

**HUMAN–LEOPARD CONFLICT IN SHIVAPURI-NAGARJUN  
NATIONAL PARK, KATHMANDU, NEPAL**



**RABINA DHAKAL**

TU Registration No: 5-2-37-570-2011

TU Examination Roll No: 336

Batch: 2072

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**Submitted to**

Central Department of Zoology  
Institute of Science and Technology  
Tribhuvan University  
Kirtipur, Kathmandu  
Nepal

## **DECLARATION**

I hereby declare that the work presented in this thesis entitled "HUMAN-LEOPARD CONFLICT IN SHIVAPURI- NAGARJUN NATIONAL PARK, KATHMANDU, NEPAL" has been done by myself and has not been submitted elsewhere for the award of any degree. All sources of the information have been specifically acknowledged by references to the author (s) or institution (s).

Rabina Dhakal

Date: 3<sup>rd</sup> July



Ref.No.:

**RECOMMENDATION**

This is to recommend that the thesis entitled "**Human-Leopard conflict in Shivapuri-Nagarjun National park, Kathmandu, Nepal**" has been carried out by **Ms. Rabina Dhakal** for the partial fulfillment of Master's Degree of Science in Zoology with special paper Ecology and Environment. This is her original work and has been carried out under my supervision. To the best of my knowledge this thesis work has not been submitted for any other degree in any other institutions.

Date: 3<sup>rd</sup> July

.....

Prof. Dr. Nanda Bdr Singh

Supervisor

Central Department of zoology

Tribhuvan University

Kirtipur, Kathmandu, Nepal



TRIBHUVAN UNIVERSITY

☎ 01-4331896

**CENTRAL DEPARTMENT OF ZOOLOGY**

Kirtipur, Kathmandu, Nepal.

Ref.No.:

## LETTER OF APPROVAL

On the recommendations of supervisor " **Dr. Nanda Bahadur Singh**" this thesis submitted by "**Rabina Dhakal**" entitled "**Human-Leopard Conflict in Shivapuri-Nagarjun National Park, Kathmandu, Nepal**" is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for Masters Degree of Science in Zoology with special paper Ecology & Environment.

Date: 14<sup>th</sup> July

.....

Prof. Dr. Tej Bahadur Thapa

Head of Department

Central Department of Zoology

Tribhuvan University

Kirtipur, Kathmandu, Nepal



Ref.No.:

### **CERTIFICATE OF ACCEPTANCE**

This thesis work submitted by **Ms. Rabina Dhakal** entitled "**Human-Leopard Conflict in Shivapuri-Nagarjun National Park, Kathmandu, Nepal**" has been accepted as a partial fulfillment for the requirements of Master's Degree of Science in zoology with special paper Ecology and Environment.

### **EVALUATION COMMITTEE**

.....

Supervisor

Dr. Nanda Bdr Singh

Professor

Central Department of Zoology

.....

Dr. Tej Bdr Thapa

Head of department

Professor

Central department of Zoology

.....

External examiner

Mr. Juddha Gurung

.....

Internal examiner

Dr. Hari Prasad Sharma

Date of examination: 23<sup>rd</sup> July, 2019

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## **ABBREVIATION**

GPS	- Global Positioning System
HLC	- Human leopard conflict
HWC	- Human wildlife conflict
IUCN	- International Union for Conservation of Nature
SPSS	- Statistical Package for the Social Sciences
KMTNC	- King Mahendra trust for Nature Conservation
NRDB	- National Red Data Book
WWF	- World-Wildlife Fund
VDC	- Village Development Committee
DNPWC	- Department of National Park and Wildlife Conservation
Masl	- meter above sea level
NT	- Near Threatened
SNNP	- Shivapuri-Nagarjun National Park
NTNC	- National Trust for Nature Conservation
CITES	- Convention on International Trade in Endangered Species
RBNP	- Royal Bardia National Park

## ABSTRACT

In present scenario, the topic human-leopard conflict has attracted a great attention. In Nepal, common leopards (*Panthera pardus*) are widely distributed in different protected areas as well as human dominated landscape. The main objective of this study was to assess the human leopard conflict in Shivapuri-Nagarjun National Park. Specific objectives were to find out the present situation and techniques to minimize conflict, livestock depredation and human casualties and quantify it in terms of economic loss and lastly the perception of local people towards leopard conservation. I collected data on livestock depredation, leopard death and human casualties using questionnaire survey (n= 210) in the buffer zone of SNNP and analyzed it in SPSS. The houses were selected by random sampling method. In some of the areas I used Snowball sampling method to know about the people whose livestock were recently depredated by leopard. Only four leopards were found dead and one got injured because of various reasons. The possible reasons repeatedly loss of livestock, road accidents at night time and one was due to the electric current. The total number of livestock depredated by leopard was 131, among them 88 were goats, 32 dogs, six hens, one buffalo, three cow and a calf and also few human beings were injured or attacked by common leopard within 5 years. The total estimated economic loss was US\$ 9,600 whereas only five people got compensation of US\$ 530. The number of leopard visiting to human settlements area had been decreased as well as livestock depredation after a devastating earthquake of 2072 BS. This was mainly due to the destruction of old houses, people movement towards city areas and loss of livestock because of earthquake. Most of the people preferred fencing (37.14%) for the minimization of conflict whereas 12.86% and 10.48% also answered killing and threatening; respectively. Around 30% of respondents believed that conservation of leopard helped in tourism. As, my study area was located in the Kathmandu where there was high literacy rate, every people were aware about the benefits of leopard conservation. So, the different caste group (Brahmin, Chhetri, Newars, and Tamangs) inhabiting in the buffer zone and different age group of people showed positive perception.

# 1. INTRODUCTION

## 1.1 Background

### 1.1.1 Human–wildlife conflict

Conflict between human and wildlife is the critical threats faced by many wildlife species today, and the topic is receiving increasing attention from conservation biologists (Dickman, 2010). Human wildlife conflict (HWC) is defined as any interaction between humans and wildlife that results in negative impacts on human life socially, economically and culturally and also on the conservation of wildlife populations or on the environment (Athreya *et al.*, 2007). Human wildlife conflict arises mainly because of the loss, degradation and fragmentation of habitats through human activities such as logging, animal husbandry, agricultural expansion and developmental projects (Fernando *et al.*, 2005). Human wildlife conflict is a situation when the needs and behavior of wildlife negatively impact on the goals of human or when the goals of human negatively impacts the needs of wildlife (Dickman, 2008). A human wildlife conflict is very common phenomena from the past and becomes serious problem throughout the world (Bhattarai, 2009).

### 1.1.2 Common leopard

Nepal is home for three species of leopard: Common leopard *Panthera pardus*, Clouded leopard *Neofelis nebulosa* and Snow leopard *Uncia uncia*. Common leopard is also called as forest leopard (Ghimirey, 2006). Common leopard is most common among these three species which not only resides in forest or heavy cover but also flourishes in open country (Prater, 1998).

This spotted cat has short powerful limbs, heavy torso, thick neck, and long tail. It has large black spots grouped into rosettes on the shoulders, upper arms, back, flanks and haunches, and smaller scattered spots on the lower limbs, head, throat and chest, and the belly has large black blotches. The body color of leopard is yellow with black spots. The coat color varies from pale yellow to deep gold or tawny, and is patterned with black rosettes. Like human fingerprints, each individual leopard's spots are unique (Brakefield, 1993). The head, lower limbs and belly are spotted with solid black. Coat color and patterning are broadly associated with habitat type (Pocock, 1932). Black leopards (the so-called "black panthers") occur most frequently in humid forest habitats (Kingdon, 1977), but are merely a color variation, not a subspecies. The leopard's dark rosettes help it to blend into the foliage while stalking their prey.

### 1.1.3 Distribution of common leopard

Geographically leopards are distributed throughout Asia and Africa along with the Amur valley of Russia (Bailey, 1993; Edgaonkar, 1993; Chellam, 1998). Leopards are the most common felid widened throughout much of the Sub-Saharan Africa, the Middle East and much of tropical and temperate Asia (Nowell and Jackson, 1996). In south Asia Pakistan,

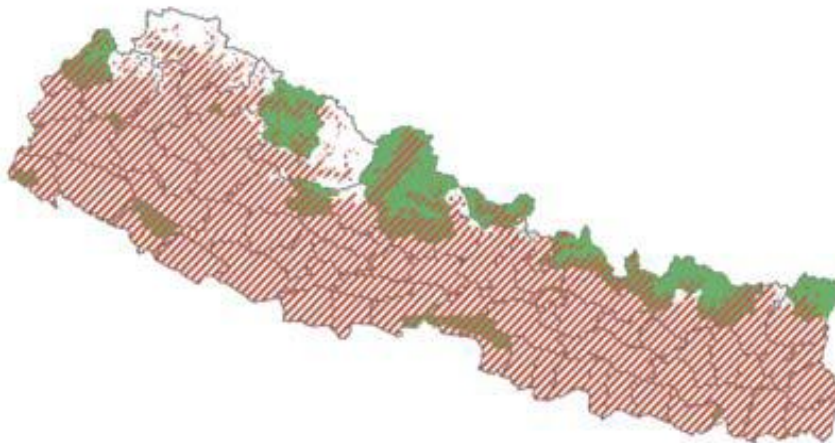
India, Nepal, Sri-lanka and Indo-China are countries where Leopards are distributed (Shrestha, 1997).



(Source: IUCN Red list of threatened species, 2016)

**Figure 1: Spatial Distribution of leopard's habitat**

Nepal has recorded 12 felid species including common leopard which has large size in comparison with others (Lamichhane *et al.*, 2016) and also most generous and universal wild representative of Felidae family (Nowell and Jackson, 1996). Out of seventy-five districts, Common leopards are vastly spread in seventy-three districts except Dhanusha and Okhaldhunga up to 3,000 m sharing its habitat with Snow leopard (Shah *et al.*, 2004; Jnawali *et al.*, 2011).



(Source: Jnawali *et al.*, 2011)

**Figure 2: Distribution of Common leopard (*Panthera pardus*) in Nepal**

The home range of leopard is so varied that from 6 km<sup>2</sup> (Seidensticker, 1990) to over 2000 km<sup>2</sup> (Bothma *et al.*, 1997) can be occurred. In Nepal, leopards can inhabit in areas below 4400masl of elevation (KMTNC, 1998) and even reported at 5200m of elevation (Jackson, 1984).The leopards lead a solitary lifestyle. Males inhabit territories of 5 to 40 square km, which may overlap with the territories of several females. Annual home ranges of the two males in the study conducted by Odden and Wegge (2005) in RBNP, Nepal were 47 and 48 km<sup>2</sup> and had an overlap of only 7%, whereas the overlap between the female's home range (17 km<sup>2</sup>) and that of one of the males was 56%.

Availability of prey resources, habitat, landscape feature and also human attitude and activities towards leopard influence the distribution pattern of this species (Zimmermann, 2004).

#### **1.1.4 Behavior and Food**

The leopard is very strong and lithe cat which is capable of climbing trees carrying prey up to three times its own weight. The leopard can also descend trees head first. Because of its powerful limbs, the leopard can easily leap forward more than 6 meters and upward more than 3 meters. Along with the jaguar, the leopard is considered the strongest of the wild cats. The leopard and jaguar are judged to be roughly 10 times stronger than a human athlete of the same weight (Plessis and Smit, 2005).

Leopards lead a solitary and nocturnal lifestyles generally kill more prey at night between sunset and sunrise (Hamilton, 1976; Bailey, 1993). One of the unique and opportunistic behaviors of leopard is that it can ambush terrestrial prey by leaping down from the branches (Kruk and Turner, 1967). Leopards show behavioral differences in habitats where they are not competing with larger carnivores (Eisenberg and Lockhart, 1972).

They usually preferred to hunt on the medium sized prey species like ungulates as a primary food (Bailey, 1993 and Thapa, 2011) and also small preys like hare, rodents, birds, reptiles, mongoose, porcupine and large size prey species like cattle and buffalo (kumar, 2011). Leopards are responsible for livestock depredation even there are delimited wild species in forest because of their habitat preference i.e. forest, bushes and agricultural land (Maharjun, 2016).

#### **1.1.5 Conservation status of common leopard**

Globally leopards are vulnerable (IUCN, 2016) and nationally also vulnerable under criterion D based on a population suspected to consist of fewer than 1,000 mature individuals (Jnawali *et al.*, 2011) and get killed for socio-economic reasons, as their demand for bones and skin is high (Bailey, 1993). The leopard is listed in Appendix I in the Convention on International Trade in Endangered Species (CITES) which prohibits trade of leopard or its body parts. Leopard is not listed under the protected mammal of Nepal under the Department of National Parks and Wildlife Conservation Act 1973 (DNPWC 1973), but included as a susceptible mammal in National Red Data Book (NRDB, 1995).



### 1.1.6 Human-leopard conflict

Leopards reside both in protected areas and outside the protected areas and also on the periphery of human settlements unlike the tiger (*Panthera tigris*) which lives primarily inside the protected areas (Prater, 1948; Santiapillai *et al.*, 1982; Tikader, 1983; Johnsingh, 1992). It is so because they are highly adaptable species and they can eat wide variety of prey species (Prater, 1948; Betram, 1982; Edgaonkar and Ravi 1997, Stander *et al.*, 1997; Mukherjee and Mishra, 2001; Kulkarni *et al.*, 2004). Leopards can easily inhabit in croplands in human dominated areas (Athreya *et al.*, 2004). This close proximity to humans often results in conflict. Secretive nature and increment in population size define leopard as most problematic wildlife species (Ghimirey, 2006).

Leopard is common in the forests across Himalayas and its food is wild prey species such as ghoral, barking deer, wild boar, and jungle fowl (Kumar, 2011). Leopard population continue to decline because of many factors such as decreasing animal prey and habitat loss so, leopards often enter villages to find food including livestock (Partasasmita *et al.*, 2016). Increase in conflict between leopard and human during last decade may be the result of habitat fragmentation, scarcity of wild prey species, livestock depredation and to some extent may be due to the increase of leopard population (Kumar, 2011). Ecological, biological and anthropogenic factors operate independently to cause the global decline of carnivore species (Cardilo *et al.*, 2004). Human carnivore conflict is a global problem negatively impacting carnivore populations and local livelihoods worldwide (Constant *et al.*, 2015). Livestock depredation by carnivores is one of the main causes of human carnivore conflict (Graham *et al.*, 2005).

Livestock depredation occurs in almost all areas where livestock and large carnivore co-exist (Karlsson and Johanson, 2010). With strict protection of habitats, bans on hunting and public awareness programs, populations of big cats have increased in a few protected areas (Nowell and Jackson, 1996); however, their population declines in most areas are mainly due to wildlife trade and prey depletion (Karanth and Sunquist, 1995).

As it causes serious threat to human welfare the human-leopard conflict attracts the great attention in the present scenario (Wang and Macdonald, 2006). Leopards are particularly prone to conflict with livestock herders because of their prey preferences, which is between 10 to 40 kg, the same as goat and sheep (Hayward *et al.*, 2006). People lose their crops, livestock, property and sometimes their lives on the other hand animals, which are already endangered or threatened, are often killed by the people (Mishra *et al.*, 2004). Conflict affects both the people and animal.

For the effective conservation and management of wildlife and protected areas, the information on biodiversity such as distribution of wildlife, their home range, community interaction and contribution in the development of ecosystem is very necessary (Basnet, 1998). The current situation of anthropogenic dominance means that humans should now take responsibility for managing as well as maintaining the diversity of wild species and ecosystem (Hutton and Leader-Williams, 2003).

Only one factor cannot define the causes of livestock depredation by big cats, there are lists of it. Some studies shows that depredation rates are directly related to rainfall, livestock husbandry practices, village's characteristics and livestock enclosure and number of natural prey (Woodroffe and Frank, 2005).

## **1.2 Objective of the study**

### **1.2.1 General Objective**

- To assess the human-leopard conflict in Shivapuri- Nagarjun National Park.

### **1.2.2 Specific Objectives**

- To explore the current situation of human-leopard conflict and techniques adopted by the local people to minimize conflict in SNNP.
- To evaluate the livestock depredation and human casualties by leopard and quantify it in terms of economic loss.
- To identify perception of local people towards leopard conservation.

## **1.3 Rationale of the study**

SNNP altogether occupy area where Human-wildlife conflict occurs most frequently. Wildlife species such as barking deer, common leopard, monkey, wild boar are of prime concern. Though, the park head office recently confirmed the buffer zone areas, the mitigation measures for conflict has not been properly implied. The status of leopard in SNNP is uncertain. Most of the research work head the topic of Human-wildlife conflict but neither on the status of wildlife species particularly leopard.

Human-leopard conflict is serious threat that attracts the great concern in present scenario. Mostly the conflict occurs in the buffer villages of National parks and Conservation areas. Direct contact with wildlife occurs in both rural and urban areas, but it is more common in outside and inside protected areas. People lose their crops, livestock, property and sometimes their lives on the other hand, animals which are already endangered or threatened, are often killed by the people (Mishra *et al.*, 2004).

Livestock depredation by carnivores is one of the main causes of human carnivore conflict (Graham *et al.*, 2005) and it occurs in almost all areas where livestock and large carnivore co-exist (Karlsson and Johanson, 2010).If the solutions to the conflicts are not adequate, local support for the conservation declines. The studies on conflict provide the information about the current situation of conflict and local people perception towards the conflict which help in minimizing the human wildlife conflict.

The conservation program should address the problem of livestock depredation which helps in gaining the support of local people for the conservation of leopard in the local area.

#### **1.4 Limitation of the study**

Present research work is meant for Master Level Dissertation and following limitations felt during the study.

- It was difficult to know about the buffer zones areas because of the local level election which modify the ward numbers of municipalities.
- It was difficult to do questionnaire survey in some of the areas due to its topography. There were no public vehicle in some areas of Shankharapur Municipality and Tokha Municipality So, walking for 5-6 hrs to reach there was not possible.

## 2. LITERATURE REVIEW

Human-wildlife conflict is an interaction between people and wildlife which negatively affect wildlife populations, environment as well as social, economic and cultural life of human (Madden, 2004). According to World Wildlife Fund (WWF), human-wildlife conflict led to the endangerment and also extinction of several species as it often occurs when human being and animals collide as a result of invasion on territory, deforestation and poaching and habitat loss. Thus, HWC is survival threat to many animal species.

Today's we are only focusing in capitalistic development where numerous new technologies are invented day by day for humans welfare either by deforestation or by fragmentation of natural habitat, these anthropogenic activities directly affect the habitat of wildlife. Globally, human activities such as settlement expansion, habitat loss, fragmentation, land use practices, depletion of natural prey are occurring. The biggest threats for carnivores are poaching and retaliation killing (Nowell and Jackson, 1996; Thapa, 2011).

Quammen (2003) stated that leopards are very adaptable, and can live close to human habitations, they generally avoid human and tolerate proximity to humans better than lions and tigers and often come into conflict with humans when raiding livestock.

Karanth *et al.* (2004) explained that carnivore density is known to be independent on prey density and conflict tends to increase during periods of drought or when the leopard's natural preys became scarce.

Athreya *et al.* (2007) stated that increasing population of leopard outside the forest in certain areas accompanied by a large number of attacks on people showed the high density, which is a result of declining natural habitats, prey species and preyed on domestic animals in huge number. The frequently sighted leopard cubs in agricultural fields indicated rising of the number of leopard.

Athreya and Belsare (2007) conducted study across India which confirmed that there is important role of domestic dog in the leopard's diet which shows that the abundance of feral animal populations helps sustain leopard populations in human dominated areas in India.

Thapa (2011) showed the activity of leopard was found to be slightly higher during the night time, about 52% both males and females were found to be more active between 16:00-22:00 hours and 53% of livestock were killed during night and 47 % killed during day from grazing field nearby villages.

Angelici (1998) reported that population of leopard declined significantly in most of the African continent because of the value of the beautiful spotted pelts. Similarly, Retaliatory killing occurs across the leopard range, but it is correlated with human attacks and livestock depredation (Shah *et al.* 2004).

## 2.1 Human-leopard conflict in world

In June 2005, leopard killed six women in Gallies forest located in the Western Himalaya of Pakistan. As a result, the retaliatory killings of the leopards increased (a total of 15 leopards killed within three years from the area), attacks on human beings also increased (17 human beings were attacked and badly injured by the leopard) and rate of livestock depredation also increased (Waseem and Khan, 2014).

Sanei (2011) documented that the forest converted to highway, housing areas and other land uses causing the low density of leopards due to small size of habitat despite of the availability of prey species. It is suggested that minimum four individuals survived in 1411ha protected area of Malaysia (Ayer Hitam Forest Reserve in Selangor).

Ahmed *et al.* (2012) conducted a questionnaire survey to understand the level of human – carnivore conflict, 16 villages was selected and 238 people were interviewed. Altogether 57 livestock depredation events was reported among them leopard was involved in 27 incidents.

Kabir *et al.* (2013) conducted a household survey where a total of 301 livestock were killed between June 2007 and August 2008 by leopards. Small bodied were more vulnerable than large bodied cattle.

Kala *et al.* (2013) estimated that leopard density was approximately 0.33/km<sup>2</sup> in the sanctuary and killed 1,763 domestic animals about 90% of which were cattle, during a 14 year period. Within the sanctuary, leopards killed 1 person and injured 9 others.

Shehzad *et al.* (2014) recognized that common leopard is a generalist predator, subsisting mainly on domestic animals. Based on the frequency of occurrence of prey items in 57 faecal samples, the diet of leopard is dominated by domestic goat(64.9%), followed by domestic dog (17.5%) and Cow Bos Taurus (12.3%). Domestic animals occurred in 54(95%) of the 57 samples.

Atreya *et al.* (2014) reported that almost complete dependence of leopards (*panthera pardus*) on domestic animals as prey in the crop land of Ahmednagar district, Maharashtra India. From the analysis of 85 confirmed leopard scats 87% of the leopard's prey biomass consisted of domestic dogs (*Canis lupus familiaris*) alone. The only wild sps that occurred in the leopard diet were rodents, small civets, *Viverriculaindica*, bonnet macaque, *Macaca radiata* and other primates.

Constant *et al.* (2015) explored the impacts, characteristics and management of human-leopard conflict on game and livestock in the Blouberg Mountain Range. Leopards represented 89% of reported game attacks with highest number of attacks on impala and 60% of reported livestock attacks.

## 2.2 Human-leopard conflict in Nepal

According to Karanth and Sunquist (1995) the average weight that leopard killed was 37.6kg. Eliasson (2003) researched in Royal Bardia National Park (RBNP) about diet composition of leopard which results that smaller chital, domestic mammals monkeys, and small wild mammals constituted their main prey in all seasons, whereas, in dry season wild boar and birds constituted as important prey.

Tamang (2000) reported that in the Buffer zone area of Royal Bardia National Park, livestock depredation was quite high. It was found that the depredation by the leopard was second only to Tiger. The livestock depredated by leopard during six years was 87 which were 19.68% of the total loss.

Human-leopard conflict mostly occurs in midland regions (the terai, mid hills and lesser Himalaya) of Nepal (Maskey *et al.* 2001).

.Ghimirey(2006) conducted the household survey to know the magnitude of livestock depredation caused by the leopard .The total annual monetary loss due to depredation came out to be as 5,45,000which is equivalent to US\$7370.84.The depredation per household came out to be NRs3585.35 which is equivalent to US\$ 48.49.

Koirala *et al.* (2012) explained that human-leopard conflict is related to livestock depredation .The highest losses to common leopard were suffered in winter and in grazing land,with goats being the major victim .the highest financial impact was associated with predation on goats,with common leopard accounting for 95% of total monetary loss to predators over the two year study period.

Aryal *et al.* (2014) explored the interaction between livestock and predators in the upper Mustang region of Nepal in terms of economic and ecological impacts .The number of livestock killed by the predators during the study period was 706, 75%of which was attributed to snow leopards. An estimated US\$44,213 was lost between October 2009 and June 2011 due to livestock predation.

Gosai *et al.* (2014) carried out a questionnaire survey where two hundred respondents from different places were questioned, 75% of them were Newars and 85% had farming occupation. Among them 40% respondents had lost their livestock and 6 people had been killed by leopards.

Karki and Rawat (2014) estimated the human casualties by leopards and preventive measures to reduce casualties. A total of 18 humans have been killed during 27 months in 7 village Development Committees (VDCs) including 3 injuries during 23 June 2011 to 28 Feb. 2014.Most of them are children and girls.

### **2.3 Perception towards leopard conservation**

The study conducted by Ghimire (2006) to perceive the status of common leopard in Kunjo VDC of Mustang district, Nepal with many evidences such as pugmark, scats and scraps from which concluded the presence of common leopard in that area and he also reported that 39.46% local people agree that the leopard conservation benefit us as they act as a supportive to the biodiversity conservation, tourism development and ecological balance while 30.26% people think that there are no benefits of leopard.

Khatiwoda (2006) interviewed with 26 household in Kanchanjunga Conservation Area which revealed that 51% of the respondents had negative attitudes towards snow leopard due to its livestock depredating nature.

Dar *et al.* (2009) researched in and around the Machiara National Park showed the negative perception of people towards leopard as it causes the greatest financial loss (19.8%) amongst other carnivores.

According to Thapa (2011), study conducted in Chitwan National park, about 65% of local people gives positive perception towards leopard conservation, this positiveness symbolize the importance of leopard in natural ecosystem, tourism industry and recreation and lastly religion/ cultural.

A research carried in Kanha-Achanakmar Corridor, Central India about Human-carnivore conflict showed that leopard is most common for livestock damage and is high in monsoon which creates negative impact on local community but still people have positive attitudes towards its conservation (Ahmed *et al.* 2012).

Koirala *et al.* (2012) conducted a study on human-leopard conflict in Annapurna Conservation Area of Nepal concluded that leopard killed more livestock than any other predators. The majority of the local people expressed strongly negative views toward conservation of the leopard.

Bhandari (2015) conducted a questionnaire survey where 200 questionnaire sheets were used to collect information, 65% of total respondents like common leopard while 35% local wanted to displace leopard, 77 respondents wanted an increase in population of leopard, 94 of them wanted to decrease and 29 had no any idea which results that maximum number of people had negative perception though they like leopard.

Khajju (2017) conducted a questionnaire survey in Bhaktapur area where 26% had high positive view towards the conservation of this beautiful creature leopard and 56 responded as positive only whereas 16 % answered there is no any benefit of conserving leopard.

## 3. MATERIALS AND METHODS

### 3.1 Study area

#### 3.1.1 Location

Shivapuri-Nagarjun National Park is situated in the North side of Kathmandu valley (Figure 3). The park Headquarters is in Panimuhan, Budhanilkantha Municipality of Kathmandu District. It was established in 2002 AD. SNNP has two islands of forest namely Shivapuri and Nagarjun. Geographically, Shivapuri forest located within 27°45' to 27°52' N latitude and 85°16' to 85°45' E longitude and Nagarjun forest is located within 27°43' to 27°46' N latitude and 85°13' to 85°18' E longitude. It claims part of Kathmandu, Nuwakot, Dhading, and Sindhupalchowk districts of Nepal. The elevation range is 1350 masl to 2732 masl. (SNNP, 2014)

#### 3.1.2 Climate

The park is located in a transition zone between subtropical and temperate climate. The annual precipitation of about 1,400 mm falls mostly from May to September, with 80% during monsoon. Temperatures vary from 2–17 °C during the winter season, rising to 19–30 °C during the summer season. (SNNP, 2014)

#### 3.1.3 Flora and fauna

Shivapuri-Nagarjun national park is located in sub-tropical and lower temperate zone of Nepal. Park has recorded 1250 species of vascular plants and 129 species of mushrooms. *Schima-Castanopsis*, Pine, and Oak-Rhododendron are the dominant vegetation in this park. SNNP has four major types of forest

- (i) Lower mixed hardwood forest
- (ii) Chirpine forest
- (iii) Oak forests
- (iv) Upper mixed hardwood forest

The common vegetation includes Chilaune (*Schima wallichii*), Chesnut (*Castanopsis indica*), Utis (*Alnus nepalensis*), Chirpine (*Pinus roxburghii*), Bayberry (*Myrica esculanta*), Wild Himalayan pear (*Pyrus pashia*), Laligurans (*Rhododendron arboretum*), Common walnut (*Juglans regia*), and Himalayan yew (*Taxus wallichiana*).

Clouded leopard (*Pardofelis nebulosa*), pangolin (*Manis* sp.), Assamese monkey (*Macaca assamensis*), leopard cat (*Prionailurus bengalensis*) are the protected mammals found in SNNP. Common mammals include common leopard (*Panthera pardus*), Himalayan black bear (*Ursus thibetanus*), Himalayan goral (*Naemorhedus goral*), jungle cat (*Felis chaus*), Himalayan serrow (*Capricornis thar*), wild boar (*Sus scrofa*), barking deer (*Muntiacus muntjak*), rhesus monkey (*Macaca mulata*) and yellow throated marten (*Martes flavigula*).



The park has 311 species of birds including 117 migratory birds. Common species of bird species are white backed vulture (*Gyps africanus*), Himalayan griffon (*Gyps himalayensis*), black vulture (*Coragyps atratus*), beard vulture (*Gypaetus barbatus*), dark kite (*Milvus migrans*), hen harrier (*Circus cyaneus*), goshawk (*Accipiter gentilis*), sparrow hawk (*Accipiter nisus*), common buzzard (*Buteo buteo*), Asian black eagle (*Ictinaetus malaiensis*), steppe eagle (*Aquila nipalensis*) kalij pheasant, leaf birds (*Chloropsis spp*), bushchat (*Saxicola caprata*), cuckoos (*Cuculus canorus*). Importantly, the spiny, wren babler (*Pnoepy gapusilla*) are the endemic birds found in Shivapuri-Nagarjun National Park.

King cobra (*Ophiophagus hannah*), green pit viper (*Trimeresurus albolabris*) and rat snake, skink, lizards, geckos are common reptiles found in SNNP. Frogs and toads are common amphibians. The park has 102 species of moths and butterflies. (SNNP, 2014)

### 3.1.4 Socio-Economy

The Kathmandu valley has been home to people of various ethnicities with different traditions and cultural practices. The largest ethnic groups are Brahmins followed by Newars, Chetri and Tamangs in buffer zones. Some of them are native to that land whereas some migrated from other hilly and terai regions. As a whole buffer zone covers 14,558 households and the total population is 79,776 where 40,187 are females and 39,789 are males. People living nearby Shivapuri forest patch are mostly involved in farming and livestock rearing but in Nagarjun forest patch they are involved in business and cooperate jobs. This might be due to the easy availability of different facilities such as roads, internet etc.

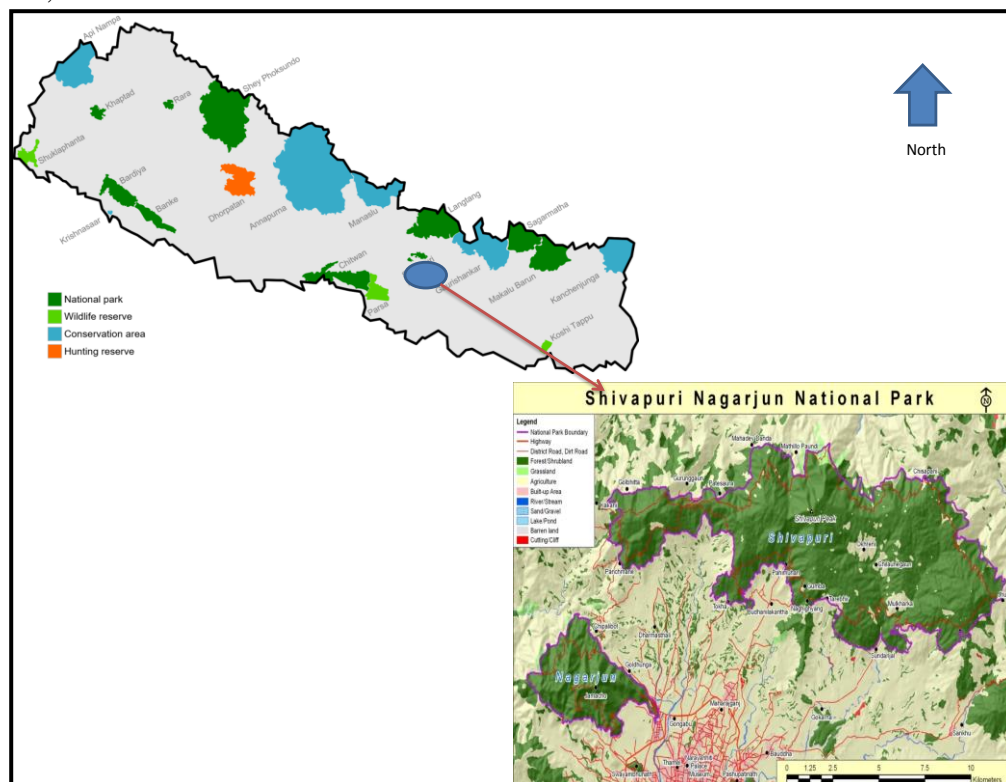


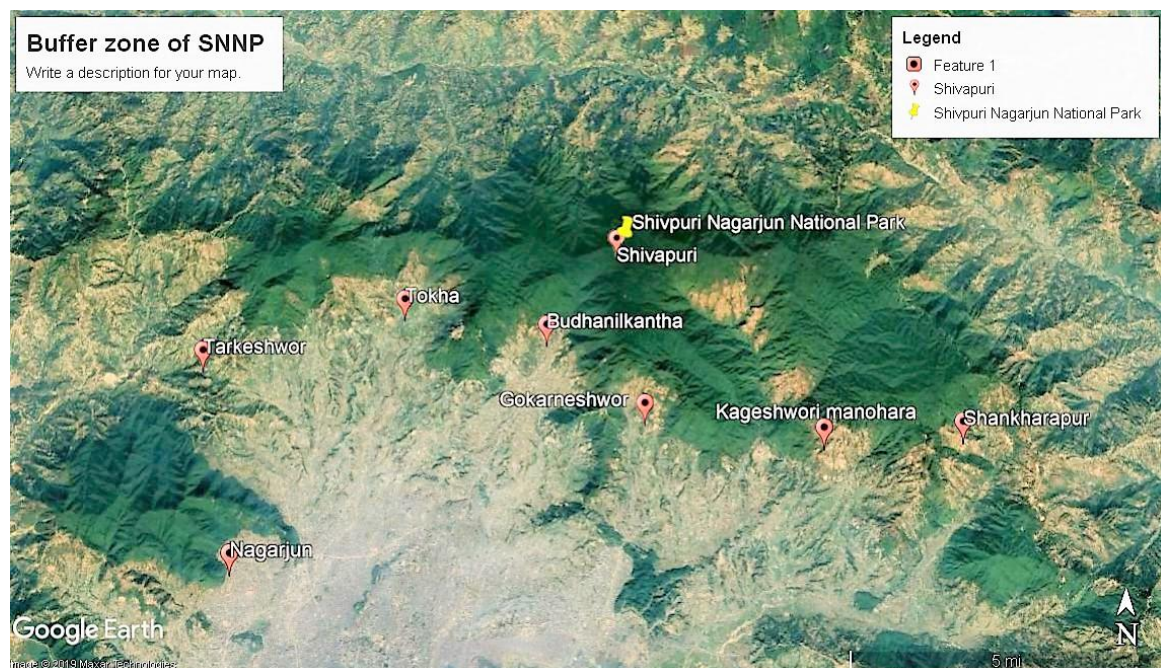
Figure 3: Map of the study area (SNNP) in the map of the protected areas of Nepal.

### 3.2 Buffer zone

On Chaitra 15, 2072 B.S Government declare the buffer zone areas of SNNP which primarily include 29 VDC of four districts (Kathmandu, Nuwakot, Sindhupalchwok and Dhading). As per the Buffer zone bulletine, there are altogether 149 wards in 29 VDC among them buffer zone occupies only total area of 105 wards and half of the area of remaining 44 wards. (Bufferzone bulletine, 2016)

About 27.174 sq km or 23.28% of areas of buffer zone is occupied by forest and 83.893 sq km i.e 74.47% is used as agricultural land whereas only 2.616 sq km (2.24%) is used for other purposes such as settlements. But now, the election held in 2074 modified some of the areas of buffer zone. I had conducted research in buffer zone areas of Kathmandu district which include 7 municipalities named

1. Nagarjun Municipality- Ward no, 2, 1, 8, 6 and 3
2. Tarkeshwor Municipality- Ward no, 1, 2, 3, 4, 5 and 7
3. Tokha Municipality- Ward no, 1, 2 and 4
4. Budhanilkantha Municipality- Ward no, 1, 2 and 5
5. Gokarneshwor Municipality- Ward no, 1, 2 and 3
6. Kageshwori -Manohara Municipality- Ward no 1
7. Shankharapur Municipality- Ward no 1, 2, 4, and 8



**Figure 4: Map of study area showing Buffer zones**

### **3.3 Materials**

GPS, Pen, Notebook, Camera were used in research study.

### **3.4 Methods**

#### **3.4.1 Data sources**

The sources of data used were primary and secondary data. Primary data were collected through field visit, direct observation, formal and informal interviews and questionnaire survey with the local people whereas secondary data sources were collected through literature, headquarter of SNNP and internet.

#### **3.4.2 Data Collection**

##### **3.4.2.1 Primary data collection**

Firstly, preliminary survey was done in September and visit to Pani Muhan head office to know about the current situation of the conflict. Then after field visit and semi-structured questionnaire set were used to get primary information from the area. Field visit period was one month from November to December, 2018.

##### **3.4.2.2 Sampling method**

My study area includes seven municipalities of Kathmandu zone which lies in buffer zone. Only some wards of these municipalities were partly occupied by buffer zone. Random sampling method was implied to conduct the questionnaire survey to find out the suitable causes, mitigation measures and people's perception about leopard conservation and satisfaction of local people about the compensation provided by national's park office.

Similarly, Snowball sampling method was used to find key informants such as member of buffer zone user committee, ward's office head to know the information regarding compensation pattern, People whose livestock was killed by leopard, most conflicted animals and also the mitigation measures of the conflict in local level.

##### **3.4.2.3 Questionnaire survey**

There are altogether seven municipalities from Kathmandu district which are included in buffer zone of SNNP. There are about 14,478 households in the buffer areas. Altogether, 210 household from seven municipalities were questioned. These respondents include equal number of males and females. The key informants for the questionnaire survey were the local people whose livestock had been killed by leopard recently.

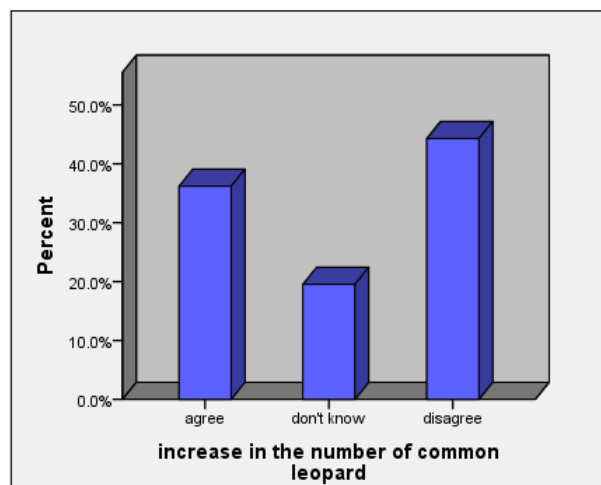
### **3.5 Data Analysis**

The collected data from questionnaire survey were analyzed by combining data of questionnaire, interview survey and personal communication with national park's officers and member of buffer zone user committee. Every questions as well as responses of the respondent were coded in SPSS 20.0 software for analysis of responses statistically and the results obtained from different set of questions were calculated in terms of percentage. Line chart, pie-chart and bar chart were produced to represent the responses of respondent. GPS location of most conflicted areas among all the wards of seven municipalities was shown in the map using Google Earth.

## 4. RESULTS

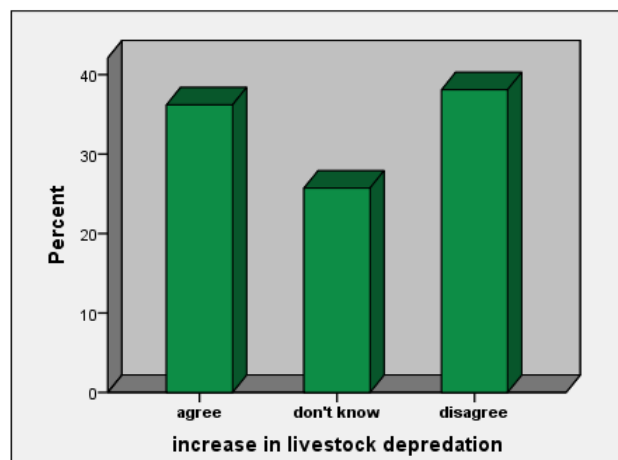
### 4.1 Current situation of Human leopard conflict

Among the 210 respondents, 36.2% agreed that the population of leopard had been increased in recent years whereas 19.5% didn't know about the increasing and decreasing of leopard population and 44.3% disagreed as shown in figure 5. Before an earthquake leopard frequently visit to the human settlements area and many people had seen them, but now they hadn't seen leopard for longer time.



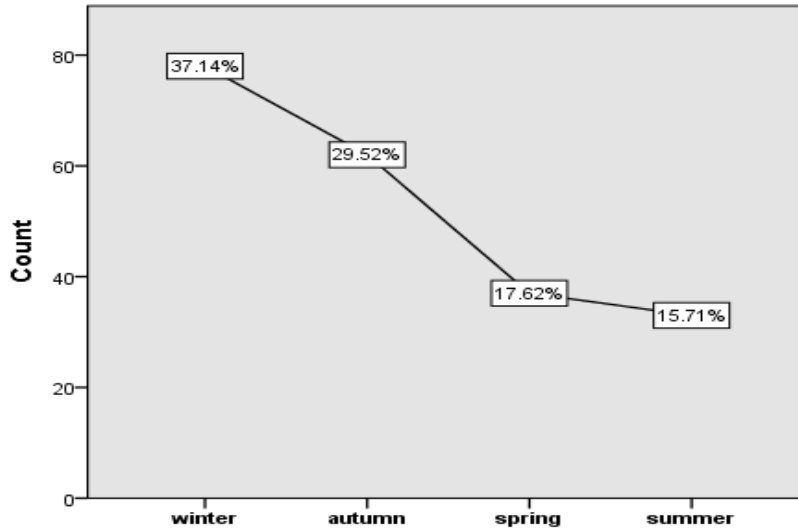
**Figure 5: Percentage of people agreed, didn't know and disagreed in the increment of leopard's number.**

Likewise, 38.1% disagreed that livestock depredation in recent years had been increased, 25.7% of the respondent didn't know about the trend and 36.2% agreed that livestock depredation had been increased showed by figure 6.



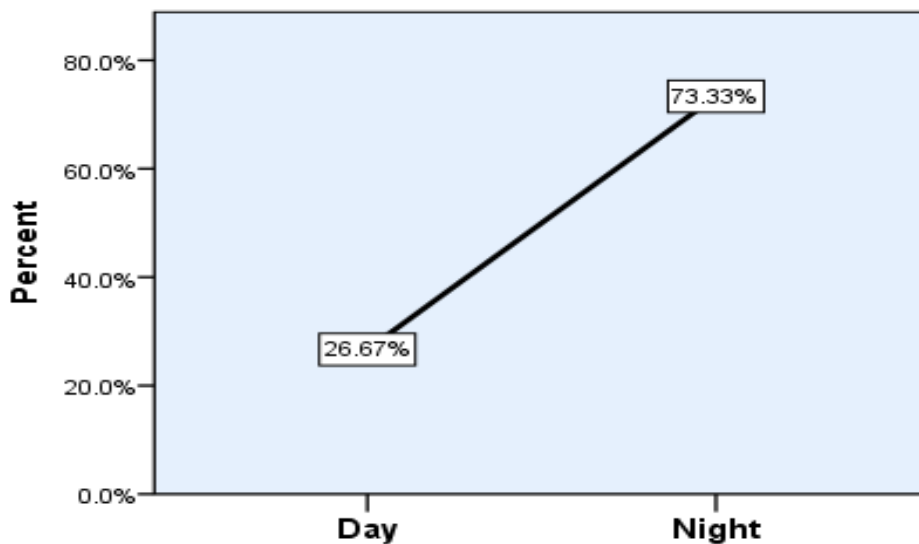
**Figure 6: Percentage of people agreed, didn't know and disagreed in the increment of livestock depredation.**

Most of the respondents about 37.14% and 29.52% had witnessed maximum damage in winter and autumn season; respectively whereas very few respondents 15.71% said summer and 17.62% said spring as the season with least damage. It is displayed in following line graph (figure 7).



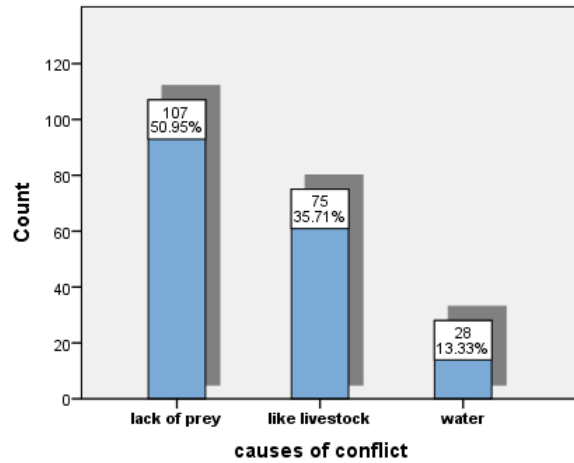
**Figure 7: Season’s Leopard causing maximum damage**

Leopard is solitary and nocturnal in behavior. It attacked its prey in low light condition mostly at night as 73.33% of the respondents stated that their livestock was predated in night and 26.67% of people said that leopards often attacked its prey at day time as shown in figure 8.



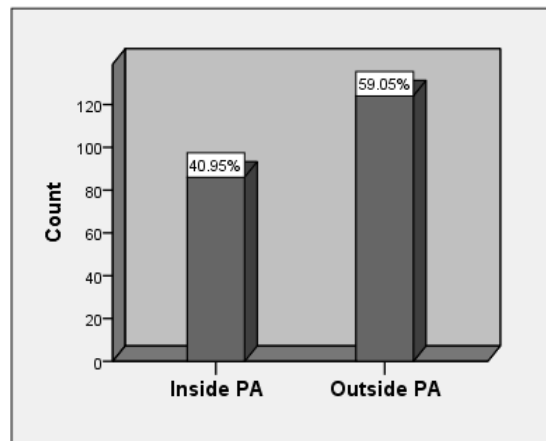
**Figure 8: livestock depredation rate at day and night**

Among 210 respondents, 50.95% answered that the causes of leopard visit in human settlement area were due to lack of prey, 35.71% said that leopard liked livestock and the rest of the respondents 13.33% mentioned that the causes might be the water as settlement areas were nearby the water resources.



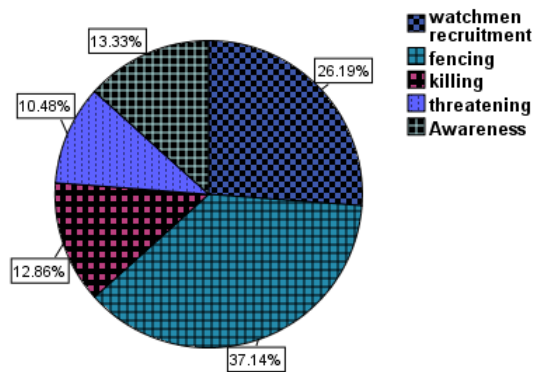
**Figure 9: Causes of leopard visit to settlement areas**

Human-leopard conflict could occur both in outside or inside the protected areas but maximum in outside the protected areas or livelihood as stated by 59.05% of the respondents. Similarly 40.95% of people said it occur inside the protected areas. It is demonstrated by figure 10.



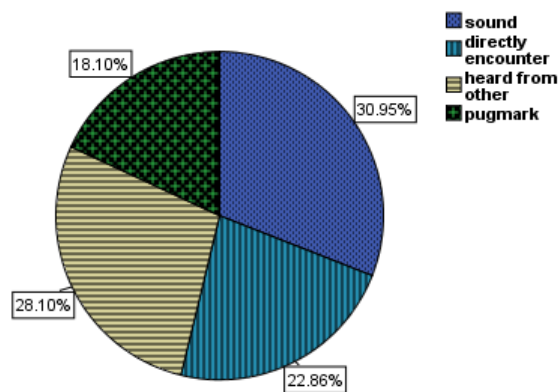
**Figure 10: Maximum occurrence of conflict**

SNNP is the only National Park situated in the Kathmandu valley. It was nearby to the settlement area, there was no proper fencing around the border line of the park that animal could easily come to the livelihood areas. Most of the respondents around 37.14% suggested that fencing should be properly built and 26.19% also said that there was a need of watchmen recruitment. Awareness program should be run as said by the 13.33% of the respondent. Besides these, 10.48% of people said killing and 12.86% said threatening as a mitigation measure because their livestock were repeatedly killed or injured by the leopard.



**Figure 11: Mitigation measures suggested by local people to minimize conflict**

Leopard often visit to the settlement areas. About 22.86% of respondent saw leopard directly in the morning or evening time whereas 30.95% heard their sound only. Similarly , 28.10% of respondent heard from other people and 18.10% of people had seen their pugmark. That confirmed the abundance of leopard in the particular area.

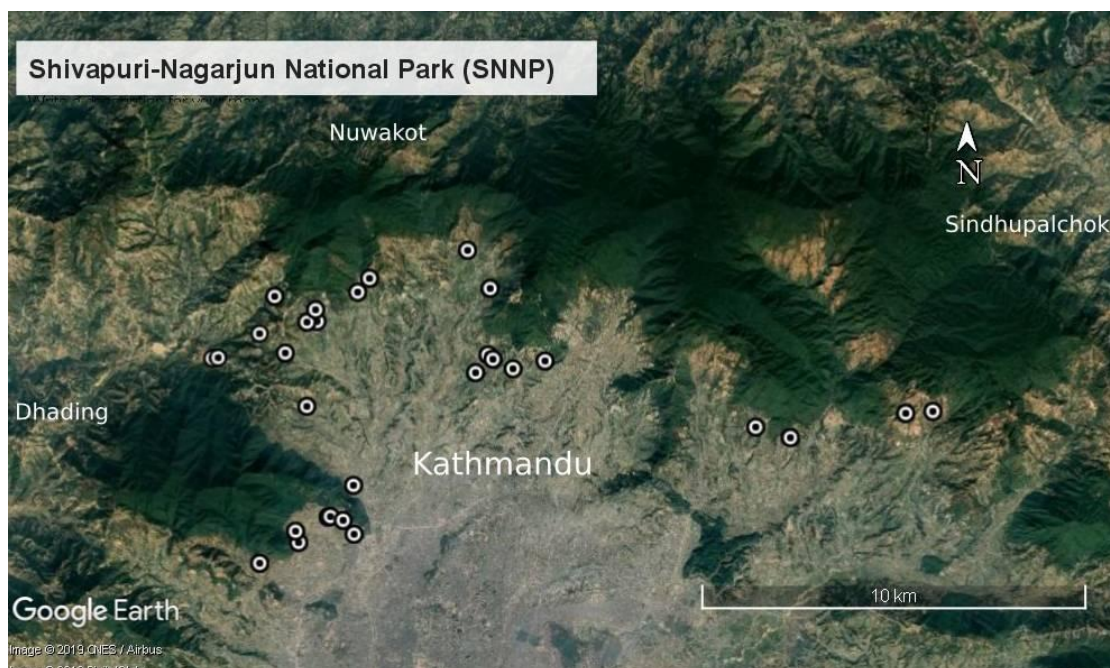


**Presence of leopard**

**Figure 12: People encountering leopard in various ways**

At present the most conflicted area was the Tarkeshwor, Tokha and Nagarjun Municipality. Goats were depredated more in Tarkeshwor and Tokha area whereas dogs were in Nagarjun area because people living there were involved in other business rather than livestock rearing. Tarkeshwor was the area which is in between the Shivapuri and Nagarjun forest patch. Therefore, not only leopards, others wild animals also often use this area to travel from one forest to another. So, this municipality is highly affected comparing to others. Human-leopard conflict was least in other municipalities, but crop depredation was more by rhesus monkey, wild boar, porcupine and barking deer. The main occupation of people living in Budhanilkantha, Kageshwori-Manohara and Shankharapur Municipality was farming, so there crops were depredated more by wild animals rather than livestock.





**Figure 13: GPS location of conflicted areas**

#### **4.2 Livestock depredation and estimated economic loss**

After the declaration of buffer zone, Park office had started to provide compensation for the affected people. But due to lack of information and negligence by Park's officers as well as people living in buffer zone areas, the distribution program didn't run effectively.

The total number of animals depredated was 131 within five years. The depredation of goats were high in shivapuri forest patch mainly Tarkeshwor and Tokha area as 88 goats were depredated. Similarly 32 dogs were depredated from Nagarjun forest patch and large size prey like one buffalo, three cows and a calf were killed by leopard. Recently six hens from the farm were eaten by the leopard. This result showed that in the previous two years the depredation rate was high comparing with next three years because many people had shifted from the village to city area as their home was destroyed by earthquake of 2072 B.S and also people living there were involved in co-operate business activities rather than traditional way of farming and livestock rearing as it is located near Capital city Kathmandu.

The total estimated loss was U\$9,600 only U\$530 had been compensated by National park office. The name of people getting compensation in 2073/2074 was shown in table no 1.

**Table1: People getting compensation for livestock loss**

S.N	Name of respondent	Address	Total no of livestock	Livestock killed by leopard	Compensated amount
1	Ram Lal Tamang	Tarkeshwor-3	5	1 goat	\$100
2	Kalpana Pariyar	Tarkeshwor-3	3	1 goat	\$100
3	Chandika Phuyal	Tarkeshwor-5	4	1 goat	\$100
4	Dhana Phuyal	Tarkeshwor-5	4	1 goat	\$130
5	Kedar Prasad Bhandari	Gokarneshwor- 3	6	1 calf	\$100

There was death of four leopards and one got injured. The reasons behind it were self defense, road accidents and trapped in electric current. The area where they got killed was shown in table no 2.

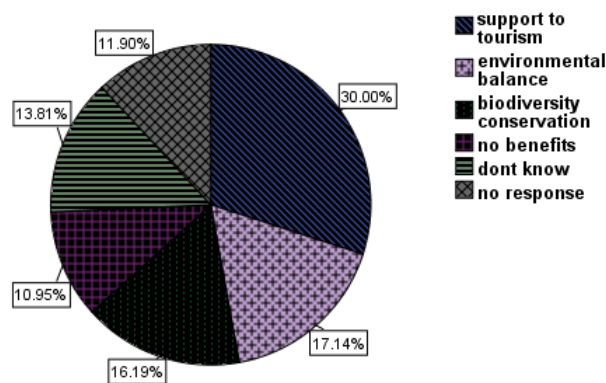
**Table 2: Leopard killed / injured**

S.N	Area	Killed/ injured	Year	Reason
1	Tarkeshwor -3	Killed	2072	Livestock loss
2	Gokarneshwor-2	Killed	2071	Many livestock depredated by leopard
3	Kageshwori- Manohara -1	Killed	2075	Electric current
4	Nagarjun -1	Injured	2072	Self defense
5	Tarkeshwor- 1	Killed	2073	At night by vehicle

Three people were injured by leopard attacks. Ganga Giri from Tarkeshwor was attacked when she was in forest to cut the grass. Similar case goes with the Ishwor Pd Bhandari, he was attacked from the backside on his arms while cutting the grass nearby forest. Rudra Pd Aryal from Tinpiple was attacked in dusk while returning to home from office.

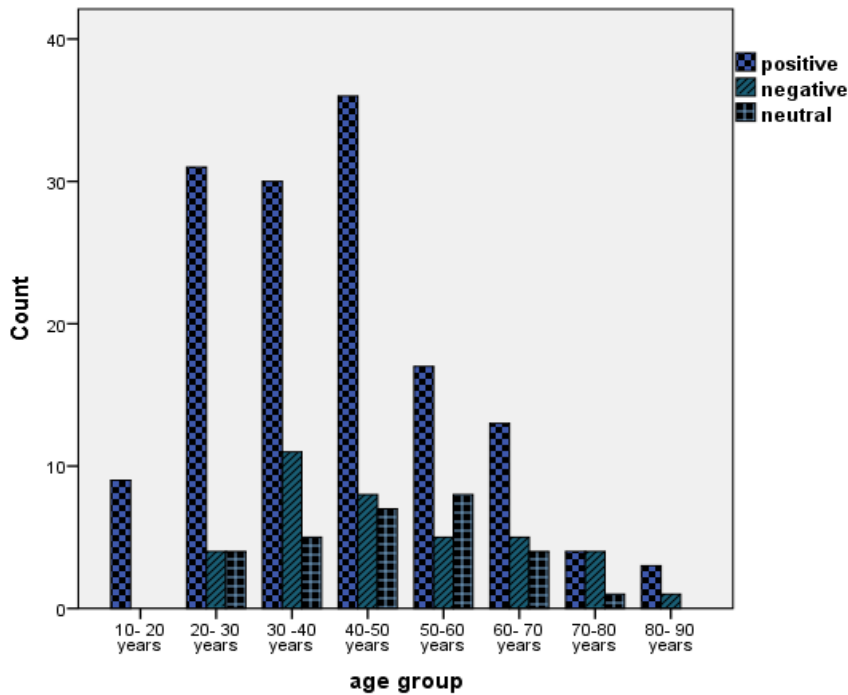
### 4.3 Perception toward leopard conservation

As, SNNP lies in Kathmandu valley (Capital city), most of the people responded positively and they were all aware about the benefits of leopard conservation. SNNP is one of the refreshments and major touristic areas for hiking, observing wild fauna and flora in their habitat. Restaurants and hotels for the tourists were constructed which benefitted the people living in buffer zone areas. Some of the benefits of leopard conservation were support to tourism, environmental balance and biodiversity conservation. Very little that was 10.95 % of the total respondents said there were no benefits of conserving leopard whereas most of the people 30% said conserving leopard could support tourism. Very few respondents 13.81% didn't know about the benefits of conserving leopard. It is illustrated by figure 14.



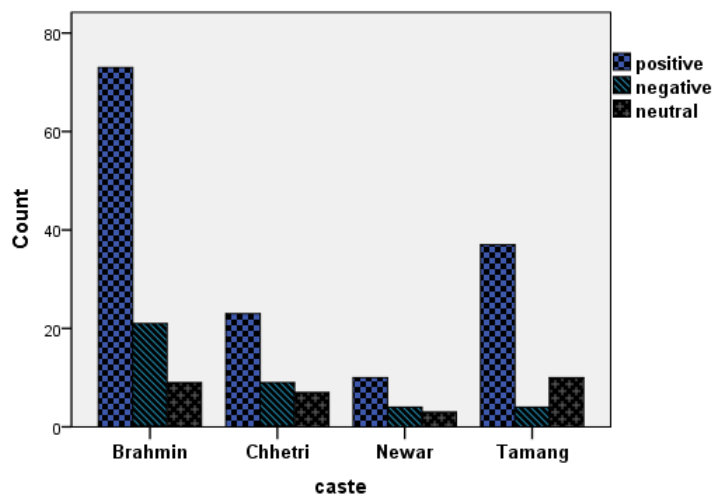
**Figure 14: Benefits of leopard conservation**

People belonging to every age group had positive attitude towards the leopard conservation. The literacy rate of the Kathmandu city was high as compared to the other cities because of the developed infrastructure, so people belonging to any age group were aware of the fact that conserving leopard meant alternative source of income by the increment of tourists and also balancing the ecosystem as well as biodiversity conservation. The respondents mostly belonged to the 40-50 years of age group; among them 17.14% of the respondents had the positive perception. Respondents belonging to 10-20 years age group didn't show negative responses.



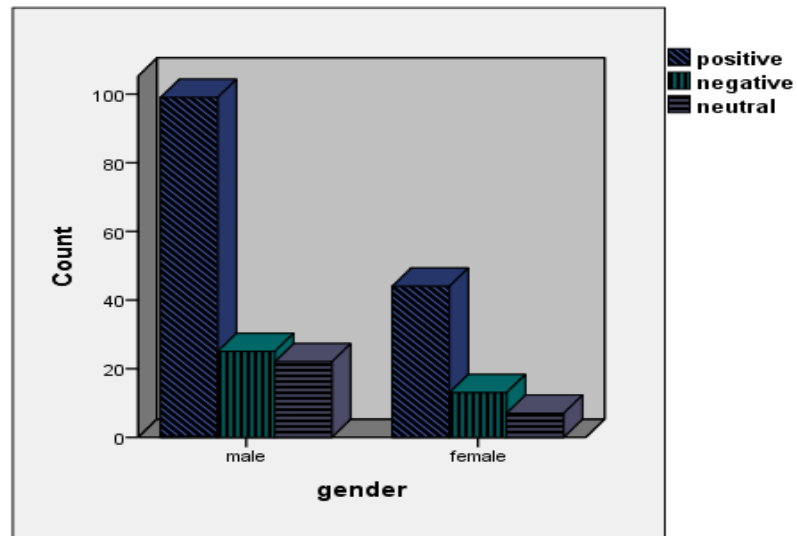
**Figure 15: Perception towards leopard conservation according to age group**

In SNNP buffer zone most inhabitants were Brahmin followed by Buddhists (Rai, Tamang, Magar, and Lama). The positive responses and negative responses were high in Brahmin i.e 34.76% and 10%; respectively comparing to others because of their high population.



**Figure 16: Perception of people according to the caste**

Altogether there were 210 respondents, among them 146 were males and only 64 were females. Both gender equally showed the positive and negative perception as per their population size, 47.14% of male and 20.95% of female showed positive perception whereas 11.90% of male and 6.19% of female showed negative perception towards leopard conservation.



**Figure 17: Perception of people according to gender**

## 5. DISCUSSION

### 5.1 Current situation of Human-leopard conflict

The rate of livestock depredation had been decreased so as the leopard occurrences in the buffer zone areas. Various factors might be responsible for this such as modernization; people nowadays were searching for alternatives for traditional farming and livestock rearing, they were involved in business or job. Another factor was earthquake, after an earthquake they had shifted to the city areas for their better settlements. Current study showed that maximum respondents disagreed to the fact that there was increase in number of common leopard and livestock depredation and very few agreed which was similar with the study of Pokharel (2015) as 35% of people residing in Kathmandu Valley noted the increase of leopards in their surroundings and 50 % claimed constant population of leopard in their area within 2010-2013.

In the lower belt of Annapurna Conservation Area, the loss due to the leopard was higher in winter season (Koirala *et al.*, 2012), but the livestock depredation by leopards was more common in summer and monsoon season (Thapa, 2011). Current study also showed that depredation rate was higher in winter and autumn seasons this was because of low intensity of light from the sun as it played significant role in predation of livestock. Less light more chance of conflict was especially near the forest areas.

Leopards often entered or visited to the settlements area nearby forests because of the continuous decrease of forest with its natural prey. Moreover, they were habituated in those areas due to the easy availability livestock or they like the taste of livestock and might not return back to their natural habitat. Street dogs and also some domesticated animals were easily available prey for leopards (Athreya *et al.*, 2007). Even this study implied that lack of prey was one of the major causes of conflict followed by water and liking of livestock. Some street and domesticated dogs from the Nagarjun area were also predated by leopard.

People living in SNNP buffer zone had directly seen the leopard and but many had heard from others unlikely the documentation of Khaiju (2017) in Bhaktapur area as 34.37% of people living there had directly encountered the leopard and 21.87% had heard from others. It was because Bhaktapur was an open and crowded area, when one leopard visited everyone could see it but the buffer zone of Shivapuri and Nagarjun was moreover occupied by bushes and trees where leopard could hide.

Human-carnivore conflict is more complex issue as predators and human share the same habitat which should be resolved in the field of conservation. So the issue needed to be managed properly to achieve the goal of wildlife management (Thapa, 2011). Various mitigation measures were implied for the conflict management. Current study revealed that fencing around the national park's border was much necessary and also Watchmen recruitment. Those people who were victims or whose livestock were predated, they suggested negative measures such as killing and threatening. According to the study conducted by Pokharel (2015) majority of people suggested afforestation and fencing

along with the awareness. Both the studies showed that the most suitable mitigation measure was fencing around the National Park's border.

Among all the seven municipalities, conflict mostly occur in Tarkeshwor municipality not only by the leopard, but also other animals such as rhesus monkey, wild boar, barking deer and porcupine because it was the area which joined the Nagarjun and Shivapuri forest patch and might be wild animals travel from Nagarjun to Shivapuri through that area and also recently the rhesus monkey from Pashupati area had been translocated to Shivapuri forest near this municipality which caused Human-wildlife conflict.

## **5.2 Livestock depredation and estimated economic loss**

For the first time park's office provided compensation on 2017-11-21. Though, government had started providing compensation to the victim's, but it hadn't been effectively distributed. Both the parties' national park's officers as well as the local people were responsible for this. Many people still didn't know about the compensation program and also officials particularly didn't visit to the affected areas. In my result, I found, only five people got compensation of their livestock depredation and the total loss was US\$ 9,600 in five years but the total estimated economic loss in the Kunjo VDC of Mustang was US \$7370.84 in a year which is NRs 5,45,000 (Ghimirey, 2006). It was because people living in Kunjo VDC were mostly involved in livestock rearing and there was less abundance of natural prey for leopard.

In the western Himalaya of Pakistan, six women were killed by leopard and 17 were injured. This causes the retaliatory killing of 15 leopards (Waseem and Khan, 2014) but here very few leopards were killed and injured by human and also leopard attacking to human was a rare case because larger the area of Himalaya, more the abundance of leopard.

## **5.3 Perception towards leopard conservation**

Human beings didn't shared similar views; they all had different views, way of thinking, opinion or perception towards the leopard conservation. I have categorized it in terms of age, gender and caste. Almost every person from 10 year old to 80 year old was asked some questions regarding their attitudes towards the leopard conservation. Maximum number of people gave positive perception, only few had negative perception and some of them were neutral. Negative perception mainly arose because of the conflict as leopard was the main reason for their livestock loss which affected their economy as well.

SNNP was inhabitant by all caste groups, most of them were Brahmin and Chhetri. Some ethnic groups such as Newar, Tamang, Rai were permanent residential of these areas and some people migrated from other hilly and terai regions of Nepal. People mostly responded positively towards conservation. As my result showed that positive attitudes were mainly because of the awareness, education, it didn't matter which caste groups, age groups and gender.

Despite this, local perception towards leopard was negative in Kunjo VDC some 30.26% thought that the conservation of leopard didn't provide any fruitful results to them and 27.63% people were not well aware of the benefits of leopard conservation. Altogether 57.89% people didn't care about leopard conservation which could be the critical threats to leopard population (Ghimirey, 2006). The main reason behind that was livestock depredation and economic loss but people still showed positive attitude though their livestock was depredated (Ahmed *et al.*, 2012). Similarly Thapa (2011) figured out about 65% positive and Thapa (2015) reported 64% positive view on leopard conservation and also 56% of respondents gave positive response and 16 % stated that there were no benefits in conserving leopard (Khajju, 2017). Likewise, this study also revealed that positive perception was higher than negative, about 24.76% of people living in SNNP buffer zone didn't care about the leopard conservation whereas maximum of people expressed that conservation of leopard help in tourism development which was a positive sign that could help to protect leopard.



## 6. CONCLUSION AND RECOMMENDATIONS

### Conclusions

- After the massive earthquake of Baisakh 12, 2072 the leopard visiting settlements area has been decreased so as the livestock depredation. Most of the people suggested that the suitable measures for minimizing conflict should be the proper fencing in Shivapuri forest patch and reconstruction of the destroyed wall in the Nagarjun forest patch.
- Nagarjun area is more developed than Shivapuri because it lies near the highway and Balaju areas. So, livestock such as goats are depredated more in Shivapuri and dogs are killed in Nagarjun. The number of livestock depredated by leopard is 131 where goats and dogs are high in number. The estimated total amount of loss is \$9,600. Only five people have got the compensation for his livestock loss. Very few people were attacked by the leopard and four leopards were killed and one got injured because of various reasons.
- Though, park's head office announced of providing compensation to the local people, the distribution of compensation hasn't been effective. In some cases, local people weren't aware or they didn't know about this program whereas in some cases park's officers ignored visiting to the conflicted areas. These issues not only widen the conflict between people and wildlife, but also park and people.
- People of all age group, gender and caste shows positive perception towards the leopard conservation as Shivapuri- Nagarjun is only National park in Kathmandu valley which is the source of refreshments for internal as well as external tourists. This can increase the economy of local people living there.

### Recommendations

- Fence with wire should be constructed in the border area of National Park so, that wild animals couldn't easily visit to the settlements area.
- Park's officers should team up with different buffer zone user committee to run the compensation programs effectively and frequent visit to the conflicted areas should be done.
- Some awareness programs about the leopard behavior, rescue techniques should be run in school and colleges.
- The way for passing and moving from one forest to another must be monitored and establishment of suitable corridor without any disturbance. This could prevent the encountered and conflict mainly in Tarkeshwor area.

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## ANNEXES

### Annex I. Livestock depredation and estimated economic loss

S.N	Name of respondents	Address	Total no of livestock	Livestock killed by leopard					Estimated Economic loss
				2071	2072	2073	2074	2075	
1	Dhana phuyal	Tarkeshwor- 3	4					1goat	\$ 130
2	Shyam kumar phuyal	Tarkeshwor- 2	3				3 hens		\$100
3	Nawaraj Adhikari	Tarkeshwor-5	8				1 goat	3 hens	\$250
4	Kanchi Chlaugai	Tarkeshwor- 2	5			1goat	1 goat		\$200
5	Shikar Aryal	Gokarneshwor-3	4			2 goat			\$200
6	Shyam Aryal	Tokha- 1	3				1 baby goat		\$70
7	Yuga Prasad	Tarkeshwor- 2	2			1 goat			\$100
8	Mohan Sunuwar	Nagarjun-2	1					1 dog	
9	Ramesh Shrestha	Nagarjun-1	2				1 goat		\$100
10	Ram Shrestha	Nagarjun-3	1					1 dog	
11	Barsha Pokharel	Nagarjun- 4	1					1 dog	
12	Shyam Bahadur Balami	Nagarjun-1	4			1 dog	2 dogs	1 dog	
13	Basanta Ghimire	Tokha -1	7	2goats	1goat				\$300
14	Ganga Roka	Tokha-1	5		1goat				\$100
15	Navaraj Sapkota	Gokarneshwor-2	3	1 buffalo					\$130
16	Sona Taming	Tarkeshwor-3	4	2 goats					\$200
17	Narayan Khatri	Nagarjun -3	1	2 dogs	1dog				
18	Chandra Ghimire	Tarkeshwor- 3	6	2 goats	1 goat				\$300
19	Sushma Dhakal	Tokha -1	4		1cow				\$140
20	Arjun Balami	Nagarjun-2	1	2 dogs	1dog	1 dog			
21	Sanobabu Lama	Nagarjun-3	1	3dogs	1 dog	1 dog			
22	Laxmi Adhikari	Tokha-4	5	2 goats	1 goat	1 goat			\$400
23	Purna Bahadur	Tokha- 5	3		1 goat				\$100
24	Maili Tamang	Tarkeshwor-3	5	1 goat	2goat				\$300



25	Raju Lama	Nagrjun-1	1			1 dog			
26	Ravi Lama	Nagarjun-2	3			1 dog		1 dog	
27	Ishwor Pd Bhandari	Tarkeshwor-2	2	1 goat			1 goat		\$100
28	Tilak Thapa Magar	Kageshwor-1	1		1 goat			1 dog	\$100
29	Milan Lama	Kageshwor-1	1	1 goat				1 dog	\$100
30	Kedar pd Bhandari	Gokarneshwor-3	2					1 calf	\$100
31	Shyam Bahadur Lama	Tokha-2	3		1 goat		1 goat		\$200
32	Krishna Pd kuikel	Tokha-2	2	1 dog			1 goat		\$100
33	Bachhuram Kuikel	Tokha-2	3					2 goat	\$200
34	Raj Kumar Kuikel	Tokha-2	2					1 goat	\$100
35	Dev Kumar Lama	Tarkeshwor-2	4	1 dog			1 goat		\$100
36	Rina Adhikari	Tarkeshwor -3	5			1 goat			\$100
37	Dubanath	Tarkeshwor -3	2				1 goat		\$100
38	Binita Ghimire	Tokha-1	4		1 goat		1 goat		\$200
39	Mithram Giri	Tokha-4	3				2 goat		\$200
40	Ram Lal Tamang	Tarkeshwor-3	5	1 dog		1 goat			\$100
41	Chandika Phuyal	Tarkeshwor-5	2			1 goat			\$100
42	Kalpana Pariyar	Tarkeshwor-3	3			1 goat			\$100
43	Rajkumar Tamang	Tarkeshwor-5	4		1goat				\$100
44	Radha Puri	Tarkeshwor-5	3	1 cow					\$140
45	Bharat Ghimire	Kageshwor-1	5		1 cow				\$140
46	Sanjita Giri	Tokha -5	3	1 goat		1 goat			\$200
47	Sujana Lama	Tokha-5	6	2 goats	1 goat				\$300
48	Achyut Pandey	Tokha-4	4	1 goat	1 goat				\$200
49	Laxmi Limbu	Tokha -4	7	1 goat	2 goats				\$300
50	Bimala Manandhar	Tarkeshwor-5	4	1 goat	3goats				\$400
51	Radhika Bhattarai	Tokha- 4	5	3goats	2 goats	1goat			\$500
52	Ashok Kumar Chamrel	Tokha-1	6		2 goat	1 goat			\$300
53	Chandra Kanta Dhakal	Tarkeshwor-2	5	1 goat	1 goat				\$200

54	Jit Bhadur Lama	Tarkeshwor-3	5		1 goat				\$100
55	Sumina Lama	Tokha-1	3	1 goat					\$100
56	Radheshyam Lama	Nagarjun -8	1	1 dog		2dog			
57	Punya Bajra Lama	Nagarjun-3	1		1 dog		1 dog		
58	Maila Balami	Nagarjun-1	1		2 dogs			1 dog	
59	Sailo Shrestha	Tarkeshwor-3	4		1 goat	1 goat			\$200
60	Srijana Dhakal	Kageshwori-1	3	1 goat					\$100
61	Man kumari Thapa	Tokha-1	5		2 goats				\$200
62	Rani Tamang	Tarkeshwor-3	4	1 goat					\$100
63	Krishna Bahadur	Gokarneshwor3	2	1 goat					\$100
64	Bhola pd Dhakal	Tarkeshwor-5	4		2goat				\$200
65	Dal Bdr Tamang	Tarkeshwor-1	3		2goat	1goat			\$300
66	Laxman Bhandari	Tokha-4	5		1goat				\$100
67	Bishnu Maya	Tokha-2	8	3goats	2goats				\$500
	<b>Total</b>								<b>\$9600</b>

## **Annex II. Cases of leopard attacks on human and death of leopard from the field site**

During the field visit I found three people injured by the leopard attack and few people who have recently encounter leopard in the settlement areas. All the stories regarding the onset of conflict situation are given below.

### 1. Ganga Giri

A 55 years old woman from Tarkeshwor -3, who had lost her two goats 4-5 years ago, was wounded by leopard recently. She was in the forest to cut the grass for her livestock and suddenly leopard attacks her from back which was hiding in the bushes. She was badly injured in her back and arms.

### 2. Ishwor Pd Bhandari

He was attack by leopard when he was cutting the grass nearby the forest. According to him, leopard attack from the back side on his arms. In defense he also attack leopard with sickle and leopard ran away. He was 67 years old living in Kageshwori- Manohara municipality ward no 1.

### 3. Rudra Pd Aryal

A 40 years old man of Tarkeshwor, Tinpipla was injured by leopard in dusk when he was returning to home from office. He wasn't aware of leopard crossing the path, when he saw he shout loudly so, leopard attack him. Some men from nearby houses came then leopard ran away. According to him, 11-12 years old child and an adult man was killed by leopard 10 years ago.

Similarly, two leopards died in these three years. One was in the road accident and the other was trapped in the electric current during his visit to buffer zone in Kageshwori-Manohara Municipality ward no 1.

Many other people from Budhanilkantha and other places had directly encountered leopard during morning and evening time.

### Annex III. Cases of human casualties in different countries due to leopard attack

Country	Region	Deaths	Year(s)	References
Nepal	Pokhara valley, Gandaki zone	12	1987-1989	Leopards attack in Nepal. Cat news (IUCN) 1989.
	Parwat district, Gandaki zone	1	2009	<a href="http://www.ekantipur.com/np/2066/9/2/fullstory/303627.html">http://www.ekantipur.com/np/2066/9/2/fullstory/303627.html</a>
	Baitadi district, Mahakali zone	15	2010-2012	www.cnn.com/ASIA/
	Kavrepalanchok district, Bagmati zone	1	2013	<a href="http://khabarsansani.com/?p=1346">http://khabarsansani.com/?p=1346</a>
	Lalitpur district, Bagmati zone	1	2014	DFO, Lalitpur
	Argakhanchi district, Lumbini zone	4	2014	<a href="http://hankweekly.com/index.php?action=news&amp;iid=5851">http://hankweekly.com/index.php?action=news&amp;iid=5851</a>
India	Sanjay Ghandi National National Park, Maharashtra	16	1986-1996	Quammen, D 2003. Monster of God: The maneating predator in the jungles of history and the mind. Page 55–61. Norton & Company, New York.
	Mandi district, Himanchal Pradesh	13	1987-2007	Kumar, D., N. P. S. Chauhan 2011. Human leopard conflict in Mandi district, Himachal Pradesh, India. Julius-Kühn-Archiv 432: 180–181.
	Uttar Pradesh	95	1988-1998	Hart, D. L. R. W. Sussman 2005. Man the hunted: Primates, predators, and human evolution. Page 1–11, 60–62. MA: Westview Press, Cambridge.
	Pauri garhwal district, Uttarakhand	140	1988-2000	Goyal, S. P., D. S., Chauhan, M. K., Agrawal, R. Thapa, 2000. A study on distribution, relative abundance and food habits of leopard ( <i>Panthera pardus</i> ) in Garhwal Himalayas. Report submitted to Wildlife Institute of India, Dehradun.
	North bengal	15	1990-2008	Leopard study report. A report submitted to World Wide Fund for Nature 1997. New Delhi, India.
	Junagadh district, Gujrat	29	1990-2012	Shastri, P 2013. "Leopards kill 12 in Junagadh, Injure 48 in one year". The Times of India.
	Himanchal Pradesh	6	2000-2007	Marker, L., S. Sivamani, 2009. "Policy for human-leopard conflict management in India". Cat News 50: 23–26.
	Pune district, Maharashtra	18	2001-2003	Athreya, V.R., S.S. Thakur, S. Chaudhuri and A.V. Belsare 2004. A study of the man-leopard conflict in the Junnar Forest Division, Pune

				District, Maharashtra. Unpublished report Submitted to the Office of the Chief Wildlife Warden, Nagpur. India.
	Jammu and Kashmir	17	2004-2007	Nabi, D. G., S. R., Tak, K. A., Kangoo, M. A. Halwai, 2009. "Injuries from leopard attacks in Kashmir". <i>Injury</i> 40: 90–92
	Erode area, Tamil Nadu,	2	2015	<a href="http://www.deccanherald.com/content/463344/deaths-due-animal-attacks-rise.html">http://www.deccanherald.com/content/463344/deaths-due-animal-attacks-rise.html</a>
Pakistan	Ayubia National Park, Khyber Pakhnhkwa	12	1989-2006	Lodhi, A 2007. Conservation of leopard in Ayubia National Park, Pakistan. University of Montana.
	Machiara National Park, Azad Kashmir	2	2004-2007	Dar, N. I., R. A., Minhas, Q., Zaman, M. Linkie, 2009. Predicting the patterns, perceptions and causes of human–carnivore conflict in and around Machiara National Park, Pakistan. <i>Biological Conservation</i> 142: 2076–2082
Srilanka	Yala National Park	1	2011	<a href="http://www.sundaytimes.lk/110717/Plus/plus_11.html">http://www.sundaytimes.lk/110717/Plus/plus_11.html</a>

(Source: Monsoon, 2015)

**Annex IV. Questionnaires**

Name:

Age:

Sex:

Occupation:

Ward no:

Municipality:

Family size:

- 1) What is the wildlife's found in your area?
- 2) What are the wildlife's that mostly affects you negatively? Please list five in priority basis.

i) .....

ii) .....

iii) .....

iv).....

v) .....

- 3) Have you seen common leopard?

i) Yes ii) no

If yes, where (place).....

When (month).....

How many (number).....

- 4) Do you have livestock? If yes then

Livestock sps.	Number
Cow	
Goat	
Buffalo	
Chicken	
Dog	
others	

5) What are your livestock and others pet animals that were killed / wounded by common leopard in t?

Animals	Total	Killed	Wounded	loss	Rs
Goat					
Dog					
Cow					
Buffalo					
Chicken					
Others					

6) Did you get compensation?

- i) Yes                      ii) no

7) What might be the causes of leopard visit to the settlement areas?

- i) lack of prey              ii) like livestock              iii) water

8) There is an increase in the number of common leopard within these three years?

- i) agree              ii) don't know              iii) disagree

9) There is an increase in the incidences of livestock depredation in this area?

- i) agree              ii) don't know              iii) disagree

10) What time the leopard is mostly active? (Attacks livestock)

- i) Day                      ii) night

11) In which season's leopard causes maximum damage?

- i) winter              ii) spring              iii) summer              iv) autumn

12) How do you know about the presence of leopard?

- i) Sound              ii) directly encounter  
iii) Pugmark              iv) heard from others

13) What are the techniques that should be used in order to minimize human-leopard conflict?

- i) Watchmen recruitment      ii) fencing      iii) killing
- iv) Threatening      v) awareness

14) Have any of the villagers become wounded/attacked or killed by the leopard last year?

- i) Yes      ii) no

If yes,

Name of people.....

Where.....

How.....

15) Where does the human leopard conflict (leopard attacking man) occur more frequently?

- i) Inside PA      ii) outside PA

16) Do you like wild animals?

- i) Yes      ii) no

17) What are the benefits of conserving leopard?

- i) Support to tourism
- ii) Environmental balances biodiversity conservation
- iii) No benefits
- iv) Don't know
- v) No response

18) Is there any incident of leopard being killed in the area?

- i) Yes      ii) no

If yes, where.....

When.....

How.....

19) What do you think we should conserve leopard or not?

- i) Positive      ii) negative      iii) neutral



**Annex V. Some photos from the field site**



**Photo 1: Fencing at the border of Nagarjun forest patch**



**Photo 2: Border line of National park in Tarkeshwor Municipality-1**



Photo 3: A house nearby forest of Tokha Municipality-1



Photo 4: Human settlements near the Shivapuri forest Patch



Photo 5: Interaction with local people



Photo 6: Questionnaire survey