitwan and Tanahun districts using aerial photographs taken in 1978 and 1994 and land-utilization map and base maps of 1986. In Kali Khola watershed, agriculture and forest occupied 366.45 ha and 436.96 ha in 1999 whereas it was 194.90 ha and 537.36 ha in 1978 respectively. The increase in agriculture area came from forest, shrub-land and shifting cultivation with 32.81% of forestland converted into shifting cultivation and agriculture.

6.2 Human wildlife conflicts

The local community have been facing one or more than one nature of problem but crop damage was found to be the most common problem at the community farm land. Similar to my result, in a study "A case study on human-wildlife conflict in Nepal; with particular reference to human-elephant conflict in eastern and western terai regions" by Shrestha et al (2007), crop raiding was the most common problem in Suklaphanta wildlife reserve, Bardia National Park and Jhapa district. Most of the farmers at Suklaphanta wildlife reserve have been growing paddy, wheat, maize, sugarcane, lentils, mustard and potatoes in their agricultural land. Some of the farmers have reported that they gave up to grow maize, potatoes, lentils, mustard and other cash crops due to wildlife problem. The wild pig followed by spotted deer were found to be two mainly responsible animals to damage maize and potatoes and hence they gave up to grow them. Some of the respondents have shifted to the alternative income source and other had enforced to leave their agricultural land fallow due to wildlife problem. Few of the respondents had reported that they had left their agricultural land fallow due to water seepage problem from ground level and hence they had converted their agricultural land into fish pond. Among the respondent's grown major agricultural crops, maize loss was found to be more due to wildlife compared to the other agricultural crops such as paddy and wheat. It is found that they had lost their grown crop due to damages caused by wildlife ranging approximately 5 % to 90 % of total estimated harvested quantity from their

agricultural field. The average percentage of crop loss was found to be 29 % per household per annum. Similar to my study, in a study on *"Human-wildlife conflict in Nepal*" done by the WWF Nepal (2007) showed that Jhapa and Bardia were the most severely and about equally affected by human-elephant conflict in terms of crop damage, where every year a household loss nearly a quarter of their total annual income from crop production. The average cost of crop loss caused by wildlife was found higher as compared the study on *"Park people conflict- A case study from Beldandi VDC adjacent to Suklaphanta Wildlife Reserve of western lowlands, Nepal"* by Malla (2003) where it was showed that the park people conflict was due to resource use problem, grazing problem, wildlife damage and resettlements problems and average loss per household due to crop damage is NRs. 962/yr. It may be due to the increase in trend of crop damages and also rise in the price of the food crops as compared to the previous years.

The major crop raider animals of Suklaphanta wildlife reserve were wild pig, spotted deer, blue bull, elephant, swamp deer, elephant, rhino, rabbit, monkeys, porcupine and peacock. Similar to my study, in a study on *"Park and People Conflict"* by Shrestha (1994) showed that habitat destruction, population pressure and food shortage were the major causes for the arising of the HWC. The major wildlife species were Rhino, Deer, Tiger and Leopard. The major problems were crop damage and livestock depredaton. The crop loss was found to be the acute one. Similarly, a study on *"Park–people conflict in Koshi Tappu wildlife reserve"* in Paschim Kusaha VDC of Koshi Tappu wildlife reserve using interview and scheduled questionnaire in 1997/98 by Limbu & Karki (2003) showed that wild buffalo and wild pig was the major crop raider. Wild buffalo and wild pig was responsible for damaging 85.15 % and 14.84% crop respectively.

Most of the crop damage and property losses by wildlife were found to be occurred at night. Similar to my result, in a study by Shrestha et al (2007) in eastern and western Terai regions of Nepal, it was found that most of the crop raiding and property damage by elephants reported to occur at night is found prevalent. The wildlife spends the day time inside the reserve but monkeys, peacock and porcupine were reported to come at any time to damage their agricultural corps. Elephant, wild pig and rhino used to come at night and responsible to cause agricultural crops damage and house/shelter and store grain destruction. They had reported that some of the human casualties had taken place during day time inside the reserve as well as their farmland which is located near by the reserve due to wild pig and leopard. Illegally, some of the local people used to go to the reserve in order to graze their livestock, collect fuelwood, agricultural implements and grasses. At that time, few human casualties had

been taken place but victims did not have right to claim compensation as given by human wildlife relief guideline. Because there is no any provision to claim the compensation when the incidents occurred inside the park. Human as well as other surrounding disturbance factors were reported to be responsible to cause crops damage as well as other losses occurred more at night time as compare to the other time.

The elephants spend the day time inside the park or close to the edge forest areas. Suklaphanta buffer zone community mostly used to grow paddy and wheat for their livelihood. Two peak seasons for wheat and paddy raiding were found to be at April and October respectively i.e. one for wheat maturing time and another for paddy maturing time. Similar to my result, in a study by Shrestha et al (2007), the season of crop damage in western and eastern Terai regions of Nepal were two peak seasons; one during paddy maturing time (September-November) and one for maize or wheat (June-July) is found prevalent.

There is strong linkage between agriculture, livestock and forests in Nepalese farming system; the farmers in the Suklaphanta buffer zone is subsistence level and every household produce agricultural crops such as paddy, maize, wheat, potato, sugarcane, lintels and other cash crops and most of the household found to be kept one or two cows, a pair of bulls for ploughing, one or two buffalos and three to four goats and sheep. The mean loss of livestock depredation due to wildlife was found to be comparatively low (0.195 livestock per year per household; the sum of four-year loss is approximately 14.80 % of the total existing livestock) as compared to the study in Bardia National Park, where the loss of livestock, due to tiger *(Panthera tigris)* is 0.25 head per household per year (Bhattari, 2009) and 0.55 in the Pin Valley National Park, India (Bagehi & Miahra, 2006). This rate of predation, however, is higher in comparison to the study of the Jigme Singye National Park of Bhutan where the predation rate was found for the year 2000 was 0.007 (Wang & Macdonald, 2006). This may be due to the comparatively less number of tiger population in Suklaphanata Wildlife Reserve (n=17) than Bardia National Park (n=50). The depredation rate of goats and sheep was found comparatively higher than cows, buffaloes, oxen and dogs. It may be due to the higher number of goats and sheep keeping by the local people than other livestock for their livelihood and another factor may be due to open grazing of goats and sheep within the reserve or nearby the reserve or buffer zone community forest where cows, buffaloes, oxen and dogs kept as stall feeding and used to feed their agricultural production. During field visit, I had also experienced that more number of goats and sheep was seen openly at the boundary of the park as well as buffer zone forests than other livestock for grazing. Most of the

households depend upon the agricultural byproducts for their livestock feed. It is due to restriction in forest.

6.5 Trend of human wildlife conflicts

The Suklaphanta buffer zone community have been facing one or more than one nature of problem but crop damage was found to be the most common problem. The human wildlife conflict is site specific; the problem of wildlife was found to differ from one buffer zone user group to the other buffer zone user group. The trend of nature of conflicts also found to differ from one to another. The human wildlife conflict in Suklaphanta wildlife reserve was found to be increased due to the factors such as increase in wildlife population, improvement in the condition of community forestry, lack of fencing, reduction in guarding by humans, deforestation and degradation of wildlife habitat, smell of local material used in alcohol making and land use land cover change. The respondents stated that there was a good fencing before built by the park authority but now, it doesn't work properly due to old or somewhere the fencing was theft by local people. There are generally two types of buffer zone user based upon the distance from the reserve. The users who are staying far away from the reserve are comparatively less affected by the wildlife problems than those who are staying at nearby the reserve. Nearby users had complained that those people who are staying far away from the reserve and less affected by the wildlife problems are responsible for the theft of wooden fence built by the park authority and hence, the nearby users are forced to bear comparatively more losses than distant users. The purpose of theft was to use the wooden pole in one hand and to make an easy way in order to illegally collect forest resources from the reserve whenever possible in another hand. There is a provision of handover of buffer zone forest as buffer zone community forest to the buffer zone community for conservation, management and utilization of forest resources with participation and collaboration of local people. And hence, some of the previous barren land has been converted into more greenery and dense forest in one hand and these forests have been providing wildlife habitat in other hand. The buffer zone community forest user groups had reported that these days, community forests are providing as wildlife habitat for many wildlife particularly wild pig, peacock, porcupine, spotted deer, blue bull, monkeys, and occasional habitat for rhino, elephant, leopard and tiger as well. As a result of community forest, incidents of crop damages, livestock depredation, human casualties and shelter/house and store grain destruction felt comparatively more than before by the buffer zone community. In addition, the buffer zone community had reported that the community forest also serves as an important role to increase the wildlife population

particularly wild pig, spotted deer, peacock, porcupine and hence they are experiencing more crop damage these days than before. Another reason to increase in trend of crop damage might be due to decrease in guarding by humans. Some of the respondents were found to be shifted to another income source for their livelihood and enforced to left their agricultural land as fallow due to wildlife problem and reduction in guarding the crops as well. The intensity of crop damages also depends upon the frequency of crop guarding by humans and type of the crop grown. The crop damages by wildlife is directly proportional to the frequency of crop guarding by humans and inversely proportional to the late ripening crops. One of the respondent under Betkot buffer zone user committee said that he had lost almost 90 % of his 2.5 bighas paddy crops last year due to late ripening hybrid paddy crops as well as less guarding by themselves.

Recently, the number of park posts has been increased up to the 14 with government park managers in different locations of the reserve in order to effectively manage the wildlife of the reserve. Respondents had felt that it might be the possible cause of decrease in crop damage due to wildlife. Some of the buffer zone people had found to be shifted to other source of income for their livelihood such as small scale business, wage labor, foreign employment and other local level transaction works by leaving their agricultural land follow. In addition, the fencing and watch tower also found to be successfully managed and effectively worked in some places to block the reserve wildlife to enter the farm land and to escape wildlife from their farmland respectively. Most of the buffer zone people felt that education and awareness implemented by the different stakeholders has been playing important role to diminish the conflicts by making local people aware regarding the conflicts. There was a provision to allow the local people legally in order to collect forest resources such as fuelwood, leaf litter, dry grasses as well as graze the livestock inside the park but now, these activities are totally banded by laws. And hence, there is little interference of human activities which result to diminish the human wildlife conflicts. Similarly, increase in number of park post distributed all over the reserve with park managers and effective fencing in some area could be the way of minimizing the conflicts.

The Suklaphanta wildlife reserve consists comparatively less number of predator i.e. tiger population (n=17) than Bardia and Chitwan National Park where the population of tigers are 50 and 120 respectively but the prey density is 78.62 animals/km^2, 92.6 animals/km^2 and 73.63 animals/km^2 at Suklaphanta, Barida and Chitwan Natonal Park respectively (DNPWC, 2014). Thus, there will be sufficient food available inside the reserve for predator at Suklaphanta wildlife reserve and hence, the wild predator occasionally come to visit the

buffer zone due to food scarcity. It might be the reason to contribute in diminishing the human casualties and livestock depredation due to wild predator. During key informant survey, the park warden also reported that the reason behind in comparatively less number of livestock depredation and human casualties than other national park is due to the plenty of food availability inside the reserve for predator.

It was found that the Suklaphanta buffer zone users have been adopting one or more than one mitigation measures in order to defense against wildlife. Burning fire, scare crow, live fence, making noise, wooden fence, clearing bushes, beating drum, guarding by dogs and humans were found to be adopted mitigation measures at the Suklaphanta buffer zone. The effectiveness of the adopted mitigation measures varies from one to another and its effectiveness depends upon the kind of the wildlife.

6.4 Attitude and tolerance of local people

The local people showed positive thinking in favors of conservation and participation towards wildlife. The extent of support and participation of people in the conservation of carnivores largely depends on how the local people place value on these predators (Gussel, et al, 2009). In my study, even though wildlife caused crop damages, livestock depredation, human casualties and shelter/store grain destruction, majority of the people liked wildlife and showed willingness to conserve the wildlife. Most of the respondents were Hindu and they considered that wildlife such as elephant, rabbits and tigers have religious value. The elephant is related with the goddess Ganesh and tiger is considered as the vehicle of the goddess Durga (goddess of mighty). Because of these religious value, they felt that killing a wild animal is contravening their religious value and against the god and it is a matter of humanity and morals. And hence, these wild animal played positive role for conservation. The respondents also considered that the beautiful, charismatic and an endangered wildlife species are the national heritage and they felt that it is citizen's responsibility to conserve and promote these wild species. They believed that there will be employment generation through various national as well as international conservation organization as these organizations invest fund while doing conservation activities. They also believed that they will generate income through eco-tourism. They assumed that domestic as well as international tourist will visit to see these beautiful, charismatic and endangered wild species and hence, local people will be benefitted through tourism activities. There is a homestay called Rana Tharu cultural homestay at suklaphanta buffer zone and about thirty-six households are getting benefits through this homestay from the tourists who visit the Suklaphanta wildlife reserve in order to see most

endangered, beautiful and charismatic wild species. There are other people who are getting benefits through small hotels as well. Few of the respondents were found to be aware that wildlife has importance in maintaining the ecosystem and hence, they liked wildlife and showed positive attitude towards wildlife conservation. Similar to my study, in a study "Attitude of local people toward wildlife conservation: A case study from the Kasmir Valley" by Mir et al (2015), support for wildlife conservation was justified primarily for ecological reasons, aesthetic, social and economic reasons prevalent.

There is a provision that about 30-50 % of the park earned revenue goes to the buffer zone community for development through the fourth amendment of the National Park and Wildlife Conservation Act 1973. The total allocated revenue to the buffer zone community should be distributed as percentagewise; community development (30 %), income generation and skill development (20 %), education and awareness programs (10 %), conservation programs (30 %) and administrative expenses (10 %). Thus, buffer zone community has been getting benefits through many activities conducted by the buffer zone management committee as well as buffer zone user groups. The buffer zone people below the poverty line were found to be benefited through many income generation activities supported by the buffer zone management committee. Thus, the revenue sharing mechanism between the park and buffer zone community has been playing vital role in wildlife conservation.

Besides these, there are various national and international NGOs such as National Trust for Nature Conservation (NTNC), Zoological Society of London (ZSL), Terai Arc Landscape, Nepal (TAL) working in the field of biodiversity conservation in the Terai region of Nepal and hence, these organizations also attributed to change the positive attitude of the local people towards wildlife conservation. The community based anti-poaching organizations and community level eco-clubs leaded by the local community themselves were also found to be committed to make the local community aware of wildlife conservation and fund raising efforts of conservation lovers who come to visit the park. They are responsible to implement the relevant wildlife conservation laws at local level. The success of wildlife conservation and HWC reduction largely depends on the ability of managers to recognize, embrace and incorporate differing stakeholder values, attitudes and beliefs (Messmer, 2000) Elisa Distefano has mentioned that services or forestry departments, non-governmental organization (NGOs), conservation organizations, wildlife managers, the scientific community, tour operators and the tourism industry, rural villagers and other participants, is expected to enhance the participation, contribution and support of each counterpart. Encouraging the creation of partnerships and diverse stakeholders' compliance and collaboration will make any strategy more successful, will foster

mutual assistance and strengthen the possibility of resolving the HWC issue. Both people and wildlife suffer tangible consequences and different stakeholders involved should commit themselves to tackle and resolve the conflict in the near future.

Some of the respondents disliked wildlife because they have lost their livestock due to wildlife, crop damages, house/store grain destruction and occasionally human casualties and these economic losses have impacted in their livelihood. Similar to my study, in a study by Mir and Noor (2015) mentioned that the reasons for negative attitude towards wildlife conservation is the conflict with the wild animals and resulting economic losses prevalent. Buffer zone management committees are legally elected to mobilize local communities to implement conservation programmes, with overall responsibility for planning, resource distribution and conflict mitigation (DNPWC, 1999a, 2012). However, these committees invest more funds in community development than conflict mitigation (Silwal et al., 2013). It was found that the gender and education level also attributed to the attitude of local people in participation and conservation of wildlife. Nepalese society is male dominated society and hence, in most of the cases, females have to go to forest in order to collect forest resources so that they got comparatively more accidents due to wildlife. Similar to my study, in a study "Attitude of local people toward wildlife conservation: A case study from the Kasmir Valley" by Mir et al (2015); about 84 % of respondents supported wildlife conservation, where 15.82 % opposed prevalent.

CHAPTER-VI

CONCLUSION AND RECOMMENDATION

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

Land use land cover pattern of SWR and its BZ was found to be dynamic; about equal proportionate in gain and loss of land use land cover pattern was noticed over the time period. From 1989-2015, there was increase in forest by 671.58 ha whereas decrease by 1099.08 over the same time period. Similarly, increase in cultivated land by 942.39 ha whereas decrease by 1015.29 ha, increase in grassland by 1241. 55 ha whereas decrease by 1073.25 ha, increase in shrub land by 340.02 ha whereas 460.08 ha, increase in sandy area by 994.68 ha whereas decrease by954.09 ha, increase in water bodies by 720.99 ha whereas decrease by 535.41 ha and increase in other land by 295.64 ha whereas decrease by 69.65 ha over the same time period. Thus, gain and loss due to land use land cover change in different terrestrial and aquatic wildlife habitat such as grassland, forest land, shrub land, water bodies, cultivated land and other land have adverse impact on sustainability of wildlife population and becomes a cause of human wildlife conflicts.

This study evidently showed that local people perceive human-wildlife conflict as a problematic issue. Thus, this study concludes that there exists a human wildlife conflict in Suklaphanta wildlife reserve and its buffer zone and human casualties, livestock depredation, crop damage, house/shelter destruction and store grain destruction were found as five consequences due to wildlife and loss of wildlife due to retaliatory killing or by poaching also exists. The local community have been facing one or more than one nature of problem but crop damage was found to be the most common problem at the community farm land. Most of the farmers at Suklaphanta wildlife reserve have been growing paddy, wheat, maize, sugarcane, lentils, mustard and potatoes in their agricultural land. Some of the farmers have been reported that they gave up to grow maize, potatoes, lentils, mustard and other cash crops due to wildlife problem. It is found that more than 85 % respondents found to bear crop damages losses caused by wildlife; they had lost their grown crop due to damages caused by wildlife raiding approximately 5 % to 90 % of total estimated harvested quantity from their agricultural field. The average percentage of crop loss per household was found to be 29 % per annum. Elephant, rhino, wild pig, spotted deer, swamp deer, blue bull, monkey, rabbit, porcupine and peacock are found to be responsible wild animals to cause the crop damages at Suklaphanta buffer zone. Among them, the wild pig followed by spotted deer and blue bull were found to be three mainly responsible animals to damage maize and potatoes and hence

they gave up to grow it. Some of the respondents have shifted to the alternative income source and other had enforced to leave their agricultural land fallow due to wildlife problem. Most of the crop damage and property losses by wildlife were found to be occurred at night. The wildlife spends the day time inside the reserve but monkeys, peacock and porcupine were reported to come at any time to damage their agricultural crops. Elephant, wild pig and rhino used to come at night and responsible to cause agricultural crops damage and house/shelter and store grain destruction. They had reported that some of the human casualties had taken place during day time inside the reserve as well as their farmland which is located near by the reserve due to wild pig and leopard. Illegally, some of the local people used to go to the reserve in order to graze their livestock, collect fuelwood, agricultural implements and grasses. At that time, few human casualties had been taken place. Two peak seasons for wheat and paddy raiding were found to be at April and October respectively i.e. one for wheat maturing time and another for paddy maturing time.

There is strong linkage between agriculture, livestock and forests in Nepalese farming system; the farmers in the Suklaphanta buffer zone are of subsistence level and every household produce agricultural crops such as paddy, maize, wheat, potato, sugarcane, lintels and other cash crops and most of the household found to be kept one or two cows, a pair of bulls for ploughing, one or two buffalos and three to four goats and sheep. The mean loss of livestock depredation due to wildlife was found to be comparatively low (0.195 livestock per year per household; the sum of four-year loss is approximately 14.80 % of the total existing livestock. The depredation rate of goats and sheep was found comparatively higher than cows, buffaloes, oxen and dogs.

The human wildlife conflict in Suklaphanta wildlife reserve was found to be increased due to the factors such as increase in wildlife population; particularly population increase of wild pig, blue bull and spotted deer, improvement in the condition of community forestry, lack of fencing, reduction in guarding by humans, deforestation and degradation of wildlife habitat, smell of local material used in alcohol making and land use land cover change.

It is found that the Suklaphanta buffer zone users have been adopting one or more than one mitigation measures in order to defense against wildlife. Burning fire, scare crow, live fence, making noise, wooden fence, clearing bushes, beating drum, guarding by dogs and humans were found to be adopted mitigation measures at the Suklaphanta buffer zone. The effectiveness of the adopted mitigation measures varies from one to another and its effectiveness depends upon the kind of the wildlife

The local people showed positive thinking in favor of conservation and participation towards wildlife. Majority of the people liked wildlife and showed willingness to conserve the wildlife. The reasons behind the positive attitude towards wildlife conservation were that they considered wildlife as beautiful, charismatic and endangered species, maintains ecosystem, promotes eco-tourism and generate employment opportunities and contribute to the national GDP. Some of the respondents disliked wildlife because they have lost their livestock due to wildlife, crop damages, house/store grain destruction and occasionally human casualties and these economic losses have impacted in their livelihood.

7.2 Recommendation

- Crop damages due to wild pig, spotted deer and blue bull was major problem. The Suklaphanta buffer zone community losses their grown agricultural crops mainly due to these wild animals but there is no any provision to claim the compensation caused by these animals mentioned in Wildlife Relief Guidelines-2015. So, there should be provision of compensation caused by these animals in Wildlife Relief Guidelines-2015.
- The park officials, buffer zone user committee and other conservation organization should have developed management information system and proper recording of human wildlife conflicts related data.
- The community based anti-poaching unit and eco-club should be properly mobilized and hence, any sort of poaching should be immediately put in check through good networking of information in collaboration with national police and local informants.
- People should avoid livestock grazing in the wildlife reserve. Stall feeding, forage production in crop fields and a reduced number of a highly productive livestock breed are recommended.
- Most of the respondents have reported that the increase in number of park posts have been playing important role in reducing human wildlife conflicts and hence, it is recommended to increase in number of park post in the remaining areas with army posts.
- The intensity of human wildlife conflicts depends upon the condition of the wildlife habitat inside the wildlife reserve and hence, it is recommended to conduct the habitat improvement activities such as controlled burning, waterhole construction, grassland/pastureland/shrub land management.

- Illegal collection and cutting of firewood and grasses, uncontrolled grazing and encroachment at the boundary of the reserve are found during field visit and hence, it is strongly recommended to stop these illegal activities by the park authority.
- Conservation education and public awareness are useful tools in changing the behavior of local people. The education level is directly co-related with the local people tolerance due to property losses caused by wildlife. Hence, it is recommended to conduct the conservation education programs regarding the wildlife behavior/ecology throughout the Suklaphanta buffer zone and should be included as priority in the annual program of BZMC/BZUG. It should target all groups (the Community Forest User Group, women groups, the Buffer Zone User Group, school teachers and students).
- It is recommended immediately to construct the buffer zone community recommended mitigation measures such as electric fence, dry stone wall, solar fence, alternative crops, education and awareness in order to reduce human wildlife conflicts and create harmony and human wildlife co-existence.
- Most of the buffer zone community have reported that there is bureaucratic inadequacies and practical barriers to simply procure damage claim and hence, it is recommended to promote and fair payment embedded in transparent process with accurate and rapid verification of damages through amendment of Wildlife Relief Guidelines-2015.

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Annexure

I. Statistical Analysis

Have you had a wildlife problem

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	201	89.3	89.3	89.3
	No	24	10.7	10.7	100.0
	Total	225	100.0	100.0	

Specify the nature of problem

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Crop damage	116	51.6	57.7	57.7
	Human Casualties	8	3.6	4.0	61.7
	Crop, Shelter and Store grain destruction	22	9.8	10.9	72.6
	House/shelter and store grain destruction	1	.4	.5	73.1
	Crop & livestock damamge	43	19.1	21.4	94.5
	Crop, livestock, store grains and house/shelter destruction	11	4.9	5.5	100.0
	Total	201	89.3	100.0	
Missing	-999	24	10.7		
Total		225	100.0		

Do you use any mitigation measure to prevent damage due to wildlife

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	191	84.9	95.0	95.0
	No	10	4.4	5.0	100.0
	Total	201	89.3	100.0	
Missing	-999	24	10.7		
Total		225	100.0		

Estimated percent of crop damage

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	.00	3	1.3	1.5	1.5
	5.00	5	2.2	2.5	4.0
	8.00	4	1.8	2.0	6.0
	10.00	18	8.0	9.0	14.9
	12.00	3	1.3	1.5	16.4
	15.00	22	9.8	10.9	27.4
	18.00	4	1.8	2.0	29.4
	20.00	14	6.2	7.0	36.3
	21.00	1	.4	.5	36.8
	22.00	7	3.1	3.5	40.3
	23.00	1	.4	.5	40.8
	24.00	2	.9	1.0	41.8
	25.00	22	9.8	10.9	52.7
	28.00	3	1.3	1.5	54.2
	30.00	16	7.1	8.0	62.2
	32.00	5	2.2	2.5	64.7
	33.00	1	.4	.5	65.2
	34.00	1	.4	.5	65.7
	35.00	10	4.4	5.0	70.6
	37.00	2	.9	1.0	71.6
	38.00	4	1.8	2.0	73.6
	40.00	6	2.7	3.0	76.6
	41.00	1	.4	.5	77.1
	42.00	1	.4	.5	77.6
	45.00	11	4.9	5.5	83.1
	50.00	7	3.1	3.5	86.6
	54.00	1	.4	.5	87.1
	55.00	7	3.1	3.5	90.5
	56.00	6	2.7	3.0	93.5
	60.00	5	2.2	2.5	96.0
	65.00	2	.9	1.0	97.0
	70.00	5	2.2	2.5	99.5
	90.00	1	.4	.5	100.0
	Total	201	89.3	100.0	
Missing	-999.00	24	10.7		
Total		225	100.0		

Estimated cost of crop damage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	3	1.3	1.5	1.5
	1000.00	11	4.9	5.5	7.0
	1500.00	5	2.2	2.5	9.5
	2000.00	15	6.7	7.5	16.9
	2400.00	1	.4	.5	17.4
	2500.00	4	1.8	2.0	19.4
	2800.00	2	.9	1.0	20.4
	3000.00	16	7.1	8.0	28.4
	3600.00	2	.9	1.0	29.4
	4000.00	12	5.3	6.0	35.3
	4500.00	6	2.7	3.0	38.3
	5000.00	16	7.1	8.0	46.3
	5600.00	5	2.2	2.5	48.8
	6000.00	8	3.6	4.0	52.7
	6400.00	1	.4	.5	53.2
	7000.00	9	4.0	4.5	57.7
	7500.00	1	.4	.5	58.2
	8000.00	16	7.1	8.0	66.2
	9000.00	3	1.3	1.5	67.7
	9400.00	1	.4	.5	68.2
	9600.00	8	3.6	4.0	72.1
	10000.00	8	3.6	4.0	76.1
	10400.00	1	.4	.5	76.6
	10800.00	1	.4	.5	77.1
	12000.00	6	2.7	3.0	80.1
	13500.00	3	1.3	1.5	81.6
	14000.00	1	.4	.5	82.1
	15000.00	2	.9	1.0	83.1
	17400.00	1	.4	.5	83.6
	18000.00	2	.9	1.0	84.6
	18200.00	1	.4	.5	85.1
	20000.00	15	6.7	7.5	92.5
	22000.00	1	.4	.5	93.0
	24000.00	1	.4	.5	93.5
	25000.00	1	.4	.5	94.0
	28000.00	1	.4	.5	94.5
	29850.00	1	.4	.5	95.0
	30000.00	1	.4	.5	95.5
	40000.00	1	.4	.5	96.0
	44400.00	2	.9	1.0	97.0
	50000.00	4	1.8	2.0	99.0
	57600.00	1	.4	.5	99.5
	60800.00	1	.4	.5	100.0
	Total	201	89.3	100.0	
Missing	-999.00	24	10.7		
Total		225	100.0		

Statistics									
		Do you keep livestock?	Total number of livestock keep	Number of cow killed	Number of goat & sheep killed	Number of buffalo killed	Number of ox killed	Number of dog killed	Which wildlife is the major responsible for livestock depredation
N	Valid	225	225	225	225	225	225	225	54
	Missing	0	0	0	0	0	0	0	171
Mean		1.02	5.28	.06	.61	.02	.04	.05	8.37
Std. Error of Mean		.010	.233	.018	.129	.011	.016	.021	.066
Std. Deviation		.148	3.501	.277	1.938	.163	.247	.309	.487
Minimum		1	0	0	0	0	0	0	8
Maximum		2	19	2	20	2	2	2	9
Sum		230	1189	14	138	4	8	12	452

Education level and perception/attitude towards wildlife conservation

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Education level * Do you like wildlife	225	100.0%	0	0.0%	225	100.0%

Education level * Do you like wildlife Cross tabulation

Count

		Do you like wildlife		Total
		Yes	No	
Education level	Illiterate	33	14	47
	Primary	35	12	47
	Lower secondary	47	10	57
	Secondary	14	7	21
	Higher secondary	31	8	39
	Graduate	13	0	13
	Post Graduate	1	0	1
Total		174	51	225

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.003[a]	6	.238
Likelihood Ratio	10.940	6	.090
Linear-by-Linear Association	3.093	1	.079
N of Valid Cases	225		

a. 4 cells (28.6%) have expected count less than 5. The minimum expected count is .23.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	-.117	.061	-1.767	.079[c]
Ordinal by Ordinal	Spearman Correlation	-.113	.065	-1.693	.092[c]
N of Valid Cases		225			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

II- Gender and perception/attitude towards wildlife conservation

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Gender of respondent * Do you like wildlife	225	100.0%	0	0.0%	225	100.0%

Gender of respondent * Do you like wildlife Cross tabulation

Count

		Do you like wildlife		Total
		Yes	No	
Gender of respondent	male	119	31	150
	female	55	20	75
Total		174	51	225

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.027[a]	1	.311		
Continuity Correction[b]	.713	1	.398		
Likelihood Ratio	1.008	1	.315		
Fisher's Exact Test				.316	.198
Linear-by-Linear Association	1.022	1	.312		
N of Valid Cases	225				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 17.00.

b. Computed only for a 2x2 table

II. Questionnaire

A. For Household Interview

Household characteristics

1. **Name of respondent:** _____
2. **Gender (Tick):** 1. Male 2. Female
3. **Age of respondent:** _____ years
4. **Ethnic background (Tick):** 1. Tharu 2. Dalit 3. Chhetri 4. Brahamin 5. Other
5. **What level of education have you attained?**

Illiterate	Primary	Lower Secondary	Higher Secondary	Bachelor

6. **Re-settler:** 1. Yes 2.No
7. **If yes, how long have you been here:** _____ years
8. **Why did you resettle:** 1. Infrastructures 2. Resettlement by reserve 3. Encroachment 4. More productivity
9. **Number of family members in the household census:** _____
10. **Occupation of respondent**: 1. Farmer 2. Government employe 3. Business 4. Student 5. Unemployed 6. Wage labour 7. Foreign employment
11. **Approximate distance of the individual homestead from protected areas**
    1. 0-1 km 2. 1-2 km 3. 2-3 km 4. 3-4 km 5. 4-5 km 6. More than 5

12. Current land-use:

(1) Crop farming (2) Livestock 3. Crop & livestock

13. Agriculture land holding

Land holding	Cultivated (acre)	Fallow (acres)	Leased in (acres)	Leased out (acres)

14. If left fallow, what was the reason for land being left fallow?

1. Wildlife problem 2. Shortage of man power 3. Less production 4. Problem of seepage water

15. Crop grown

Food crop cultivated (last season)

Crop types	Paddy	Maize	Wheat	Mustard	Potato	Sugarcane
Area Cultivated(Katta)						
Quantity harvested (kg)						

16. Cash crop grown

Crop types	Ginger	Lentil	Turmeric	Fruit trees
Area Cultivated(Katta)				
Quantity harvested (kg)				

17. Livestock information

Which livestock do you keep? Rank in terms of economic importance

Livestock types	Cow	Goat and Sheep	Buffalo	OX
Tick				
Number owned				

18. How do you feed livestock?

1. Graze in forest, 2. Collect from forest, 3. Farm produce

4. From market 5. Communal land 6. Buffer Zone 7. Produce fodder

19. Have you had a problem of wildlife?

1.Yes 2. No

20. Do you have crop damage?

1. Yes 2. No

21. Crop lost to wild animals?

1. Yes 2. No

List of crop damage against wild animal

Wild animals	Paddy	Maize	Wheat	Mustard	Potato	Sugarcane	Time
Elephant							
Rhino							
Swamp deer							
Blue bull							
Spotted deer							
Monkey							
Rabbit							
Pudkey Badel							
Porcupine							
Peacock							

Code (Time): 1. Early morning 2. Daytime 3. Evening 4. Night 5. Anytime

Estimated crop damage percent	Estimated cost of crop damage

22. Did you have livestock damage?

1. Yes 2. No

23. What wildlife species was involved?

1. Tiger 2. Leopard

24. Numbers of livestock killed in last four years.

Cow	Goat & Sheep	Buffalo	Ox	Dog

25. Estimated cost of livestock damage: _____

26. Do you have human causalities?

1. Yes 2. No

27. If yes, specify the nature of human causalities?

1. Human death 2. Serious human causalities 3. Normal human injury

28. Do you have stored grain damaged?

1. Yes 2. No

Quantity of stored grain damaged	Estimated cost of stored grain damaged

29. Do you have house/shelter destruction?

1. Yes 2. No

Quantity of house/shelter destruction in last five years.	Estimated cost of house/shelter destruction

30. Total cost of damages due to wildlife _____

31. What is the trend of crop damage due to wildlife?

1. Increasing 2. Decreasing 3. No change

32. If crop damage has increased, what is the cause of increase?

1. Increase in wildlife population 2. Community forest 3. Lack of fencing

4. Reduction in guidance by human

33. If crop damage has decreased, what is the cause of decrease?

1. Alternative source of income 2. Increase in number of park posts 3. Fencing

4. Machan

34. What is the trend of human casualties?

1. Increasing 2. Decreasing 3. No change

35. If human casualties had increased, what is the cause of increase?

1. Increase in wildlife population 2. Community forest 3. Lack fencing 4. Degradation of forest and deforestation

36. If human casualties have decreased, what is the cause of decrease?

1. Restriction in forest 2. Increase in number of park post 3. Awareness 4. Fencing

37. What is the trend of livestock depredation?

1.Increasing 2. Decreasing 3. No change

38. If livestock depredation has increased, what is the cause of increase?

1. Increase in wildlife population 2. Community forest 3. Lack of fencing 4. Degradation and deforestation

39. If livestock depredation has decreased, what is the cause of decrease?

1. Restriction in forest 2. Increase in number of park post 3. Awareness 4. Fencing

40. What is the trend of house/shelter damage?

1.Increasing 2. Decreasing 3. No change

41. If shelter damage has increased, what is the cause of increase?

1. Increase in wildlife population 2. Community forest 3. Land use change of routes of wildlife 4. Smell of local materials used in alcohol

42. If shelter damage has decreased, what is the cause of decrease?

1. Decrease in wildlife population 2. Improvement in wildlife habitat 3. Effective management by park authority 4. Increase in number of park post

43. What is the trend of stored grain damage?

1.Increasing 2. Decreasing 3. No change

44. If stored grain damage has increased, what is the cause of increase?

1. Increase in wildlife population 2. Community forest 3. Land use change of routes of wildlife 4. Smell of local materials used in alcohol

45. If stored grain damage has decreased, what is the cause of decrease?

1. Decrease in wildlife population 2. Improvement in wildlife habitat 3. Effective management by park authority 4. Increase in number of park post

46. Where was the problem taken place?

1. Wildlife reserve 2. Buffer zone 3. Buffer zone community forest 4. Farm land 5. Human settlement area

47. Which year did the problem start?

1. This year 2. >1-10 years ago 3. >10-20 years ago 4. Over 20 years ago

48. Number of incidence per year

1. Once 2. Twice 3. Thrice 4. More than 3 times

49. In which period of year problem is more severe?

1. January 2. February 3. March 4. April 5. May 6. June 7. July 8. August 9. September 10. October 11. November 12. December

50. What is the cause of change of cultivation of crops?

1. Wildlife problem 2. Less productivity 3. Lack of manpower

51. Have you experienced land use change of SWR and its BZ?

1. Yes 2. No

52. What are the consequences of crop-livestock and property damage? (Tick)

(1) Reduction in overall food supply to a family (2) Shift to alternative means of income (3) Poor family wealth (4) Other-Specify

53. What are the consequences of death or injury to the principle earner or women? (Tick)

(1) Family depth due to paid employment (2) Aggravated pre-existing poverty (3) loss of children School attendance (4) Distribution of children parent relationship (5) Poor child development (6) Other-Specify

54. What problems are you facing while guarding crops and livestock? (Tick)

(1) Diseases due to malaria (2) Mental health morbidity due to lack of sleep at night (3) Children's poor school attendance and performance (4) Low possibility of future employment opportunities (5) drop out of school (6) Fair to travel (7) Other-Specify

55. What could be the possible cause of land use land cover change of SWR and its BZ?

1. Agriculture expansion 2. Encroachment 3. Population growth 4. Infrastructure Development 5. Overgrazing 6. Uncontrolled forest fire 7. Resettlement by reserve 8. Riverbank cutting

56. Do you use mitigation measures?

1. Yes 2. No

57. If yes, what measures do you use to prevent crop damage due to wildlife? Tick the ones that you use

Mitigation measures	**Tick**	**Effectiveness (1. Less effectiveness, 2. Effective, 3. Most effectiveness)**	**Effective against what species**
Making fire			
Scare crow			
Live fence			
Making noise			
Wooden fence			
Clearing bushes			
Beating drum			
Guarding by dogs			

58. What mitigation measures do you think park should provide?

1. Dry stone wall 2. Electric fence 3. Solar fence 4. Education and awareness 5. Insurance and compensation 6. Alternative crops

59. Do you like wildlife?

1. Yes 2. No

60. Why do you like wildlife?

1. Beautiful species 2. Endangered species 3. Maintains eco-system

5. Part of our life/culture/religious

61. Why don't you like wildlife?

1. Attacks/Injuries/kills livestock 2. Attacks/Injuries/kills humans 3. Crop damage

62. Reason behind conservation of wildlife

1. Religious Importance 2. Tourism aspects 3. Ecosystem importance

63. Do you like wildlife in community forest?

1. Yes 2. No

65. Do you think wildlife should be conserved?

1. Yes 2. No

66. Are you satisfied from thee problem wildlife management?

1. Yes 2. No

67. Knowledge about conservation of wildlife by laws

1. Yes 2. No

68. People's response in absence of wildlife at SWR and its BZ?

1. Sad 2. Relieved 3. Indifferent

69. I support wildlife conservation even if my family member is killed?

1. Agree 2. Neutral 3. Disagree

70. I support wildlife conservation even if my family member is attacked and injured?

1. Agree 2. Neutral 3. Disagree

71. I support wildlife conservation programs even if my family member is killed?

1. Agree 2. Neutral 3. Disagree

B. For Key Informant Interview

1. What type of human-wildlife conflict occurs in this PA? Which one is a more serious threat for conservation?

2. How are these conflicts mitigated/ minimized?

3. How are problems wildlife handled/managed?

4. Can you suggest other better ways of minimizing conflict?
5. What measures can be adopted to increase tolerance of people to losses by wildlife? (Please give 0 for least priority and 4 for highest priority):

a. conservation education/awareness
b. timely monetary compensation against losses
c. effective local participation in management and conservation activities
d. implement ICDP
e. others (specify):

6. Do you have any record of revenge killing of wildlife? Please give details (no., where, when)

7. Have you have faced any problems in wildlife conservation due to human-wildlife conflict? Please specify:

8. How can wildlife be conserved in a better way?

9. How can involvement of local people in wildlife poaching be minimized?

C. Checklist for focus group discussion

1. Current land use practice
    - Crop
    - Livestock
    - Crop and livestock
2. How people observe land use/land cover changes in their locality?
3. What could be the possible factors to cause land use/ land cover change at Suklaphanta wildlife reserve?
4. The trend of the hill migrant to the Suklaphanta buffer zone
5. Community forestry is effecting land use pattern and why?
6. Nature and trend of the human wildlife conflict at Suklaphanta wildlife reserve
7. Does community forestry play a vital role to increase in human wildlife conflict.
8. Reasons behind the increase in trend of the human wildlife conflict.
9. Suklaphanta buffer zone community adopted mitigation measure and their effectiveness in order to reduce the human wildlife conflict.
10. Local people perception towards wildlife conservation.

PHOTO PLATES: Field Visit: 1. Monkeys visit on farm land. 2. Interaction with local farmers

3. Interaction with local farmers.

4. Crop damage by wild pig

5. Livestock grazing

6. Blue bull

Buffer zone community adopted mitigation measures




Consequences of HWC