HUMAN- LEOPARD (*Panthera pardus* Linnaeus, 1758) CONFLICT IN GODAWARI MUNICIPALITY, LALITPUR, NEPAL

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Nepal
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DECLARATION

I hereby declare that the work presented in this thesis entitled **"HUMAN-LEOPARD (*Panthera pardus* Linnaeus, 1758) CONFLICT IN GODAWARI MUNICIPALITY, LALITPUR, NEPAL"** has been done by myself, and has not been submitted anywhere for the award of any other degree. All sources of the information have been specifically acknowledged by references to the author(s) or institution(s).

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RECOMMENDATION

This is to recommend that the thesis entitled **"HUMAN-LEOPARD (*Panthera pardus* Linnaeus, 1758) CONFLICT IN GODAWARI MUNICIPALITY, LALITPUR, NEPAL"** has been carried out by Ms. **Alina Maharjan** for the partial fulfillment of Master's Degree of Science in Zoology with special paper Ecology. 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 institution. I recommend that the thesis be accepted for the Degree of Master of Science in Zoology with special paper Ecology.

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LETTER OF APPROVAL

On the recommendation of supervisor Dr. Bishnu Prasad Bhattarai, this thesis submitted by Ms. Alina Maharjan entitled "**HUMAN-LEOPARD (*Panthera pardus* Linnaeus, 1758) CONFLICT IN GODAWARI MUNICIPALITY, LALITPUR, NEPAL"** is approved for the Examination and submitted to Tribhuwan University in partial fulfillment of the requirements for the Degree of Masters in Science in Zoology with special paper Ecology.

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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by Alina Maharjan entitled "**HUMAN-LEOPARD (*Panthera pardus* Linnaeus, 1758) CONFLICT IN GODAWARI MUNICIPALITY, LALITPUR, NEPAL**" has been accepted as a partial fulfillment for the requirements of Master's Degree of science of zoology in special paper Ecology.

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Alina Maharjan

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CONTENTS

ABSTRACT

Leopard (*Panthera pardus*) is widely distributed large cat included in threatened category of IUCN red list. In Nepal, Leopards are found in different protected areas and community forests near human dominated areas. The human-Leopard is emerging issue in the landscape near the forest areas of mid-hills. The field work was carried out from April, 2018-November 2018. The main objective of the study was to access Human-Leopard Conflict in Godawari municipality, Lalitpur and people's perception towards Leopard conservation. The specific objectives were to access the presence/absence of Leopard in forest patches, find out the current situation and extent of Human-Leopard conflict and explore socio-economy of people and their perception towards Leopard conservation. Sign survey and line transect were implemented for the evidence of presence of Leopard. Data was collected using Snowball sampling. Computer based R-studio, Ms-Excel was used after coding the crude data into the computer. Chi square test was implemented on R-studio. There were six pugmarks and other signs like scat, scrape, scratches and scent. Altogether 75 semi-structured questionnaires were done within the age group between 16-65 years old. 99% people are dependent on forest products. 85% of the households involved in livestock rearing and 15% weren't engaged. The livestock bearing households were affected. 29 households were affected by the Leopard and Wild cat, 33 were by Leopard and 13 households were not affected. Majority of the respondents were against conservation of Leopard, only 9% said Leopard should be conserved, 50% did not agreed and 41% were unsure. 9% respondents did not respond, 34% of the respondent said no benefit of conservation, 32% were unsure and 25% said there is benefit on conservation. There was no significance of male and female attitude towards the conservation of Leopard; there was significance difference according to occupation of people towards the conservation of Leopard. The finding of this study will be useful to make conservation action plan of Leopard in such human dominated landscapes.

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LIST OF ABBRERATIONS

CITES:	Convection on International Trade in Endangered Species
DFO:	Division Forest Office
DNPWC:	Department of National Parks and Wildlife Conservation
DOF:	Department of Forests
GPS:	Global Positioning System
HLC:	Human- Leopard Conflict
HWC:	Human- Wildlife Conflict
IUCN:	International Union for Conservation of Nature
SNNP:	Shivapuri Nagarjun National Park

1. INTRODUCTION

1.1. Background

Human-wildlife conflict (HLC) is defined as interaction between humans and wildlife that results in negative impacts on human social, economic or cultural life on the conservation of wildlife populations or on the environment (Athreya *et al*. 2007). Humans have competed with other species on the planet for habitat and resources and have innovated and adapted to become the dominant ecological force (Waters *et al.* 2016). HLC is serious emerging issue in conservation globally. The human activities have led to greater conflict between people and wildlife involving restoration of wildlife populations, (Harriers *et al.* 2008). Many wildlife species have become threatened due to this conflict, especially the large carnivores (Qamar *et al*. 2010). Human Leopard Conflict (HLC) most commonly involve killing of livestock, occasional attacks on human and animal (Nowell and Jackson 1996; Woodroffe 2000; Treves and Karanth 2003; Gurung 2008).

HLC has environmental impacts; Species most exposed to conflict are more prone to extinction because of the injury and death caused by humans; these can be either accidental such as road accidents, capture in snares set for other species or from falling into farm wells, or intentional, caused by shooting, poison or capture. Such human-induced mortality affects not only the population of endangered species, but also ecosystem equilibrium and biodiversity preservation (Ogada *et al.* 2003).

Humans can be economically affected through destruction and damage to property and infrastructure (For example, agricultural crops, orchards, grain stores, water installation, fencing, pipes), livestock depredation, transmission of domestic animal diseases such as foot and mouth (Hoare *et al*. 1992). Negative social impacts include missed school and work, additional labor costs, loss of sleep, fear, restriction of travel or loss of pets (Hoare *et al*.1992). Leopard (*Panthera pardus*) are mainly confined to the far-flung mountain and foothill areas of central and south Asia (Qamar *et al*. 2010). Livestock depredation problem occurs in areas with livestock and large carnivores (Karlsson and Johanson 2010). In addition, large carnivore species such as the Leopard (*Panthera pardus*), Snow leopard *(Panthera uncia*), Bengal tiger (*Panthera tigris*) residing habitats are increasingly coming into conflict with predation on livestock (Mishra *et al*. 2004).

The Leopard (*Panthera pardus*) is globally distributed (Myers 1986), in sub-Saharan Africa, India and southern Asia. The leopard has 9 genetically recognized subspecies worldwide (Stein *et al*. 2016). Three species of leopard are found in Nepal: Leopard (*Panthera pardus*), Clouded leopard (*Neofelis nebulosa*) and Snow leopard (*Uncia uncia*) (Prater 1998). There is declining trend in leopard population in many parts of Africa and south Asia due to habitat loss and depletion of prey (Santiapillai *et al*.1982; Khan 1986; Green 1987; Bailey 1993; Kumar 2011). Leopard (*Panthera pardus*) is common in the forests across Himalayas, and its food consists of wild prey species such as Himalayan goral (*Naemorhedus goral)*, Barking deer or Northern red muntjac (*Muntiacus vaginalis*), Wild boar (*Sus scrofa*), Red jungle fowl (*Gallus gallus*) and Langaur (*Semnopithecus* sp.). Increase in the frequency of confrontation between Leopard (*Panthera pardus*) and humans during last decade may be due to accelerating trend in habitat fragmentation, scarcity of wild prey base and high rate of livestock depredation and to some extent may be due to increase of local leopard population (Kumar 2011).

In Nepalese context, Leopards (*Panthera pardus*) are common in foothills of Nepalese Himalayas, though densely populated by human settlement (Nowell and Jackson 1996). The International Union for the Conservation of Nature (IUCN) enlisted the Leopard (*Panthera pardus*) as Vulnerable. The Leopard (*Panthera pardus*) are least concerned because they are widespread in distribution and have ecological flexibility (Henschel 2009). Global population status is still uncertain (Henschel 2009).

Leopard *(Panthera pardus*) is considered as top predator in its home range and plays an important role in continuation and conservation of biodiversity (Terborgh 1992). The Leopard's *(Panthera pardus*) home range depends on prey availability, the size of territories decreases with the increase of population density of leopard but if human disturbance occurs, their territories tends to expand (Marker and Dickman 2005). Gunawan *et al*. (2012) stated that Leopards *(Panthera pardus*) tend to keep distance approximately more than half a kilometer from human settlements. Home range of leopard varies from 6 km^2 (Seidensticker *et al.*1990) to over 2000 km^2 (Bothma *et al*.1997), generally male territories ranged between 30 and 78 km^2, whereas 15– 16 km^2 for females (Nowell and Jackson 1996). In Nepal's Bardia National Park, territory is 48 km^2 for males and 5–7 km^2 for females**.** Leopard (*Panthera pardus*) have widespread

distribution across a range of altitude up to 4400 m (Odden and Wegge 2005; Henschel 2008; Aryal and Kreigenhofer 2009; Koirala *et al*. 2012).

1.2. Rationale

Humans are also the part of the natural ecosystems of the park and therefore human behavior can cause serious impact on any ecosystem where they exist (Thapa 2011; Bhattarai and Kindlmann 2012). It is evident that there are several reasons for conflicts to take place among forest management, authority and local people residing around the forests. Leopard (*Panthera pardus*) visits in houses and road in the areas near the forest is very common in Lalitpur especially in Godawari and Bungamati. Study on causes of conflict is not done in proper way. Leopards (*Panthera pardus*) are killed every year in the conflict areas of Lalitpur. There is no data on the injured Leopard (*Panthera pardus*) back to the jungle. The possible areas for Leopards (*Panthera pardus*) is known in the Kathmandu valley along with Lalitpur but proper data is not available. Leopard (*Panthera pardus*) is one of the most killed animal in Lalitpur for its skin and bones (DFO, Lalitpur, Annex I). The present study is significant in that it may fill the knowledge gap that exists regarding the role that it will provide practical solutions to address human-leopard conflict. It is also hoped that the study may contribute information that may help governments, wildlife managers, conservation biologists and develops harmonious relation between people and wildlife.

1.3. Objectives

General Objective:

To study the Human-Leopard (P*anthera pardus*) conflict and people's attitudes towards Leopard conservation in Godawari Municipality, Lalitpur, Nepal.

Specific objectives:

- To access the presence/absence of Leopard in forest patches of Godawari Municipality area.
- To explore the current situation and extent of the Human-Leopard conflict.
- To know socio-economy of people and their attitudes towards Leopard conservation.

2. LITERATURE REVIEW

2.1. Leopard

Leopard (*Panthera pardus*) is very common large Cats found in Nepal. It is found from Tarai to Himalaya (KMTNC 1998). It is reported to be found up to 3500 m in the Trans-Himalayan region like Upper Mustang (Shah *et al.* 2004) but according to Jackson (1984) also was found at 5200 m. Leopard (*Panthera pardus*) is found in community, national forests of Kathmandu valley, protected areas of Nepal comprising 73 districts of Nepal (Thapa 2014; Pokhreal 2015; Shah *et al.* 2004).

2.2. Human-Leopard conflict

Human Leopard conflict is emerging issue for the survival of the threatened and endangered species of animals in the world. Not only Nepal, it is a challenge to the world in case of severity of the conflict. The greater depth study is needed in order to overcome the severity of the conflict and conserve threatened and potentially endangered species (Distefano 2005). Conflict is the adverse effect of any action by humans or wildlife upon the other. It is a product of socio-economic development and political landscapes (Conforti and de Azevedo 2003).

In the global, there is continued debate on the benefits and costs of biodiversity conservation, for people living near or within protected areas (PAs) (Nyhus 2016). Conservation must be concern for natural and social scientists, concerned citizens, and political leader for the conservation of biodiversity as a necessary public good in the global, regional, and domestic levels (Johnson *et al.* 2014).

Bhattarai and Kindlmann (2012) found that the human-wildlife conflict is the major threats to protect the endangered wildlife species like Bengal tiger (*Pantera tigris tigris*) and other big cats causing conflict are likely to be extinct because they are killed or harmed by humans or they harm the humans which can be accidental, such as road accidents, while trying to capture the one species the other species captured, or intentional such as shooting, poisoning or capture as they cause the livestock depletion and also sometimes harm the humans in case of food shortage. The resource for living is the forest for both the humans and wildlife. Such human-activities not only affect the population of the most endangered species, but also affects the ecosystem and the biodiversity. The

highly disturbed areas possessed higher level of conflict between wildlife and human (Ogada *et al.* 2003).

Matthew and Upreti (2005) argued that rapid population growth and environmental degradation are main reasons for conflict of human and wildlife in Nepal especially around the national parks and conservation areas also in the peripheral region of national parks and forests are the major conservation issue that occurs because of competition for resources. Due to poverty villagers are dependent on the resources near the national parks and conservation area (Limbu and Karki 2003).

Thouless *et al.* (2016), found that expansion of human settlements and agricultural fields across Asia and Africa has caused loss of elephant habitat, degraded forage, reduced landscape connectivity, and decline in elephant population.

In context of world, Case studies of Human-Wildlife Conflict from the world Wolves (*Canis lupus*) and Bears (*Ursus* spp.*)* killing domestic sheep in North America and Europe; Pumas (*Puma concolor*) and Jaguars *(Panthera onca*) taking cattle in South America; numerous carnivore genera preying on cattle and goats in Africa; Tigers (*Panthera tigris)* and Leopards (*Panthera pardus*) killing livestock in Asia (Karantha and Madhusudan 2002).Tigers (*Panthera tigris)* and Asian elephants (*Elephas maximus*) conflict in much of Asia (Nyhus and Tilson 2004) have a consistent impact on the livelihoods of local populations of that place.

Acharya *et al.* (2016), the spatiotemporal pattern of human injuries and dead in Nepal showed Asian Elephant (*Elephas maximus*), Leopard (*Panthera pardus*) and Rhinoceros (*Rhinoceros unicornis*) were the most attacking animals followed by Bears (*Ursus spp.*) and then Bengal tigers (*Panthera tigris tigris*).

The summer diet of Leopard in the Dhorpatan Hunting Reserve are Barking deer or northern red muntjac (*Muntiacus vaginalis*), Blue sheep (*Pseudois nayaur*), also include Wild boar (*Sus scrofa*), Musk deer (*Moschus* spp.*)*, and livestock of the region (Aryal and Kreigenhofer 2009).

In Bardia National Park, Shivapuri National park major problem is crop damage and livestock predation. However, the conflict differs as the distance from park boundary to the village increases. Damages are especially caused by Chital (*Axis axis*), Wild boar (*Sus*

scrofa), Jungle cat (*Felis chaus*), Monkeys, Tiger (*Panthera tigris*) and Leopard (*Panthera pardus*), animals of the park (Allendorf *et al*. 2007; Purkait and Chalise 2005).

Carnivore density is dependent on prey density (Karanth *et al.* 2004) and the Leopard (*Panthera pardus*) is no exception. Various studies across India have confirmed that domestic dog is the Leopard's (*Panthera pardus*) diet. It is likely that the abundance of feral animal populations helps sustain leopard population in human dominated areas. (Athreya and Belsare 2007).

A study of Straede and Helles (2000), in the Chitwan National Park found that the causes of conflict were illegal transactions of forest products from the park, livestock grazing in the park, illegal hunting and fishing, crop damage, and threats to human and animal life caused by wild animals from the park. A study of Karki (2014), in the Baitadi said that due to poor condition of community forest and the status of natural prey the conflict increases in the area. (Aryal *et al.* 2012; Thirgood *et al.* 2000; Graham *et al.* 2005) stated that competition for shared and limited resources results in conflict between humans and predators.

2.3. Socio-economy and attitudes of people towards Leopard

In the study of Dar and Mir (2019), about two hundred and fifty-three cases of human injuries and seventeen human deaths were reported six Black bear (*Ursus americanus*) and eight Leopards (*Panthera pardus*) also lost their lives in different places in five wildlife divisions of Kashmir valley.

There were sixteen retaliation of leopard in protected areas of Nepal within 2006-2013 years (Thapa 2014). The people near the protected area were negative.

Adhikari *et al.* (2018), found that attacks of Himalayan black bear (*Ursus thibetanus*) and leopards (*Panthera pardus)* caused four injuries and one fatal to the human beings in the Panchase area. The people of Panchase area strongly believed the wildlife should be tanslocated.

The local people are effected much their livestock as well as the people are attacked. (Bhattarai and Kindlmann, 2012, 2013; Limbu and Karki 2003). The people living around the reserve are negative towards the wild animals.

According to Acharya *et al.* (2016), there were four hundred sixty-three conflict cases involving death or injury of people caused by wildlife over a five-year period (2010–2014). Bear (*Ursus* spp.*)*, Gaur (*Bos gaurus*), Asiatic elephant (*Elephas maximus*), Leopard (*Panthera pardus*), One-horned rhinoceros (*Rhinoceros unicornis*), Bengal tiger (*Panthera tigris tigris)*, Wild water buffalo (*Bubalus arnee*) and Wild boar (*Sus scrofa*). People were living with fear of attacks and death near the conflicted area.

In Kashmir Valley, there were six human deaths and thirty-six injured in Human-Leopard conflict incidences. People were scared the deaths of number would be large in the valley (Dar *et al*. 2019).

Pokhreal (2015), surveyed that visit of Leopard (*Panthera pardus*) in the areas of Kathmandu valley near the forests was common.

When water resource has maintained, automatically the agricultural land becomes increases which significantly increases the occurrence of Leopard (*Panthera pardus*) in Shivapuri Nagarjuna National Park (SNNP) (Maharjan *et al.* 2017).

3. MATERIALS AND METHODS

3.1. Study area

The study area Godawari (27° 35′ 24″ N, 85° 23′ 24″ E) is a municipality Lalitpur district of Central Nepal. It covers the area of 96.11 Km² and 457 m above the sea level with highest elevation of 2831 m. Godawari is situated 11 km south east of Lalitpur City. It is one of the popular hiking destinations in Nepal for its wildlife and splendid natural environment. Phulchowki is the highest point (2831 m) of Godawari. It is famous for its botanical garden and Phulchowki for bird watching and hiking site and the Godawari Kunda.

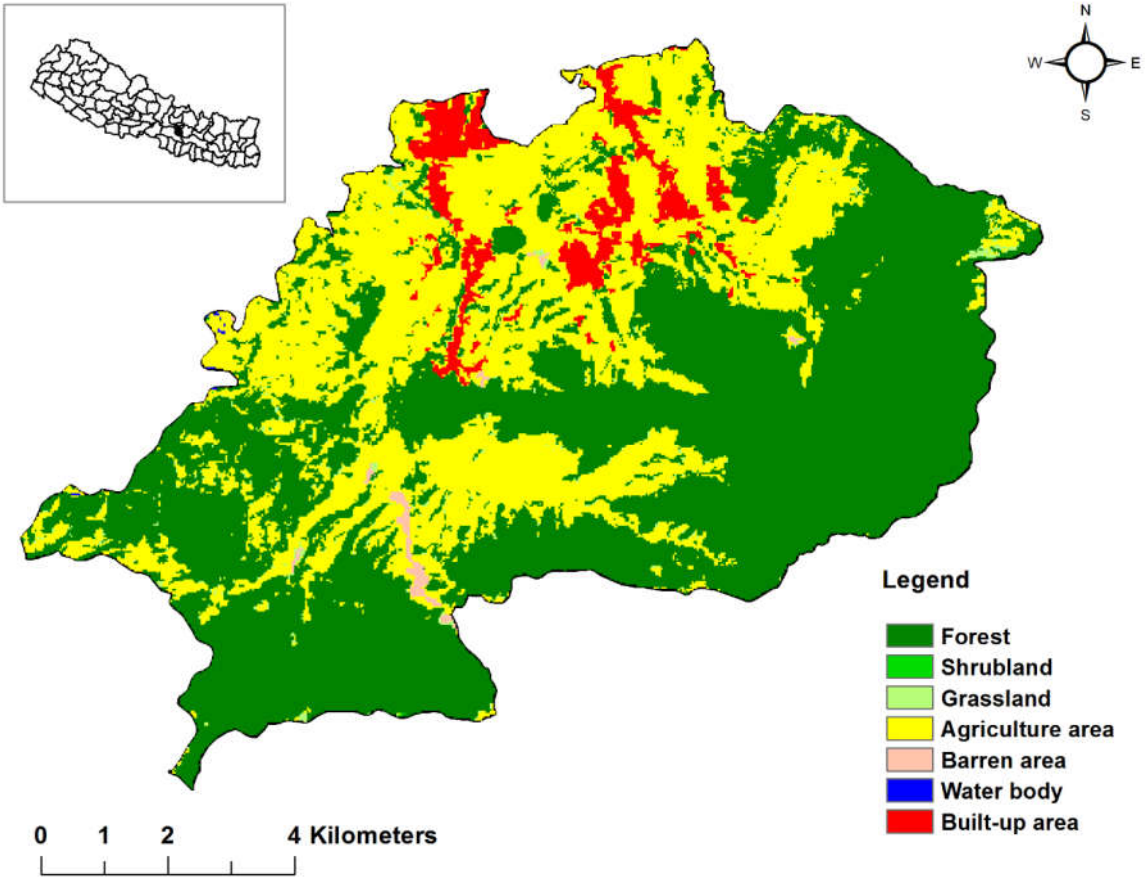

Figure 1. Map of study area showing different land cover.

Lalitpur is the third largest city of Nepal after Kathmandu and Pokhara and it is located in the south-central part of the Kathmandu valley which is a new metropolitan city of Nepal. It is best known for its rich cultural heritage particularly its tradition and craft.

3.1.1. Fauna

Leopard (*Panthera pardus*), Chinese Pangolin (*Manis pentadactyla*), Leopard cat (*Prionailurus bengalensis),* Jungle cat (*Felis chaus*), Flying Squirrel (*Ratu faindica*), Rhesus Monkey (*Mucaca mulatta*), Jackle (*Canis aurens)*, Common mongoose (*Herpestes edwardsii*).

3.1.2. Flora

Godawari lie in the deciduous monsoon forest zone with an altitude range of 1500 m to 3000 m. The major vegetations are *Castanopsis indica, Schima wallichii, Pinus roxburghii.* Above 1800 m the forest is covered with *Quercus* spp. Phulchowki hills from 1800 m to 2000 m hills are dominated by *Quercus lantana.* Above the 2000 m -2500 m mixed forest of *Quercus lamellouse* and *Quercus laureceos. Quercus semicarpifolia* are found above the 2500 m.

3.1.3. Climate

The climate is warm-temperate and subtropical, with a average mean temperature of 17.2°C. The maximum summer temperature is 33.8°C, whereas the minimum winter temperature is -0.9°C. The relative humidity is 76%. Most of the precipitation occurs during the monsoon and the average annual rainfall is about 2000 mm.

3.1.4. Socio-economy of people

Population in Godawari is increasing, over the years. Total population is 78301 and density 814.7/km^2(CBS 2011). Different ethnic groups from Terai have also become part of Godawari. Economic sectors include agriculture, education, hotels and restaurants.

3.2. Materials

- GPS
- Pen
- Notebook
- Scale
- Camera

3.3. Methods

3.3.1. Preliminary Survey

A preliminary survey was carried out in April, 2018 for the confirmation of most probable sites of Leopard *(Panthera pardus)* in the Godawari Municipality area. Line transect method was implemented for evidences of Leopard *(Panthera pardus*) at various regions and sign survey (pugmarks, scats, scrape marks, scent etc.) was also made. The field work was carried out from April 2018 to February 2019. Data were collected by following methods.

3.3.2. Data Collection

The study was based on both primary and secondary data. The primary data were collected through household questionnaire survey, interview with forest authority and user groups of the forest and field observation.

Secondary data were collected from official records and reports of municipality, Department of Forest (DoF). Other data sources were published and unpublished journals, books, articles, dissertation work and other relevant literatures.

3.3.2.1. Transect Method

Field data were collected using line transect method. This method was applied by (Anderson *et al.*1979) and later on applied by many scientists. The composition, structure of vegetation and types of disturbances in the study area were assessed line transect method. A line transect of 100 m was designed for collection of information regarding indirect signs of Leopard such as scat, pugmarks, scent, water source distance, human settlement distance, road distance, habitat character in the study area. In every 100 m distance, the habitat type and possible signs of Leopard (Panthera *pardus*) and prey species such as Northern red muntjac, wild boar and monkeys were noted.

3.3.2.2. Household Questionnaire survey

Snowball sampling method was used to conduct the questionnaire survey (Biernarcki et al. 1981). Most affected area in the municipality was identified and every possible house was asked the questions. A semi-structured questionnaire was prepared to collect data from the local communities of study area. The majority of the questions were in multiple

choice form. Questionnaire survey was used to find out extend of HLC in the study area, availability of natural resources to the local community, livestock depredation and compensation facility, attitudes of local people on Leopard (*Panthera pardus*) conservation and community awareness toward biodiversity conservation without hurting their sentiments.

3.3.2.3. Key Informant Survey

Key person interviews were conducted exclusively with those who were available during the household survey. The interviews were conducted to know the extent of HLC in their areas their role in HLC mitigation and to know the causes of the conflict. Questionnaire regarding the extent of conflict, causes of conflict, conflict management, were used. The forest department officials were the key informants of HLC in different places of study area. With the help of these key informants it got easier to ensure information regarding the extent of conflict and its effect on people to be endorsed to reduce the increasing HLC situations of the study area.

3.3.3. Data Analysis

The starting point of the line transect were chosen from the human trail to the forest then every possible transect was used to find the signs of Leopard (*Panthera pardus*). At every 100 m of line transect, the surrounding was observed to record habitat type, the distance from village, road, water resources. Whenever a scat, other signs of Leopard (*Panthera pardus*) was encountered in line transect, it was recorded as presence plot or Leopard (*Panthera pardus*) sign plot. If not present a systematic plot was established on line transect.

The collected data were analyzed by combining data of questionnaire survey and personal communication with governmental officials. Computer based R- studio, Ms-Excel was used after coding the crude data into the computer. Every questions and responses of the respondents were coded in Ms-Excel. The data was presented in descriptive form as well as in suitable table, pie chart and bar graph. GPS points recorded from the field. Chi square test was implemented on R-studio to know the significance of male and female attitude towards the conservation of Leopard (*Panthera pardus*) and attitude of people towards the conservation of Leopard (*Panthera pardus*) according to occupation.

4. RESULTS

4.1. Presence of Leopard

Signs (scat, pugmark, scratch, scrape, scent) survey were carried out in the study area to know the presence of Leopard (*Panthera pardus*). Pugmarks were mostly found near the water sources. There were ten pugmarks in total; six were near the water source of sole Leopard (*Panthera pardus*) and four places along with the pugmark of its prey Barking deer or northern red muntjac (*Muntiacus vaginalis*). Likewise there were five scats (near the road, water source, in the middle of the forest), nine scrape signs, seven scratches and scents (near the marble factory) signs found during field visit.

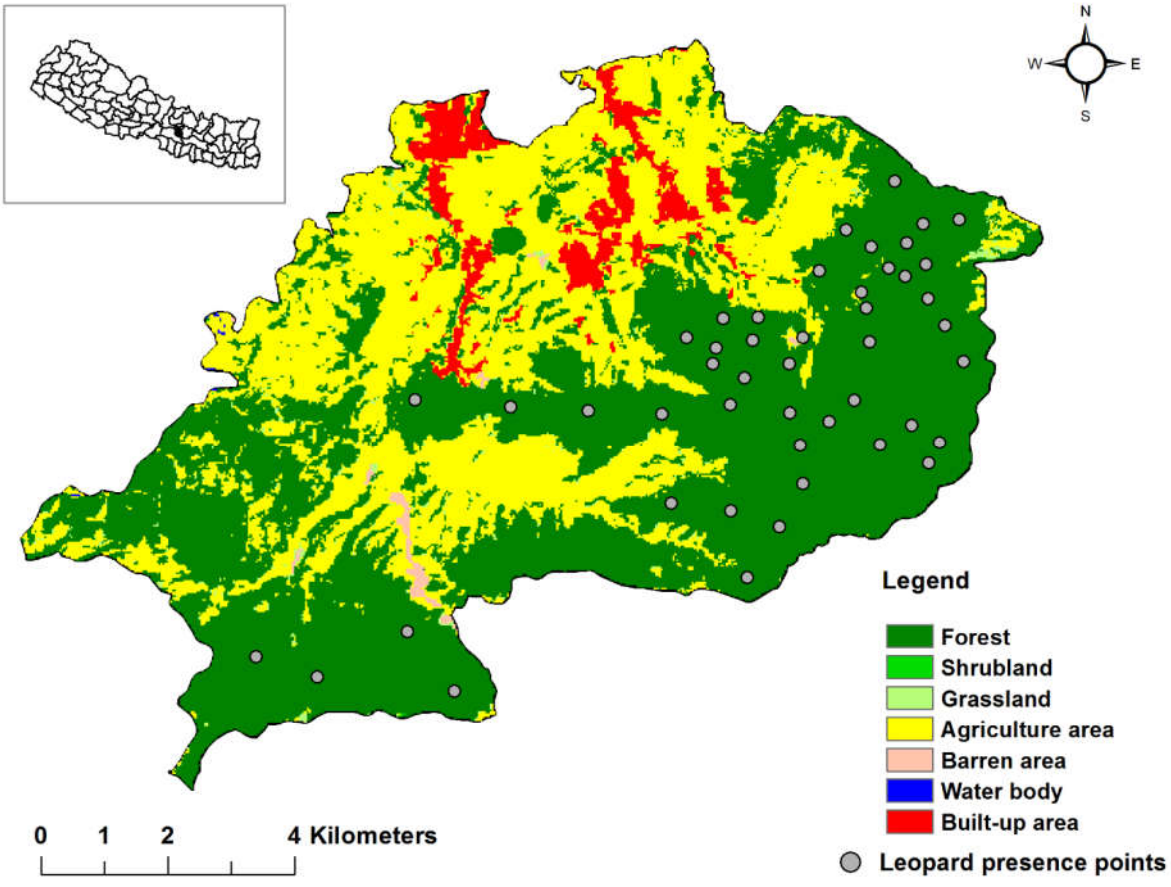

Figure 2. Map showing presence of signs of Leopard in study area.

In questionnaire survey, 57 people out of 75 had seen Leopard and 18 people had not seen Leopard (*Panthera pardus)*. Leopard (*Panthera pardus)* is heard at night near the forest areas.

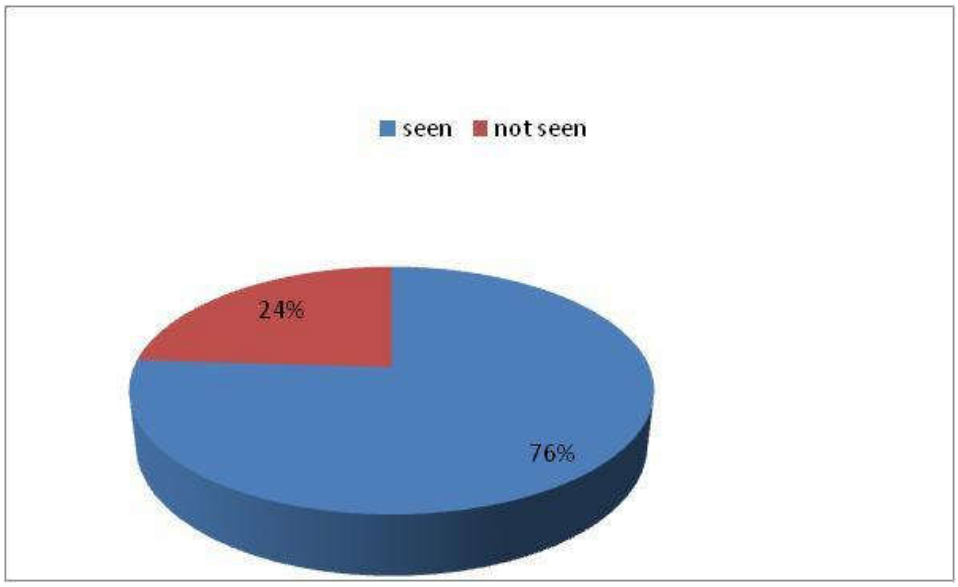

Figure 3. People's attitudes about the presence of Leopard.

4.2. Current situation and extent of Human-Leopard conflict

Altogether 75 households were interviewed from Godawari. These individuals included more number of males (40) and less females(35). Among the respondents 5 were of age group between 16 and 25 years, 12 were between 26 and 35 years, from 36 to 45 years 34, Of 46-55 age group were 15 in number, the experienced people were of age group 56-65. The total number of males was 40 and total number of females was 35 in the questionnaire survey.

Table 1. Age distribution of respondents (Annex 4).

Age Group	No. of respondent	Percentage (%)
16-25	5	7
26-35	12	16
36-45	34	45
46-55	15	20
56-65	9	12
Total	75	100

4.2.1. Forest resource Collection

The dependency of people on the forest was found to be high. 99% people were found to be dependent on forest for the products like firewood, grass. 81% of the people collected grass and firewood for household purpose, 14% collected only firewood for the purpose

of cooking the food, 4% collected only grass for feeding the livestock and 1% do not depend on the forest for the resource collection. This is one of the main reasons for HLC in Godawari.

Table 2. Resource collection by local people in the forest.

Forest products	**Usage (%)**
Grass and Firewood	81%
Firewood	14%
Grass	4%
None	1%
Total	100%

4.2.2. Livestock depredation

The families in the study area mainly depends upon the forest and the agricultural products. Among them many households had Goat (*Capra aegagrus hircus)*, Chickens (*Gallus gallus domesticus*), Buffalo (*Bubalus bubailis*), Cow (*Bos tourus*), Pigs (*Sus scrofa domesticus*) as cattle. The livestock depredation occurred whole year because they either take the livestock to pastureland or to forest for grazing. Leopards *(Panthera pardus)* even entered the village and the house; attacked all the livestock and eat all of them. The most affected time was during earthquake because heard as are kept near the settlement, settlement was scattered as most of the houses were affected and people were scared of the re-occurring of the earthquake. The guarding was not enough for the attack of the Leopard *(Panthera pardus)*. The natural prey also decreased in the forest so the attack and killing of livestock was at the peak. From questionnaire survey it was found that most affecting wildlife was found to be Leopard *(Panthera pardus)* and Wild cats (*Felis silvestris*). There were 33 households affected with Leopard *(Panthera pardus*) whereas Wild cats (*Felis silvestris*) and Leopard *(Panthera pardus)* affected 29 households. People without livestock were not affected about 13 households. In total 63 households were affected by the Leopard *(Panthera pardus)* and Wild cats (*Felis silvestris)* and 13 households were not much affected.

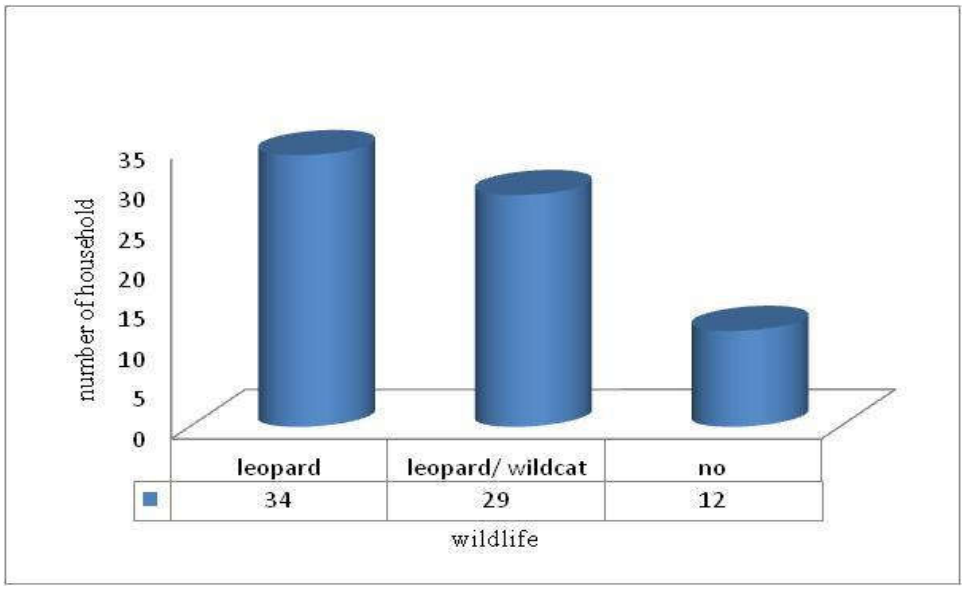

Figure 4. Livestock depredation causing wildlife.

Leopard (*Panthera pardus*) was seen or heard in almost in every season in the forest of the Godawari. According to the respondent Leopard *(Panthera pardus)* affected in all the seasons comparatively. Most respondent agreed most affected season is winter that is 50.7%. There was no much difference in respondents saying most affected season is summer that is 49.3%.

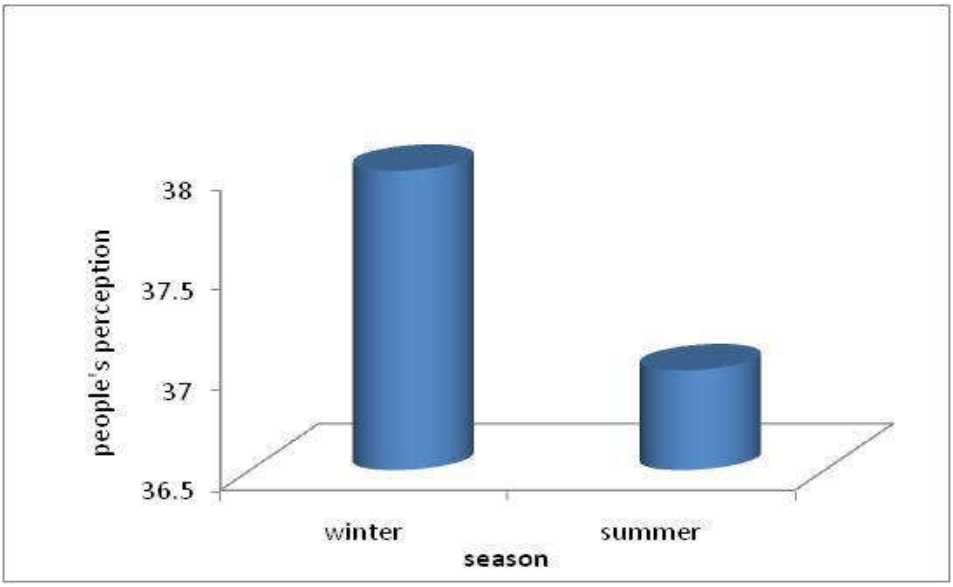

Figure 5. Most affected season

4.2.3. Attack on humans

In recent years, the cases had aroused probably after earthquake. One incident was in the study area whereas other two were near the study area. A child was attacked near the

house, a person was believed to had come in walking trail so was attacked (Annex I). In all incidents, the people were not injured. There was no incidents of people being injured or killed in the past by the Leopard (*Panthera pardus*) in the study area.

4.2.4. Reasons for Human-leopard Conflict

Most of the respondents (33%) answered the reason for Leopard(*Panthera pardus*) visit and attack on livestock in the village was lack of natural prey in the forest and 23% thought it was due to lack of conservation effort and rest of the respondent said different reasons like human disturbance in the forest, increased forest area and habitat loss of the Leopard *(Panthera pardus)*.

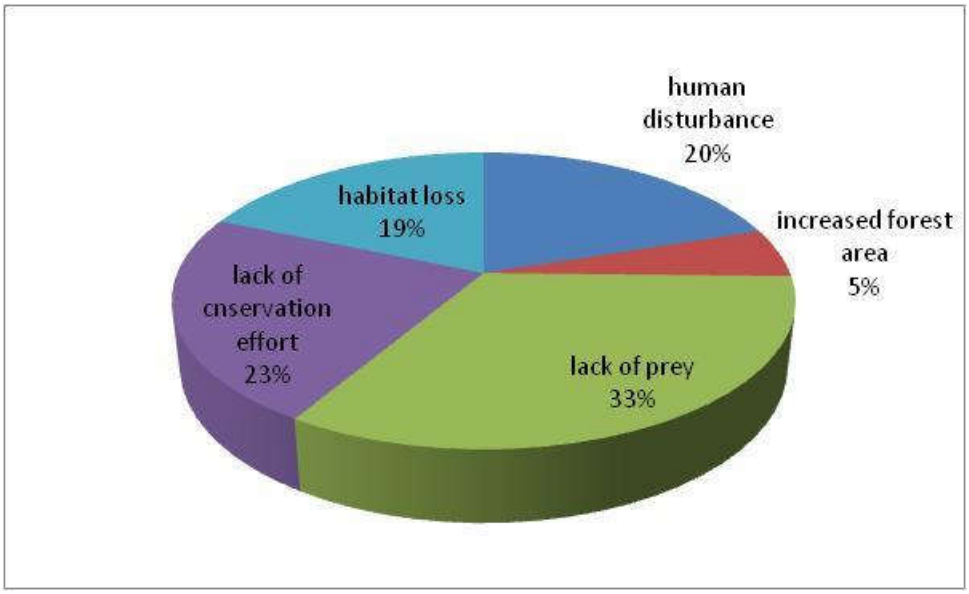

Figure 6. Reasons of Human-Leopard conflict.

4.3. Socio-economy and people's attitudes towards Leopard conservation

4.3.1 Socio-economy of the respondents

In the study area, people were mostly depended on the forest products and agriculture for their livelihood. Out of 75 respondents,7 engaged in other fields than the agriculture teachers both were female (2), very few were engaged in business (2), worked in office (3). remaining 68 people were farmers (44), followed by labors (15), students (6), plumber (1), carpenter (1) and retired personal (1). Average family size in the study area was 5. Few had 12 members in their family.

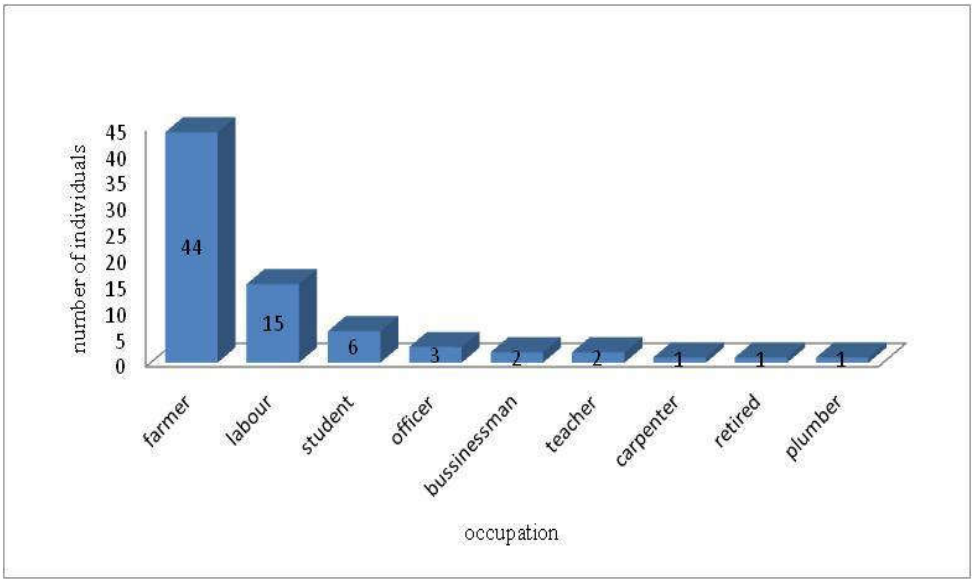

Figure 7. Occupation of the respondents.

Livestock holding

In the study area, 85% of the households involved in livestock rearing and 15% weren't engaged. Most of respondents reared Goat (*Capra aegagrus hircus*) (37%) only, 32% reared Chicken (*Gallus gallus domesticus*) and Goat (*Capra aegagrus hircus*), 5% reared only Chicken (*Gallus gallus domesticus*), 4% reared Cow (*Bos tourus*) and Goat (*Capra aegagrus hircus*) and 3% reared Buffalo (*Bubalus bubailis*), Goat (*Capra aegagrus hircus*) and Chicken (*Gallus gallusdomesticus*), and 3% reared Pig (*Sus scrofa domesticus*) and Goat (*Capra aegagrus hircus*) and 1% of respondents reared Buffalo (*Bubalus bubailis*) and Goat (*Capra aegagrus hircus*).

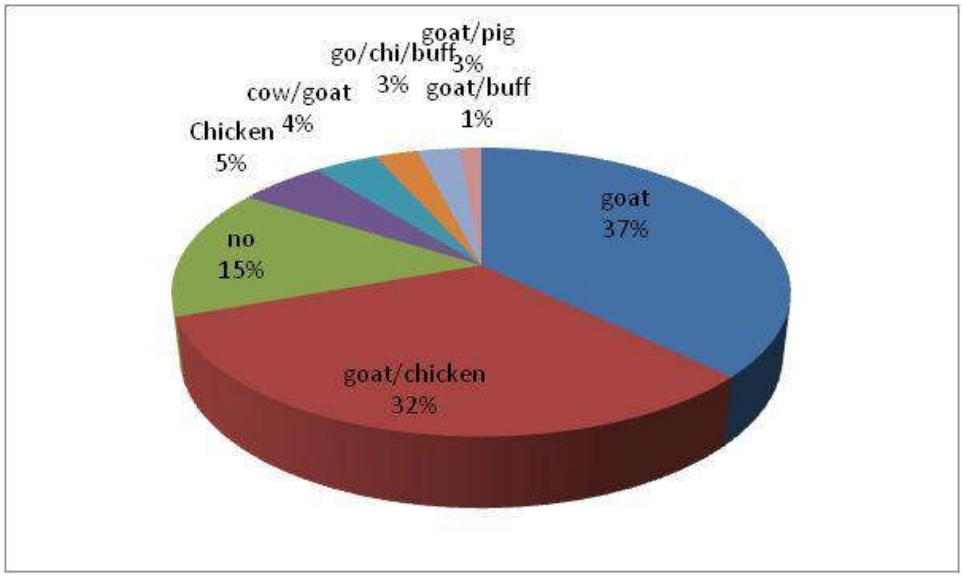

Figure 8. Number of respondents holding livestock.

4.3.2. People's attitudes towards Leopard conservation

In the questionnaire survey, to know the attitudes of people towards conservation of Leopard *(Panthera pardus)* the question was asked do we need to conserve the Leopard *(Panthera pardus)* or not. The response of people was negative. Most of the people 50% said we should not conserve it. Most of the Livestock were killed by the wildlife. Very less people said we should conserve it knowing the importance of Leopard *(Panthera pardus)*. There were people who had no idea about the thing that should we conserve Leopard (*Panthera pardus)* or not (41%). These respondents had no livestock. 9% respondents were aware about the importance of Leopard (*Panthera pardus).*

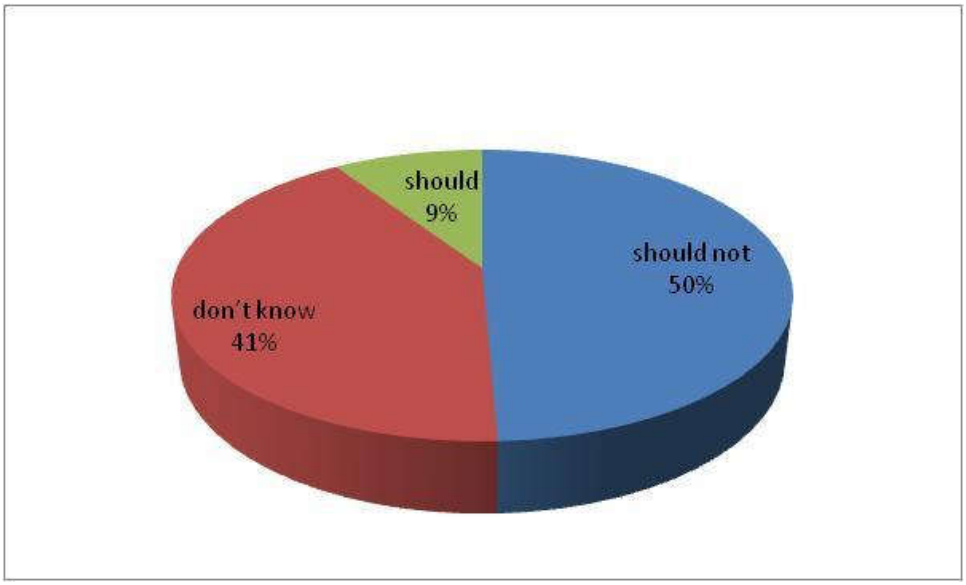

Figure 9. People's attitudes towards conservation of Leopard.

4.3.2.1. Benefits of Leopard Conservation

In the study area, to know the peoples point of view about Leopard *(Panthera pardus)*, a question was designed what are the benefits of Leopard *(Panthera pardus)* conservation; most of the respondents were negative towards the conservation of the Leopard *(Panthera pardus).* Most of them have livestock which are mostly attacked, killed by the Leopard *(Panthera pardus)*. About 34% of the respondent said there is no any benefit of conserving the leopard, 32% respondent were unaware of the benefits of conserving Leopard *(Panthera pardus*) and said I don't know. Few were aware of the fact that we have benefits of Leopard *(Panthera pardus)* conservation, 17% of the respondent said environmental balance. Around 9% on respondent were not interested in answering the

question, there was no response from their side. Rest 5% and 3% said biodiversity conservation and also supports the tourism.

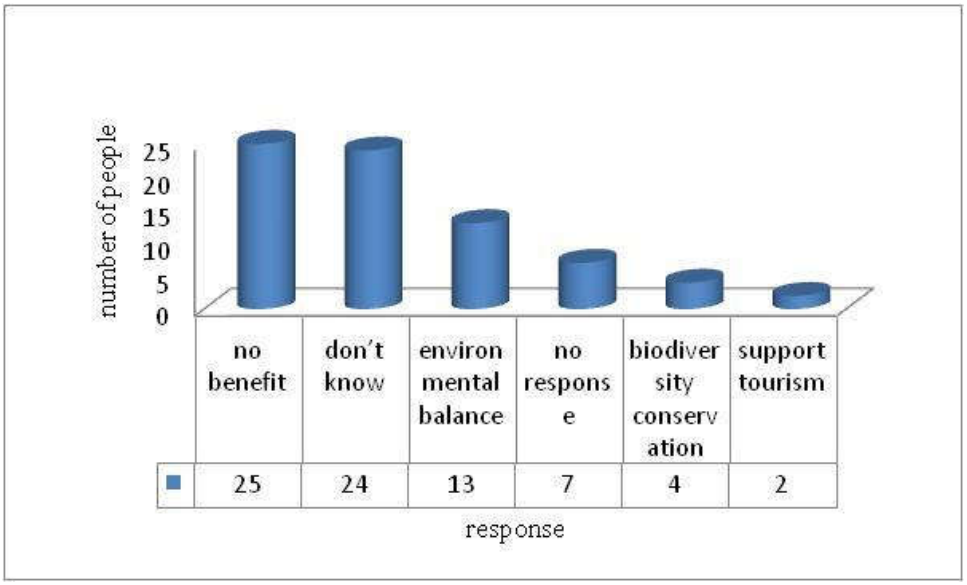

Figure 10. Benefits of Leopard conservation.

4.3.2.2. Reduction of HLC for Leopard conservation

The respondents were asked what suggestions they would like to give to the concerned authorities. 23% of the total respondents said no suggestions. Most of them were the people who didn't have livestock and didn't need to go for forest collection. Most of the people reared livestock 17% of the respondents suggested availability of pastureland so that their livestock wouldn't be eaten up by the Leopard (*(Panthera pardus)*). 16% people were aware about the importance of leopard said the strict rules are to be formed in order to minimize the conflict. There were 15% respondents who agreed public awareness must be provided. There were almost equal number of respondents saying not concerned about it and there must be a conservation effort i.e. 8% 5% of respondent said that compensation schemes must be provided to the livestock owners. Some people 4% of them said there must be public participation for better result for conservation. Lastly, 1% of the respondents said request for research survey must be done.

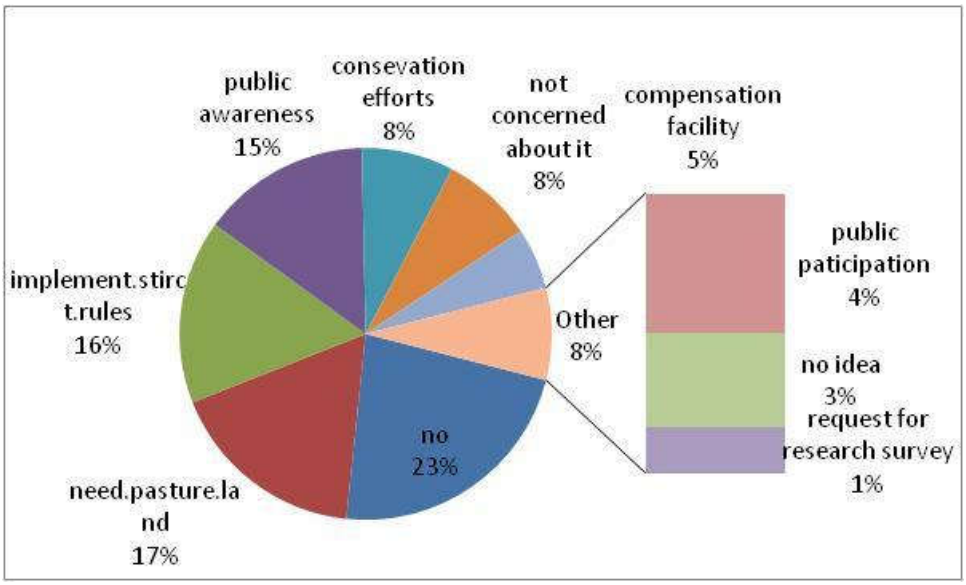

Figure 11. Response of people towards Leopard conservation.

There was no significance difference between male and female in the attitudes that Leopard (*Panthera pardus*) should be conserved or not. (χ^2=6, df=4, p-value=0.1991). There was no significance difference between male and female in the attitude on benefits of conservation of Leopard (χ^2=12, df=9, p-value=0.2133). There was significance difference in the attitude of people that Leopard (*Panthera pardus*) should be conserved according to the occupation (χ^2= 20, df = 18, p-value = 0.3328). There was significance difference in the attitude of people that Leopard (*Panthera pardus*) should not be conserved according to the occupation (χ^2= 40, df = 36, p-value = 0.297).

5. DISCUSSION

5.1. Presence of Leopard

Human wildlife conflict is emerging issue for the survival of the threatened and endangered species of animals in the world. Not only Nepal, it is a challenge to the world in case of severity of the conflict. The greater depth study is needed in order to overcome the severity of the conflict and conserve threatened and potentially endangered species (Distefano, 2005). Leopard (*Panthera pardus*) is very common large Cats found in Nepal. It is found from Tarai to Himalaya (KMTNC1998). It is reported to be found up to 3500 m in the Trans-Himalayan region like Upper Mustang (Shah *et. al.*2004) but according to Jackson (1984) also was found at 5200 m. The present study was conducted in Godawari Municipality ranging 1400 m up to 2831 m. Leopard (*Panthera pardus*) is found in community, national forests of Kathmandu valley, protected areas of Nepal comprising 73 districts of Nepal (Thapa 2011; Pokhreal 2015; Shah *et al.* 2004). The study area is community forests and lies within Kathmandu valley. Yearly Leopards (*Panthera pardus*) are killed, injured in Lalitpur (DFO, Lalitpur). Leopard (*Panthera pardus*) is one of the potentially endangered animal.

In Nepal's Bardia National Park, territories is 48 km^2 for males and 5–7 km^2 for females. Leopard (*Panthera pardus*) have widespread distribution across a range of altitude up to 4400 m (Odden and Wegge 2005; Henschel 2008; Aryal and Kreigenhofer 2009; Koirala *et al*. 2012). The site covers an area of 96.1 km² with highest elevation of 2831 m . The area and the elevation is suitable for availability of Leopard (*Panthera pardus*). Scat was mostly found in the walking trail whereas pugmarks were found near the water sources in the forest, scent was found around the marble factory. The area coverage, elevation and the sign survey proved the availability of Leopard (*Panthera pardus*) in the Godawari area. Gunawan *et al*. (2012) stated that Leopards *(Panthera pardus*) tend to keep distance approximately more than half a kilometer from human settlements. In my findings, the signs of Leopard (*Panthera pardus*) was low in the sites with loud music near the picnic spots and human settlement.

5.2. Human-Leopard conflict

A study of Straede and Helles (2000) in the Chitwan National Park found that the causes of conflict were illegal transactions of forest products from the park, livestock grazing in

the park, illegal hunting and fishing, crop damage, and threats to human and animal life caused by wild animals from the park. A study of Karki 2014, in the Baitadi said that due to poor condition of community forest and lower number of natural prey the conflict increases in the area. (Aryal *et al.* 2012; Thirgood *et al.* 2000; Graham *et al.* 2005) stated that competition for shared and limited resources results in conflict between humans and predators. In my study, the village is near to the forest and people are dependent on forest. 99% of the villagers were dependent on forest. The competition for limited resources resulted livestock depredation in the study area. Reduction on dependency on natural resources that minimized the confrontation between people, livestock and Leopard (*Panthera pardus*).

In context of world, Case studies of Human-Wildlife Conflict from the world wolves (*Canis lupus*) and bears (*Ursus* spp.) killing domestic sheep in North America and Europe; pumas (*Puma concolor*) and jaguars *(Panther aonca*) taking cattle in South America; numerous carnivore genera preying on cattle and goats in Africa; tigers (*Panthera tigris)* and Leopards (*Panthera pardus*) killing livestock in Asia (Karantha and Madhusudan 2002). Tigers (*Panthera tigris*) and Asian elephants conflict in much of Asia (Nyhus and Tilson 2004) have a consistent impact on the livelihoods of local populations of that place. In case of my study, Leopard (*Panthera pardus*) prey on the animals of the forest, deer, cattle, feral dogs, goat, cow etc. Livestock holding respondent (85%) are affected in the study area. There were few cases of dogs being eaten up by Leopard (*Panthera pardus)*.

Attacks of Himalayan black bear (*Ursus Thibetanus*) and leopards caused four injuries and one fatal to the human beings in the Panchase area (Adhikari *et al.* 2018). In my findings, there were less cases of humans injuries by the Leopard (*Panthera Pardus*). People living near the forest were more affected than living down the forest area and they reared livestock as well and were more dependent in forest area for forest products.

5.3. Socio-economy and people's attitudes towards Leopard conservation

The local people are effected much their livestock as well as the people are attacked (Bhattarai and Kindlmann 2012, 2013; Limbu and Karki 2003). The people living around the reserve are negative towards the Leopard (*Panthera pardus*). In my findings major effects occurred during earthquake. Leopard (*Panthera pardus*) entered the houses and killed livestock. A small group of people were formed and they guarded the village

during earthquake. The grazing of livestock was prohibited to the forest after the earthquake. Most of the people 50% said we should not conserve it whereas 41% didn't have any idea about it. These respondents had no livestock. The people near the forest are negative towards the wildlife.

Pokhreal 2015, surveyed that visit of Leopard (*Panthera pardus*) in the areas of Kathmandu valley near the forests was common. In my findings people were used to with the visit of Leopard (*Panthera pardus*). The livestock were attacked in the house, while grazing in the forest, dogs were taken away by the Leopard (*Panthera pardus*). People were witnesses of Leopard (*Panthera pardus*) attacks in the human settlement.

The people were not directly affected by Leopard (*Panthera pardus*) but the attacks to their properties (livestocks, domestic dogs) caused their loss. The livestock were killed but people were not compensated for the loss. Compensation is given only to people living near the buffer zones and protected areas. My study area did not come under those category. Mainly livestock holding people were negative towards Leopard (*Panthera pardus*).

There has never been a scientific research in Godawari about Leopard (*Panthera Pardus*). Thus a detailed, scientific study of Leopard *(Panthera pardus*) is needed in Godawari. This could provide an estimation of the number of Leopard *(Panthera pardus)* and natural prey in the forest.

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The conflict between human and wildlife increases when the forest area and resources are encroached by human beings. The Leopard *(Panthera pardus)* is commonly seen in the forest area and even in houses of people in search of food. The mostly affected time of conflict was during earthquake. People guarded the village by lighting fire at night to escape Leopard to the forest. The cases of human injuries were minimum in the study area, cases of livestock depredation is maximum. The humans are not affected yet but the day is not far if the human disturbance increase in same manner. This study was conducted in Godawari, Lalitpur in April 2018 to know the Human-Leopard conflict (HLC) and people's attitudes towards it's conservation. Sign survey was conducted to know the presence of Leopard *(Panthera pardus)*. Snowball sampling was employed to know the current situation and extent of the HLC and people's attitudes towards Leopard *(Panthera pardus)* conservation in the affected areas. There were presence of scats, pugmarks, scents of Leopard *(Panthera pardus)* in the transect. Altogether 75 semi-structured questionnaire were done within the age group between 16-65 years old. Frequent domestic and pet were attacked and few human injuries cases shows the HLC cases. The major reasons for HLC were lack of prey species and human disturbances in Leopard *(Panthera pardus)* habitat. Majority of the respondents were against conservation of Leopard *(Panthera pardus)* because of frequent domestic animals depredation in the study area. According to the reports of DoF (2066-2075) yearly Leopard *(Panthera pardus)* is killed and traded for its skin, injured and escaped to the jungle.

6.2. Recommendations

- Further research on the availability of wildlife in leopard habitat is essential.
- Public awareness about the importance of Leopard should be given to the people.

7. REFERENCES

Adhikari, J.N., Bhattarai, B.P., Thapa, T.B. 2018. Human-Wild Mammal Conflict in A Human Dominated Midhill Landscape: A Case Study from Panchase Area In Chitwan Annapurna Landscape, Nepal.

Allendorf, T.D., Smith, J.L.D. and Anderson, D.H. 2007. Residents' perceptions of Royal Bardia National Park, Nepal. Landscape and Urban Planning **82**: 33–40.

Anderson, D.R., Laake, J.L., Crain, B.R. and Burnham, K.P. 1979. Guidelines for line transect sampling of biological populations.-. Journal of Wildlife Management **43**: 370–378.

Aryal, A. and Kreigenhofer, B. 2009. Summer diet composition of Leopard *Panthera pardus* (Carnivore: Felidae) in Nepal. Journal of Threatened Taxa **1**(11): 565-566.

Aryal A., Hopkins J, Ji.W, Raubenheimer D., Brunton D. 2012. Distribution and diet of brown bear in the upper Mustang Region, Nepala, Nepal. Ursus **23**(2): 231–236.

Aryal A, and Kreigenhofer, B.B. 2009. Summer diet composition of the Leopard *Panthera Pardus* (*Carnivora: Felidae)* in Nepal ‚Journal of Threatened Taxa **11:** 526-536.

Aryal A., Raubenheimer D., Ji.W, Brunton, D. 2012b. Blue sheep in the Annapurna Conservation Area, Nepal: habitat use, population biomass and their contribution to the carrying capacity of snow leopards.

Athreya, V.R. and Belsare, A.V. 2006. Providing the Maharashtra Forest Department technical and veterinary support to better deal with wild animals that require human intervention. Technical report submitted to Wildlife Trust of India, New Delhi and the Office of the Chief Wildlife Warden, Maharashtra.

Bhattarai, B.P. and Kindlmann, P. 2012. Interactions between Bengal tiger (*Panthera tigris*) and leopard (*Panthera pardus*): implications for their conservation. Biodiversity and Conservation **21**: 2075–2094.

Bhattarai, B.P. and Kindlmann, P. 2013. Effect of human disturbance on the prey of tiger in the Chitwan National Park – Implications for park management. Journal of Environmental Management **131**: 343–350.

Biernarcki, P. and Waldrof, D. 1981. Snowball Sampling: Problems and Techniques of Chain Referral Sampling. Sociological Methods and Research, **10**: 141-163.

Bothma, J.d.P., Knight, M.H., le Riche, E.A.N. and Van Hensbergen, H.I. 1997. 'Range size of southern Kalahari leopard s', South African Journal of Wildlife Research **27**(3): 94–99.

Bothma, J.du.P., Knight, M.H., Riche, E.A.N., Le., and Van Hensbergen, H.J. 1997. Kalahari leopards. South African Journal of Wildlife Research **27**: 94-99.

Conforti, V.A and de Azevedo, F.C.C. 2003. Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguacu National Park area, south Brazil. Biological Conservation **111**: 215–221.

Dar, M.A. and Mir, R.A. 2019. Causalities Of Human Wildlife Conflict In Kashmir Valley, With Special Reference To Leopard And Asiatic Black Bear, Glocal University, Saharanpur, Uttar Pradesh, India.

Denizen, N., and Lincoln, Y. 2000. Handbook of qualitative research. Sage, Thousand Oaks.

Dickman, A.J. 2008. Key determinants of conflict between people and wildlife, particularly large carnivores, around Ruaha National Park, Tanzania. London: University College London.

Distefano, E. 2005. Human– wildlife conflict worldwide: a collection of case studies, analysis of management strategies and good practices. Food and Agricultural Organization of the United Nations (FAO), Sustainable Agriculture and Rural Development (SARD) paper (web document) http://www.fao.org/sard/common/ecg/1357/en/HLC_final.pdf.

Fox, J., Yonzon, P. and Podger, N. 1996. Mapping conflicts between biodiversity and human needs in Langtang National Park, Nepal. Conservation Biology **10**: 562–569.

Graham, K., Beckerman, A.P. and Thirgood, S. 2005. Human–predator–prey conflicts: ecological correlates, prey losses and patterns of management. *Biology Conservation* **122**:159–171.

Gunawan, H., Prasetyo, L.B., Mardiastuti, A., Kartono, A.P. 2012. Habitat Macan Tutul Jawa (*Panthera pardus* Melas Cuvier 1809) Di Lansekap Hutan Tanaman Pinus (Habitat of Javan Leopard (*Panthera pardus* melas Cuvier 1809) in Pine Plantation Forest Landscape. J Penelit Hutan Dan Konserv Alam **9(1)**:49–67.

Harrier. H and Grouse. R. 2008: Science, politics and human–wildlife conflict.

Henschel, P. 2008. The conservation biology of the leopard *Panthera pardus* in Gabon: status, threats and the strategies for conservation. Phd. thesis, George- August Universitatzu Gottingen, Germany.

Henschel, P. 2009. The status and conservation of leopard s and other carnivores in the Congo Basin, and the potential role of the reintroduction. Reintroduction Top-Order Predat Blackwell Publ Oxford, pp 206-237.

Hoare, R.E. 1996.The present and future use of fencing in the management of larger African mammals. Environmental Conservation **19**(2): 160-164.

Johnson, M.F., Hannah, C., Acton, L., Popovici, R., Karanth, K.K., and Weinthal 2014. Network environmentalism: citizen scientists as agents for environmental advocacy. Global Environmental Change-Human and Policy Dimensions **29**: 235-245.

Kala, C.P. and Kothari, K.K. 2013. Livestock predation by Leopard in Binsar Wildlife Sanctuary, India: human– wildlife conflicts and conservation issues, Human–Wildlife Interactions **7**(2):325–333.

Karanth, K.U., and Madhusudan, D. 2002. Mitigating human-wildlife conflicts in southern Asia. In: Terborgh, J. *et al.*(eds), Making parks work: identifying key factors to implementing parks in the tropics. Island Press, Covelo, California, pp 250–264.

Karlsson, J. and Johansson, O. 2010. Predictability of repeated carnivore attacks on livestock favors reactive use of mitigation measures. Journal of Applied Ecology **47**(1) 166-176.

Karki, J. and Rawat, G. 2014. Human-leopard conflict in Nepal: A case study from Baitadi District. DNPWC.

KMTNC. 1998. Project proposal for Manaslu Conservation Area. The King Mahendra Trust for Nature Conservation, Lalitpur, Nepal.

Koirala, R.K., Aryal, A., Parajuli, A. and Raubenheimer. D. 2012. Human-leopard conflict in lower belt of Annapurna Conservation Nepal. Journal of Research in Conservation Biology **1**: 05-13.

Kumar, D. 2011. Study of Leopard Menace, Food Habits and Habitat Parameters in Mandi District, Himachal Pradesh, PhD thesis, Saurashtra University, Gujrat, India.

Limbu, K.P. and Karki T.B. 2003. Park–people Conflict in Koshi Tappu Wildlife Reserve. Our Nature **1**: 15-18.

Maharjan, B., Shahnawaz, Thapa, T.B., Shrestha, P.M. 2017. Geo-spatial Analysis of Habitat Suitability for Leopard (*Panthera pardus* Linnaeus, 1758) in Shivapuri Nagarjun National Park, Nepal. Environment and Ecology Research **5**(2): 177-128.

Matthew, R. and Upreti, R.B. 2005. Environmental stress and demographic change in Nepal: Underlying conditions contributing to a decade of insurgency.

Marrker, L.L. and Dickman, A.J. 2005. "Factors affecting leopard (panther pardus) spatial ecology with particular reference to Namibian farmlands. South African Journal of Wildlife Research **35**(2): 105-115.

Mishra, C. 1997. Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects. Environmental Conservation **24**: 338–343.

Mishra, C., Vn Wieren, S.E., Ketner, P., Heitkönig, I.M.A. and Prins, H.H.T. 2004. Competition between domestic livestock and wild bharal Pseudoisnayaur in the Indian Trans-Himalaya. Journal of Applied Ecology **41**(2): 344-354.

Mizutani, F.; Jewell, P.A. 1998. Home-range and movements of leopard s (*Panthera pardus*) on a livestock ranch in Kenya. Journal of Zoology **244** (2): 269–286.

Mehta, J.N. and Kellert, S.R. 1998. Local attitudes toward community-based conservation policy and programs in Nepal: a case study in the Makalu-Barun Conservation Area. Environmental Conservation **25**: 310–333.

Myers, N. 1986. Conservation of Africa's cats: problems and opportunities. In Cats of the world. Miller, S.D., Everett, D.D. (Eds.). Washington, DC: National Wildlife federation, pp 437- 457.

Nepal, S.K. and Weber, K.E. 1995. Prospects for coexistence: wildlife and local people. Ambio **24**: 238–245.

Nowell, K. and Jackson, P. 1996. "Leopard Panthera pardus (Linnaeus,1758)". Wild Cats: status survey and conservation plan. Gland, Switzerland: IUCN/SSC Cat Specialist Group.

Nowell, K., and Jackson P. 1996. Wild Cats. Status and conservation Action plan IUCN/SSC Cat Specialist Group, Gland, Switzerland.

Nyhus, P.J. and Tilson, R. 2004.Characterizing human–tiger conflict in Sumatra, Indonesia :implications for conservation. Oryx **38**: 68–74.

Nyhus, P.J. 2016. Human-wildlife conflict and coexistence. Annual Review of Environment and Resources **41**: 143-171.

Odden, M., and Wegge, P. 2005. Spacing and capacity patterns of leopard (*Panthera pardus)* in the Royal Bardiya National Park Nepal. Wildlife Biology **11**: 145-52.

Ogada, M., Woodroffe, R., Oguge, N. and Frank, G. 2003. Limiting Depredation by African Carnivores: the Role of Livestock Husbandry. Conservation Biology **17**(6): 1521-1530.

Prater, S.H. 1998. *The book of Indian animals.* Bombay Natural History Society, India.

Pokhreal 2015. Human-leopard conflict in Kathmandu Valley, Master thesis, Central Department of Zoology, Kirtipur, Nepal.

Purkait, S. and Chalise M.K. 2005. Park – People Conflict and its Management in Shivapuri National Park: A Case Study of Sundarijal Village Development

Committee. Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Qamar, Q.Z., Dar, N.I., Ali, U., Minhas, R.A., Ayub, J. and Anwar, M. 2010. Human Leopard Conflict: An Emerging Issue of Leopard Conservation in Machiara National Park, Azad Jammu and Kashmir, Pakistan. Pakistan Journal of Wildlife management **1**(2): 50-56.

Santiapillai, C., Chambers, M.R. and Ishwarn, N. 1982. The leopard (*Panthera pardus fusca)* Meyer, 1794 in the Ruhuna National Park, Sri Lanka and observation relevant to its conservation. Biological Conservation. **23**: 5- 14.

Seidensticker, J., Sunquist, M. and McDougal, C. 1990. Leopards living at the edge of the Royal Chitwan National Park, Nepal. Pp 415-423 in J.C. Daniel and J.S. Serrao (Eds.) Conservation in developing countries: problems and prospects. Proc. Centenary Seminar of the Bombay Natural History Society. Bombay Natural History Society and Oxford University Press, Bombay.

Shah, K.B., Thapa, T.B., and Budha, P.B. 2004. Status Survey of the Leopard Panthera pardus Linnaeus, 1758 in Nepal. A report submitted to WWF Nepal Program, Kathmandu, Nepal.

Stein, A.B., Athreya, V., Gerngross, P., Balme, G., Henschel, P., Karanth, U., Miquelle, D., Rostro, S., Kamler, J.F., and Laguardio, A. 2019. "*Panthera pardus"*. The IUCN Red List of Threatened Species. IUCN. 2019: 15954/102421779.

Straede, S., and Helles, F. 2000. Park–people conflict resolution in Royal Chit-wan National Park, Nepal: buying time a high cost? Environmental Conservation **27**: 368–381.

Stein, A.B., Athreya, V., Gerngross, P., Balme, G., Henschel, P., Karanth, U., Miquelle, D., Rostro-Garcia, S., Kamler, J.F., Laguardia, A., Khorozyan, I. & Ghoddousi, A. 2016. *Panthera pardus*. The IUCN Red List of Threatened Species 2019: Terborgh. J., 1992. Maintenance of diversity in tropical forests. Biotropica **24**: 283-292.

Thapa, T.B., Human caused mortality in the leopard (Panthera pardus) population in Nepal 2014. *Journal of Institute of Science and Technology*, **19**(1): 155-159,

Thirgood S.J., Redpath S. M., Haydon D.T., Rothery P, Newton I, Hudson P.J. 2000. Habitat loss and raptor predation: disentangling long and short-term causes of red grouse declines. Proceedings of Royal Society of London (Biology) **267**: 651–656.

Thouless, C., Dublin, H.T., Blanc, J., Skinner, D., Daniel, T., Taylor, R. and Bouche, P. 2016. African Flephant Status Report. Occational Paper Series Of The IUCN Species Survival Commission, 60.

Waters, C.N., Zalasiewicz, J., Summerhayes, C., Barnosky A.D., and Poirier C. 2016. The Anthropocene is functionally and stratigraphically distinct from the Holocene. Science 351.

8. ANNEX

Annex I. Some case studies from the field site

During study period, visiting different conflicted areas of the Kathmandu valley, I found that many people have to say many things regarding the encounter with leopards. All the stories regarding the onset of conflict situation are summarized below:

Bungamati

A female leopard of about 3 weeks was rescued from the Fasidol and sent to the Central Zoo, Jawalakhel.

Jharuwarasi

Three years old child was attacked and killed by a leopard. The leopard was chased to the jungle by the villagers.

Chapagaun

Shambhu Thapa was attacked by an adult leopard. Leopard was chased to the jungle.

Dhapakhel

Different aged leopards attacked domesticated poultry and birds .Leopards were chased back to the jungle by villagers and the forest officers.

Champi

Leopard attacked and killed 4 years old Prasamsa Bista. Leopard escape back to the jungle.

Tikathali

Leopard entered to a house was rescued by the forest official, police and sent to the Central Zoo, Jawalakhel.

Bajrabarahi

Leopard was rescued from the forest by the forest official, police and sent to the Central Zoo, Jawalakhel.

Annex II. Cases of leopard attack ,being killed and trafficked.

Region	Year	Case	Reference
Jharuwarasi	2066	Leopard killed 3 years old child.	DFO, lalitpur
Chapagaun	2068	Leopard injured a man.	DFO, lalitpur
Bungamati	2068	Cub of leopard rescued form a house.	DFO, lalitpur
Dhapakhel	2068	Leopard killed the cattle so chased back to the jungle.	DFO, lalitpur
Champi	2069	Leopard killed 4 years old child .	DFO, lalitpur
Godawari	2070	A dead female leopard found.	DFO, lalitpur
Tikathali	2070	Leopard rescued from a house and sent to the zoo.	DFO, lalitpur
Bajrabarahi	2075	Leopard rescued from the forest and sent to zoo.	Godawari municipality

Annex III. Areas where Leopard signs were seen.

SN	Y	X	Transcet No.	Habitat	Scat	Pugmark	Scrape	Scratch/ Scent
1	27.599619	85.388551	A8	*Schima walliichi*	1	0	0	0
2	27.601205	85.390556	A11	*Schima walliichi*	0	1	0	0
3	27.601328	85.391142	A14	*Schima walliichi*	0	1	0	0
4	27.601238	85.391304	A15	*Schima walliichi*	0	1	0	0
5	27.597874	85.386882	B1	*Castanopsis indica*	1	0	0	0
6	27.591551	85.377512	B5	*Schima walliichi*	0	0	0	1
7	27.587778	85.375278	B9	*Alnus nepalensis*	0	1	0	0
8	27.580847	85.375277	B16	*Schima walliichi*	1	0	0	0
9	27.588827	85.369143	C7	*Pinus roxburgii*	0	0	0	1
10	27.585856	85.368056	C11	*Pinus roxburgii*	0	0	0	1
11	27.591206	85.369468	D6	*Schima walliichi*	0	0	1	0
12	27.587183	85.368657	D14	*Quercus species*	0	0	0	1
13	27.589558	85.364927	F9	*Mixed*	0	0	1	0
14	27.590163	85.363615	G5	*Castanopsis indica*	0	0	1	0
15	27.587936	85.363056	G7	*Quercus lantana*	0	0	0	1
16	27.592058	85.363889	H4	*Castanopsis indica*	0	0	0	1
17	27.595608	85.387657	I4	*Pinus roxburgii*	0	1	0	0
18	27.597216	85.389444	I11	*Schima walliichi*	0	1	0	0
19	27.598227	85.391111	I15	*Quercus species*	0	1	0	0
20	27.599727	85.393888	I21	*Castanopsis species*	0	1	0	0
21	27.600091	85.393894	I22	*Castanopsis species*	1	0	0	0
22	27.600111	85.394166	I23	*Castanopsis speciess*	0	0	1	0

23	27.57948	85.381478	T3	*Schima walliichi*	0	0	1	0
24	27.578169	85.382925	T5	*Schima walliichi*	0	1	0	0
25	27.600661	85.394166	I25	*Schima walliichi*	0	0	0	0
26	27.600727	85.393888	I26	*Schima walliichi*	0	0	1	0
27	27.601783	85.397232	I29	*Alnus nepalensis*	0	1	0	0
28	27.582533	85.385578	T8	*Schima walliichi*	1	0	0	0
29	27.57887	85.394709	T13	*Castanopsis species*	0	0	1	0
30	27.576286	85.399134	T19	*Myrica esculenta*	0	0	1	0
31	27.573341	85.397349	T24	*Pinus species*	0	0	1	0
32	27.571066	85.404487	T32	*Alnus nepalensis*	0	0	0	1

Annex IV. Questionnaire

Human-leopard Conflict Survey Questionnaire

Name: Age/Sex: Occupation:

Ward No.: Village: Family size:

1. Do you have domesticated animal? if yes what type and how many?

a) cow b) goat c)sheep d)chicken e) Pig

2.What are the forest products you collected from the forest? (per month)

a)firewood b)grass c)fuel woods d)timber woods

e)medicinal plants

3. Have you seen Leopard ?

Yes …… No …….

If yes, Where (Place) …… When (Month) ……. How many (number)

4.Which wildlife mostly affect you and how? Please list them. E.g., leopard - kill livestock, injure human, threat to our village etc.

a) ……...

b) ……

c) ……

d) …….

e) …….

5. Livestock depredation by Leopard before and after earthquake ? Please write in numbers before and after earthquake.

Animals	**Total**	**Killed**	**Injured**
Sheep			
Goat			
Cow			
Pig			
Others			

6. What are the areas where domestic animals are killed by Leopard?

Animals (Livestock)	**Forest**	**Kharka (Pastureland)**	**Village**	**Other**

7. In which months/season the leopard causes maximum damage?

Winter (months) ……. Summer (months) ……

8. What are the precautionary measures that you adopt to minimize the Common Leopard damage?

Watchmen recruitment……. Fencing……. Threatening (How?)……

Nothing……..Smoking…… Killing……

Other (Please specify): …….

9. Have any of the villagers become wounded/attacked or killed by the Leopard last year?

No……. Yes……..

If yes then Number of people…… Where…….

Forest…… Agricultural field……. Village……

10.What are the benefits of Leopard conservation?

……

……

11. Have you seen dead Leopard?

Yes…….. No……..

12. What you do to the dead body of domestic animals killed by the Leopard?

……

13. Is there any incident of Leopard being killed in the area?

Yes…….. No……if yes, where and how many?.....

14. Please suggest reasons for human-leopard conflict (select one or more).

Human disturbance/Lack of natural prey/habitat loss/Lack of conservation effort/Increased Forest area/others……

15. What types of the suggestions do you provide to the concerned authorities?

……

……

Annex IV. List of photographs

A retaliatory killing of Leopard in the study area (Source: DFO)

Scat of Leopard in the study area

Foot prints of prey species of leopard

Fresh scat of Leopard

Pugmark of Leopard

Sign survey of Leopard

Remaining carcass of the prey body

Leopard being rescued from Bajrabarahi area of Godawari Municipality area