ASSESSMENT OF CONSERVATION THREATS OF SNOW LEOPARD IN THE MANASLU CONSERVATION AREA, NEPAL

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In Partial Fulfilment of the Requirements for the Award of

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By

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DECLARATION

I hereby declare that the work presented in this thesis entitled, **ASSESSMENT OF CONSERVATION THREATS OF SNOW LEOPARD IN THE MANASLU CONSERVATION AREA, NEPAL** submitted to the Central Department of Rural Development, Tribhuvan University is a genuine work done originally by me and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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LETTER OF RECOMMENDATION

This is to certify that **Mr. Nowal Kishore Bhattarai** has completed this thesis work entitled, **ASSESSMENT OF CONSERVATION THREATS OF SNOW LEOPARD IN THE MANASLU CONSERVATION AREA, NEPAL** as a partial fulfillment of the requirements of M.A. in Rural Development under my supervision and guidance. To my knowledge, this research has not been submitted for any other degree, anywhere else.

I hereby forward this thesis to the evaluation committee for final evaluation and approval.

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APPROVAL SHEET

The thesis entitled **ASSESSMENT OF CONSERVATION THREATS OF SNOW LEOPARD IN THE MANASLU CONSERVATION AREA, NEPAL** submitted by Mr. Nowal Kishore Bhattarai in partial fulfillment of the requirements for the Master's Degree (M.A.) in Rural Development has been approved by the evaluation committee.

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ABSTRACT

Snow leopard (*Panthera uncia*) is the topmost predator of the remote Himalayan regions of the Central Asia. The species is categorized as threatened by IUCN due to its declining population. This study aims to assess the human-snow leopard conflict and determine the threats to snow leopard population in Manslu Conservation Area (MCA) and suggest suitable conservation strategies.

The study was carried out in Samdo village, Samagaun VDC, Manaslu Conservation Area. Census survey was carried out using well designed sets of questionnaire in each household along with key informant interview (KII) method to collect the primary data required to meet the set objectives.

Predation from snow leopards and accidents (39.39% each) were the major cause for mortality of the domestic livestock. The average loss of livestock from snow leopard predation was calculated to be 0.36 individuals per household and yak was only the livestock which was attacked and killed by the snow leopards. There were no compensation schemes for the livestock lost from predation by snow leopards at the time of study.

Almost one-third of the local people showed negative attitude towards snow leopard due to predation on their livestock. Majority of local people were unaware of the legal wildlife protection of wildlife. The villagers do not involve in any hunting activities as they are all Buddhists and their religious and cultural beliefs does not allow them to participate in killing activities.

The presence of stray dogs, declination in population of blue sheep which is the principal prey species of snow leopards in the study area and lack of conservation knowledge of the local people of Samdo village were identified as the major threats to snow leopard population.

Based on the findings, the study recommends for establishment of Snow Leopard Conservation Committee to initiate compensation schemes for the local herders as soon as possible to minimize the human-snow leopard conflict. Furthermore, effective conservation strategies can be established based on the threats assessed to the snow leopard population in the study area.

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ACRONYMS/ABBREVIATIONS

ACA:	Annapurna Conservation Area
asl:	Above Sea Level
CITIES:	Convention on International Trade in Endangered Species of Fauna and Flora
DNPWC:	Department of National Parks and Wildlife Conservation
E:	East
HH:	Household
ISLT:	International Snow Leopard Trust
IUCN:	International Union for Conservation of Nature
KII	Key Informant Interview
MCA:	Manaslu Conservation Area
N:	North
SLCC:	Snow Leopard Conservation Committee
SLSS:	Snow Leopard Survival Strategy
SPNP:	Shey Phoksundo National Park
US:	United States
VDC:	Village Development Committee
WWF:	World Wildlife Fund

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Snow Leopard (*Panthera uncia*) a high-elevation species (Jackson et al., 2009) that dwell in some of the vast secluded and rugged mountain terrain (Schaller, 1977) are amongst the least explored large cats, of the central Asian mountains where they occur (Fox, 1994; McCarthy et al., 2005). They are spread at varied altitudes ranging from 900 m to 5,500 m or more, but typically between 3,000 and 4,500 m with exception in the northern range limits where their presence is marked even between 900 m and 2,500 m (Heptner and Sludskii 1980; Jackson et al., 2009). They are found in 12 countries (Afghanistan, Bhutan, China, India, Kazakhstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan and Uzbekistan) encompassing a total potential habitat area of 1,835,000 km^2 (McCarthy and Chapron, 2003). Estimates of the total snow leopard population vary from 4,500 to 7,500 individuals in entire range (Fox, 1994).

Snow leopards in Nepal are associated with steep, broken mountainous habitat in the alpine and sub-alpine zones where vegetation is sparse (Schaller et al., 1988; Jackson and Ahlborn 1989, Oli 1997). Based on Habitat Suitability Index model, Nepal's estimated population is 300-500 (Jackson and Ahlborn, 1990) distributed in 27,432 km^2 (in which good habitat is 12,388 km2 and fair habitat is 15,044 km^2) but this figure needs to be confirmed by field surveys.

Majority of the snow leopard population in Nepal falls outside the protected areas (Jackson and Ahlborn, 1990), therefore it is a subject of concern regarding its conservational issues. However, the principal threat to the declining snow leopard population emanates from the conflict with livestock diminution and from poaching and hunting activities for its precious pelt and high medicinal valued bones supplied largely to affluent cities of Asia (Jackson, 1996).

The four major identified threats to declining snow leopard populations are: extensive hunting for pelts, reduction in prey species, hunting traditions of the tribal people within the vicinity of snow leopard habitat and over burden imposed by humans and their livestock on alpine pasture lands (Jackson, 1979). Furthermore, other researchers have also identified threats to snow leopard as retaliatory killing in defense of livestock (Bagchi and Mishra, 2005), live trapping and poaching for fur, bones and other body parts (Anwar et al., 2011), habitat loss and decline in prey base (Jackson et al., 2008).

Apart from the humans, other larger carnivores like *Canis lupus* are evidently responsible for the mortality of snow leopards (Jackson, 1996). Furthermore, other natural causes have also been identified by different researchers that accounts to the death of snow leopard such as avalanches (Mallon, 1984), diseases and insufficient nutrition (Jackson, 1996), and occasionally, misplaced footings and falling from the cliffs due to misjudgment of trails (Nath, 1982).

Snow leopards can be regarded as flagship or indicator species from a conservation and biodiversity view point (Jackson, 1996) such that the high mountain ecosystem is scrutinized for protection in both temporal and spatial scale. These felids inhabit large home ranges and thrive better in undisturbed and isolated environment, thus ensuring such suitable environment helps protect other alpine floral and faunal species as well (Jackson, 1996).

Snow leopard population is suspected to have declined by at least 20% over the past two generations (16 years) (Jackson et al., 2008). Snow leopard is listed as endangered on IUCN Red List of threatened species since 1988 (IUCN, 2004) and included in Appendix I of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) as a result of its declining population.
In Nepal, it has been fully protected by National Parks and Wildlife Conservation Act 1973.

Research on conservation threats of snow leopard in Manaslu Conservation Area (MCA) has been selected because no formal research has been conducted in this region and the effort could serve as a baseline for broader research contributing to conservation of snow leopard.

1.2 Statement of the Problem

The presence of snow leopards in Manaslu Conservation Area has been cited frequently (Shah and Baral, 2012) and there is still lack of formal researches in this region on snow leopard. It is always a tedious task to locate snow leopards in the wild due to their elusive nature and scarce distribution (Nowell and Jackson, 1996); as a consequence, it makes reliable data acquisition more complex that is further required for the conservation of the species. Therefore, this study will attempt to identify the potential conservation threats to snow leopard assuming the presence of snow leopard in the region (Bhattarai, 2016).

1.3 Objectives of the Study

The broad objective of the study is to determine the factors that pose threat to conservation of snow leopard. The study is confined to Samdo village of Samagaun Village Development Committee (VDC) of Gorkha district that lies within the Manaslu Conservation Area. The study aims to minimize the existing threats on declining snow leopard population through suitable conservation strategies. The specific objectives are listed below:

1. To analyze the livestock holding data of the available households.
2. To assess the status of human-snow leopard conflict.
3. To determine the existing threats to snow leopard conservation and suggest suitable conservation strategies.

1.4 Rationale of the Study

The demand of snow leopard pelts and bones mainly for medicinal utility in the affluent Asian cities (Jackson, 1996) have encouraged the illegal poaching and trade of snow leopards. Furthermore, loss of habitat and the human wildlife conflict that persists due to livestock depredation from the snow leopards has further aggravated the declining snow leopard population. There has been an estimate of about 300-500 snow leopard population in Nepal. This study aims to study the human-snow leopard conflicts and identify the potential threats that lead to declining snow leopard population. This study will help fill the data gap to a certain extent on the persisting threats to snow leopards in Manaslu Conservation Area. This could also serve as a basis for further broader research. Therefore, this research is of high significance which makes a sense that there is an essence of conducting this study.

1.5 Assumptions and Limitations of the Study

The study assumes the existence of snow leopards and human-snow leopard conflicts in the study area based on the literature available.

The field study covers a relatively small area due to which the results cannot represent entire MCA. However, inferences can be drawn regarding the threats in conservation of snow leopards.

CHAPTER II
REVIEW OF LITERATURE

2.1 Theoretical Review

2.1.1 Evolution of Snow Leopard

Approximately, 35 million years ago, during the Oligocene period the first felid like carnivores appeared. After going through series of divergence, the most prudent scenario implies that the modern felids evolved in Asia with divergence of the *Panthera* lineage around 10.8 million years ago (Johnson et al., 2006). Despite of the findings that, snow leopard is closely linked with the tiger (*Panthera tigris*), with divergence occurring over two million years ago (Johnson et al, 2006), the relative position of these two species is still buoyant (Eizirik et al., 2006).

2.1.2 Taxonomy and Nomenclature

Snow leopard belongs to Kingdom: Animalia, Phylum: Chordata, Class: Mammalia, Order: Carnivora and Family: Felidae (Jackson et al, 2008). There still exists perplexity regarding the genus in which snow leopard is to be placed (McVittie, 1978). Some scientists (Hemmer, 1972; Wozencraft, 2005) use *Uncia uncia* as directed by International Commission on Zoological Nomenclature. In contrast, Marma and Yunchis, (1968); Simon and Geroudet, (1970) prefer to use *Panthera uncia.* Based on large-scale phylogenetic analyses of molecular data, snow leopard is reported to be placed in genus *Panthera* (Eizirik et al., 2006; Johnson et al, 2006) and *Uncia* is not recognized as a separate genus from *Panthera* (Eizirik et al., 2006).

2.1.3 Global Distribution

Snow leopards are one of the least explored large cats (McCarthy et al., 2005) inhabiting remote and inaccessible rugged mountainous habitat of central Asia (Nowell and Jackson, 1996; McCarthy et al., 2005; Jackson et al., 2009). They are dispersed widely but scantily over the periphery of the Tibetan plateau and Taklimakan desert, Karakoram, Hindu Kush, Pamir, Kun Lun, Tien Shan, Altai-Sayan, Trans-Altai Alashan Gobi, Himalayas, Hengduan Mountains (Schaller, 1976; Fox, 1994; Nowell and Jackson, 1996; Hussain, 2003; Williams, 2008). They are confined to 12 countries across central Asia (Afghanistan, Bhutan, China, India, Kazakhstan, Kyrgyzstan,

Mongolia, Nepal, Pakistan, Russia, Tajikistan and Uzbekistan) encompassing a total potential habitat area of three million km^2 out of which only 549,706 km^2 is considered to be a good habitat (Jackson and Hunter, 1997; McCarthy and Chapron, 2003).

Snow leopards generally tend to dwell in an altitudinal range of 3,000-4,500 m (McCarthy and Chapron, 2003) with exceptions at their northern range limit, where they have been reported down below 1000 m elevation and at times as low as 500 m asl (Bannikov, 1954; McCarthy and Chapron, 2003).

2.1.4 Distribution in Nepal

In Nepal, the presence of snow leopards is reported in eight protected areas (Jackson and Ahlborn, 1990; Adhikari, 2004) which covers an area of 22,000 km^2 including forested and non-habitat areas (Adhikari, 2004) and less than fifty percentage of the area covered by these protected areas provide habitat to snow leopards (Jackson and Ahlborn, 1990). The majority of snow leopard population is distributed in the western half predominantly along the north-west Tibetan border (Dhungel, 1994) particularly in Dolpo, Humla, Mugu, Manang, Mustang and Myagdi districts (DNPWC, 2005) and certain population in the eastern half (Kattel and Bajimaya, 1995).

2.1.5 Global Population Status

During 1970's, the population of snow leopards was estimated to be around 2,000 individuals (Jackson, 1979) which is now considered low and scientists around the world believe it to be roughly between 4,500 and 7,500 individuals in the wild (Fox, 1994; Entwistle et al., 2001; McCarthy and Chapron, 2003). In addition to that, about 600-700 individuals are reared in captivity in zoos around the world (IUCN, 2004).

2.1.6 Population in Nepal

In Nepal, the population of snow leopard is estimated in the range of 300-500 (McCarthy and Chapron, 2003; DNPWC, 2005; Wikramanayake et al., 2006) which needs validation through standardized and scientific field surveys (Wikramanayake et al., 2006).

2.1.7 Biology

Morphology

The body of snow leopard is around 100-120 cm in length, naturally in spotted whitish gray (tinted with yellow) colored pelage patterned with dark and indistinct spots and rosettes which provides perfect camouflage in the bare and rocky mountainous habitat. They have short for limbs, long hind limbs and large paws which makes easier walking on the snow; well-developed chest muscles for climbing; enlarged nasal cavity, long body hair with dense, woolly under-fur to combat the cold and a long tail (80-100 cm) to balance the body and provide warmth to the body during rest (Hemmer, 1972; Fox, 1989; Jackson, 1992; Jackson, 1996; Nowell and Jackson, 1996; Robert, 1997; Shah, 1998; Theile, 2003; Janecka et al., 2008). The body weight of adult female snow leopard is between 35 kg to 40 kg while the adult male snow leopards weigh 45 kg to 55 kg (Jackson, 1992; Jackson and Hunter, 1996; Theile, 2003).

Reproduction

The copulation occurs during the mating season from January to March in the wild and majority of the births take place between late May and July (Schaller, 1977; Robert, 1997) after a gestation period of 93-110 days (Fox, 1994) producing offspring size of two or three in the Himalayas (Schaller, 1977; Theile, 2003) and up to five in the Soviet Union (Heptner and Sludskii, 1980). After 18-20 months of the birth, the cubs begin to live independently of their mothers (WWF, 2009) and they get matured enough to mate once they are two to three years old (Theile, 2003).

Life Span

In captivity, the snow leopards have been reported to live a life span of 21 years (Blomquist and Sten, 1982). However, natural accidents (falling from the cliffs due to misjudgment of trails) (Nath, 1982), natural disasters such as avalanches (Mallon, 1984), exposure to diseases, lack of sufficient nutrition, predation by wolf (*Canis lupus*) (Jackson, 1996) and abandonment decreases the life span of snow leopards in the wild to even lesser than half the captive age (Bajimaya, 2000; Theile, 2003).

Dietary Requirements

Based on the mass-energy equation developed by Kleiber (1975), it is calculated that an adult snow leopard requires approximately 3,000-4,000 kcal per kg of its body weight. In terms of food requirement, the calculation comes out to be 40-50gm of food per kg body weight per day (Emmons, 1987) implying the requirement to be 1.5 to 2.5 kg of meat daily (Jackson and Ahlborn, 1988; Schaller, 1998). This accounts to about 30 adult blue sheep (*Pseudois nayaur*) annually and correspondingly more for the mothers with the cubs, in absence of small rodent items from the snow leopard diet (Jackson et al., 1996).

Snow leopards are opportunistic predators and can kill the prey up to three times more than their own body weight (Jackson, 1992) and generally prefer hunting male blue sheep over the female ones (Schaller, 1977).

Interspersion

Snow leopards are generally crepuscular in nature (Mallon, 1984) with hunting activities recorded during day as well in undisturbed areas (Jackson and Ahlborn, 1984; Fox and Chundawat, 1988; Jackson, 1996). There are instances where snow leopards have been reported to migrate seasonally along with their prey (Novikov, 1956) and most probably such movements occur in areas where seasonal human disturbance is high, land is subjected to very less exposure towards south and west and areas with intense snowfalls (Jackson and Ahlborn, 1984).

2.1.8 Ecology

Habitat and Cover Requirements

Snow leopards inhabit the steep terrain well broken by cliffs, gullies and rocky outcrops (these landforms are used for bedding, hiding, escape cover and combating the extreme temperature) of the alpine and sub-alpine ecological zones (Jackson and Ahlborn, 1984; McCarthy and Chapron, 2003) which are highly arid with low atmospheric temperature (Jackson et al., 2010). However, in presence of ample hiding cover, they tend to occupy comparatively flat or rolling terrain in Mongolia and Tibet while they have been reported in open coniferous forests in parts of China and Russia (Jackson et al., 2010). Typically, snow leopards choose the ridgelines, crest of cliffs and river bluffs as their travel routes which enhance the probability of sighting and hunting down the prey species (Jackson and Ahlborn, 1984).

Home Range and Density

Schaller (1977) drew a conclusion that snow leopards occupy large home ranges, based on the time interval between the observation period of fresh pugmarks in the Himalayas whereas Jackson (1996) showed in his findings that the home ranges of snow leopards is significantly lesser in areas with abundant natural prey base. The home ranges overlap extensively between the sexes (Jackson and Ahlborn, 1989) while the adult males cover larger ranges than the adult females (Jackson and Ahlborn, 1984).

The home range is extended from 12 to 39 km² in major habitat (Theile, 2003) to 140 km² or larger in marginal habitat in Mongolia where the terrain is relatively open with very less prey density (McCarthy et al., 2005). Contrastingly, the scenario is different in Nepal where availability of prey species is relatively abundant (Jackson and Ahlborn, 1989) the home range extends from 13.9 to 22.3 km^2 in Annapurna Conservation Area (Oli, 1997) and 11 to 37 km^2 in Langu valley (Jackson, 1996).

The average density of snow leopard in the entire range is 1/270 km^2 (Fox, 1994) whereas 10-12 snow leopards can be found in good habitat ranges per 100 km^2 (Jackson and Ahlborn, 1989; Chundawat, 1992). In Nepal, higher density is concentrated in the western parts with availability of 5-10 snow leopards per 100 km^2 in the Langu Valley (Jackson and Ahlborn, 1989) and 4.8-6.7 individuals per 100 km^2 in Manang valley (Oli, 1994).

Social Behavior

Snow leopards are well known for their elusive nature (Nowell and Jackson, 1996) and are solitary species, except during the breeding season when they are observed in pairs and even hunt together (Hemmer, 1972) or when the mother is with her cubs (Jackson et al., 2009).

Social Marking Behavior

The social marking behavior in snow leopards comprise of scrapes, feces, scent sprays claw rakings and cheek rubbing which is associated with demarcation of territories and repertoire for locating conspecifics for mating (Jackson and Ahlborn 1988; Oli, 1991; Fox, 1994; Jackson, 1996; Jackson and Hunter, 1996; McCarthy and Chapron, 2003).

Prey Species

The principle prey species of snow leopards are blue sheep *(Pseudois nayaur)*, Himalayan tahr *(Hemitragus jemlahicus)*, ibex *(Capra ibex)* while the other prey species are takin *(Budorcas taxicolor)*, goral *(Nemorhaedus goral)*, serow *(Capricornis sumatraensis)*, markhor *(Capra falconeri)*, urial *(Ovis orientalis)*, argali *(Ovis ammon)*, musk deer *(Moschus chrysogaster, M. moschiferus)*, pikas (*Ochotoma spp.*) hares *(Lepus spp.)*, marmot *(Marmota spp.)*, monal pheasant (*Lophophorus impejanus*), chukor (*Alectoris chukar*), and snowcock *(Tetraogallus sp.p)* (Schaller, 1977; Oli et al., 1993; Chundawat and Rawat, 1994; Jackson, 1996; Bagchi and Mishra, 2005). In addition, the snow leopards also hunt down the livestock such as goats, sheep, calves, sub adult yaks and sub adult horses in areas where natural prey resource is depleted (Jackson and Ahlborn, 1984; Jackson and Chundawat, 1999; Bajimaya, 2000).

Predator-Prey Relationship

The population of snow leopard is directly proportional to the population status of its prey species (Oli, 1994). Depletion of prey base decreases the population of productive female felids, reduces the size of progeny, and increases the mortality rate of the new born, leads to expansion of home ranges which further evokes territorial clashes and thus disturbing the viability of the snow leopards (Fuller and Sievert, 2001). An acceptable predator-prey ratio should be in excess of 1: 200 on a weight basis (Schaller, 1972).

Competition with Other Predators

Snow leopards face competition from other sympatric predators such as wolf (*Canis lupus*), wild dogs (*Cuon alpinus*), lynx (*Lynx lynx*) and red fox (*Vulpes vulpes*) in the wild (Oli, 1994; Bajimaya, 2000; Mishra et al., 2003) which might force them to prefer more rugged terrain (Fox et al., 1991). The only natural predator of snow leopard is the wolf (Jackson, 1996).

2.2 Empirical Study

2.2.1 Human-Snow Leopard Conflicts

Wildlife-related crop and livestock damage is emerging as a leading source of conflict between local communities, protected areas and park managers throughout the Himalayan region that is the habitat for snow leopards (Saberwal et al., 1994; Kharel, 1997; Mishra, 1997; Sekhar, 1998).

In the Kibber Wildlife Sanctuary in Lahaul Spiti, Mishra (1997) reported that 18% of the livestock holding were killed over an 18-month period, amounting to 1.6 animals per household per annum, with an estimated total value of US $ 128 per family per year. Villages received compensation in only 28 of 131 reported cases. According to local residents, predation rates in the sanctuary had increased markedly since its establishment. The researcher attributed this to a dramatic increase in livestock numbers accompanying a shift from subsistence to a more commercially-based animal husbandry pattern.

Anwar et al (2011) identified intense predation on domestic livestock by the snow leopard to be the prime cause of conflict with the local inhabitants of Baltistan, Northern Pakistan resulting in retaliatory killing of the felids. Involvement of local farmers in the insurance schemes is the step adopted to compensate the herdsmen's losses to promote conservation of snow leopards.

The conflicts between herders and snow leopards have been studied by different researchers in Nepal (Oli et al., 1993; Kattel and Bajimaya, 1995; Bajimaya, 2000; Upadhyay, 2010; Ale et al., 2014; Adhikari, 2015). The findings of Oli et al (1993) showed that more than 50% of the interviewed herders in Annapurna Conservation Area (ACA) felt that the snow leopards should be exterminated so as to protect their livestock from further losses.

In different snow leopard ranging areas of Nepal such as Mustang, Manang and Dolpo region, there used to be a traditional practice of rewarding the villagers with food, shelter and alcohol to those who killed the snow leopard. However, this practice has now declined; nevertheless, anyone who traps the snow leopard that has killed the domestic livestock is still considered to have done community a good service (Theile, 2003).

A substantial economic loss to the herdsmen can be accounted from such attacks on domestic livestock from the snow leopards (Jackson, 1992; Oli et al., 1993; Jackson, 1996). In ACA, about 20% of the average annual income loss was incurred by a herdsmen family due to predation from snow leopards (Oli et al., 1993).

Losses caused by the snow leopard are particularly damaging since they occur in regions with underdeveloped economies, and create antagonism towards conservation efforts in general. Pastoralists often have strong negative attitudes towards the snow leopard, and retaliatory persecution in defense of livestock threatens its survival (Mishra et al., 2003).

Based on different studies, it can be concluded that human-snow leopard conflict exists in different snow leopard ranging nations. The livestock depredation is the major cause for the conflicts. Compensation schemes play a significant role in minimizing the human-snow leopard conflicts and serves for the overall conservation of snow leopards.

2.2.2 Threats to Snow Leopard Population

The principal threat to snow leopard arises from poaching or hunting for its valuable pelt and bones, the killing of animals suspected of taking livestock, and depletion (through hunting, poisoning or habitat loss) of natural prey species, thereby increasing the snow leopard's dependence upon domestic stock. Although pelts may fetch from 50 to 500 US dollars or more, the international fur trade has declined significantly due to regulation, animal rights activism, and changes in western fashion, the primary market for fur coats (Nowell and Jackson, 1996). However, snow leopards appear to face significant threat from the Chinese medicinal trade, which places high value on the bones of tiger and the larger felids. Medicinal products are marketed in Asia's wealthy cities like Hong Kong, Seoul, Taipei and Singapore, where demand greatly exceeds supply (Jackson, 1996).

The overlap in grazing areas of domestic livestock and wild ungulates has increased the competition between them attributing to declination in wild prey base. Habitat loss and reduction of wild prey stock has resulted in decline of free ranging population of snow leopards by at least 20% over the past two generations. In Nepal, wild ungulates and

domestic livestock are sometimes compared as direct competitors as their ranging areas overlap (Oli et al., 1993).

The main threats to snow leopards in Nepal include poaching for skin, poisoning by local farmers in retaliation for livestock losses, and habitat destruction, which negatively influences the snow leopards directly by removing important hunting cover, and indirectly by removing potential pasturages used by the snow leopard's primary prey species such as the blue sheep and the Himalayan tahr (Kattel and Bajimaya 1995).

The northern region of Nepal bordering Tibet and India has been reported to be the transit region for trade of snow leopard parts (Shakya, 2002). The snow leopard parts are traded by the hunters for products such as salt, butter, and livestock. The herders from Mugu district of Western Nepal trade the pelt and bones of snow leopard for sheep breeding stock with the residents across the Tibetan border (Theile, 2003). There are also reports that the hunters from the same district earn around US dollars 10-50 for a snow leopard skin which amounts to nearly the annual income of a herder in that area (Jackson, 1979; Bajimaya, 2000).   Such illegal trade is often difficult to control due to the remote and rugged terrain of those areas (Shakya, 2002).

Bajimaya (2000) showed his concerns that the trade in bones of snow leopard might be replacing the fur trade as a primary incentive to trade in the species.

McCarthy and Chapron(2003) identified twenty-one international threats to snow leopard survival and categorized them into four broad groups namely: habitat and prey related, direct killing or removal of snow leopards, policy and awareness, and other issues.

The major threats identified globally to the snow leopard population are: poaching for valuable body parts, retaliatory killing, habitat destruction, decline in prey base and lack of conservation knowledge among the local people of snow leopard ranging countries. These threats need to be assessed and suitable strategies must be formulated accordingly to successfully conserve the felids.

2.2.3 Conservation of Snow Leopard

Jackson and Ahlborn (1990) concluded that non-protected areas harbored the bulk of Nepal's snow leopard population, and that corridors were critical to encouraging the regular dispersal and subsequent genetic exchange between otherwise isolated protected area populations. Such corridors become even more critical as snow leopard habitat is further fragmented by new roads, increased livestock grazing, mining and other human activity (Fox, 1994; Jackson and Hunter, 1996). The degree of population and habitat fragmentation is unknown, but given the insular nature of mountain ranges it is likely to be significant; no doubt, snow leopard population size and distribution reflects the status of sources and sinks, and the presence or absence of corridor linkages (Fox, 1994; Jackson, 1996)

From the conservation and biodiversity perspectives, the snow leopard can be viewed as an indicator or flagship species for motivating the public and decision-makers to ensure that Asia's high mountain ecosystems are protected and well-managed in-perpetuity. Snow leopards exhibit some of the elements associated with an extinction prone species, including low population density, comparably large home range, and the need for a relatively pristine or undisturbed environment (Terborgh, 1974). While the species also shows, some features found in keystone species (Mills et al., 1993), snow leopards are better viewed as a "flagship or charismatic megafaunal species" about which to rally public support for the conservation of high-altitude areas. By protecting snow leopards, habitat for a wide-range of other alpine plants and animals is also protected. The International Snow Leopard Trust (ISLT), a non-profit organization devoted to the protection of snow leopard and its habitat, advocates the species as an indicator for environmental equality, arguing that the environment is more productive and healthy where snow leopards occur in good numbers (Jackson and Hillard, 1986).

McCarthy and Chapron, (2003) have mentioned in Snow Leopard Survival Strategy (SLSS), 2003 the potential actions to counter the threats to declining snow leopard population which are listed below:

1) Grazing management

2) Income generation

      2.1) Wildlife based ecotourism

      2.2) Cottage industry

      2.3) Ungulate trophy hunting programs

3) Reducing poaching and trade in snow leopard parts

4) Reducing livestock depredation by snow leopards

5) Animal husbandry

6) Conservation education and awareness

Snow leopard, an endangered species listed in the IUCN Red List, is one of the animal species internationally targeted for conservation (IUCN, 2004) It is listed in CITES Appendix I (as *Uncia uncia*) and is legally protected from hunting by national legislation across most of its 12 range states (McCarthy and Chapron,2003). Afghanistan has recently afforded the Snow Leopard legal protection, after listing the species on the country's first Protected Species List in 2009. This bans all hunting and trading of Snow Leopards within Afghanistan (Jackson et al., 2008).

In Nepal, the snow leopard has been fully protected under the National Parks and Wildlife Conservation (NPWC) Act 2029 since 1973. Under the Fourth Amendment of the Act it is illegal to hunt, acquire, buy or sell snow leopard parts and the penalties for persons convicted of such offences range from NRS50 to NRS100,000 (<USD1-USD1300) or from five to fifteen years in prison. Nepal has also established incentives for "whistle-blowers" and there is a provision for NRS50,000 to be paid for information that leads to the conviction of an offender (Kattel and Bajimaya, 1995). Nepal is also a signatory to the CITES and is responsible for implementing its agreements (McCarthy and Chapron2003).

The conservation strategies have been designed in accordance with the threats assessed. Compensation schemes are available almost in every snow leopard habitat countries, thus reducing the human-snow leopard conflicts. Illegal trade is checked by laws in every snow leopard thriving nations. Protected areas are being established in snow leopard habitat areas with landscape management principles.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Design

Scientific, analytic, descriptive approach alongside the people's participation has been adopted for the research. The framework of research design is described below:

Figure 1: Schematic diagram of the research design.
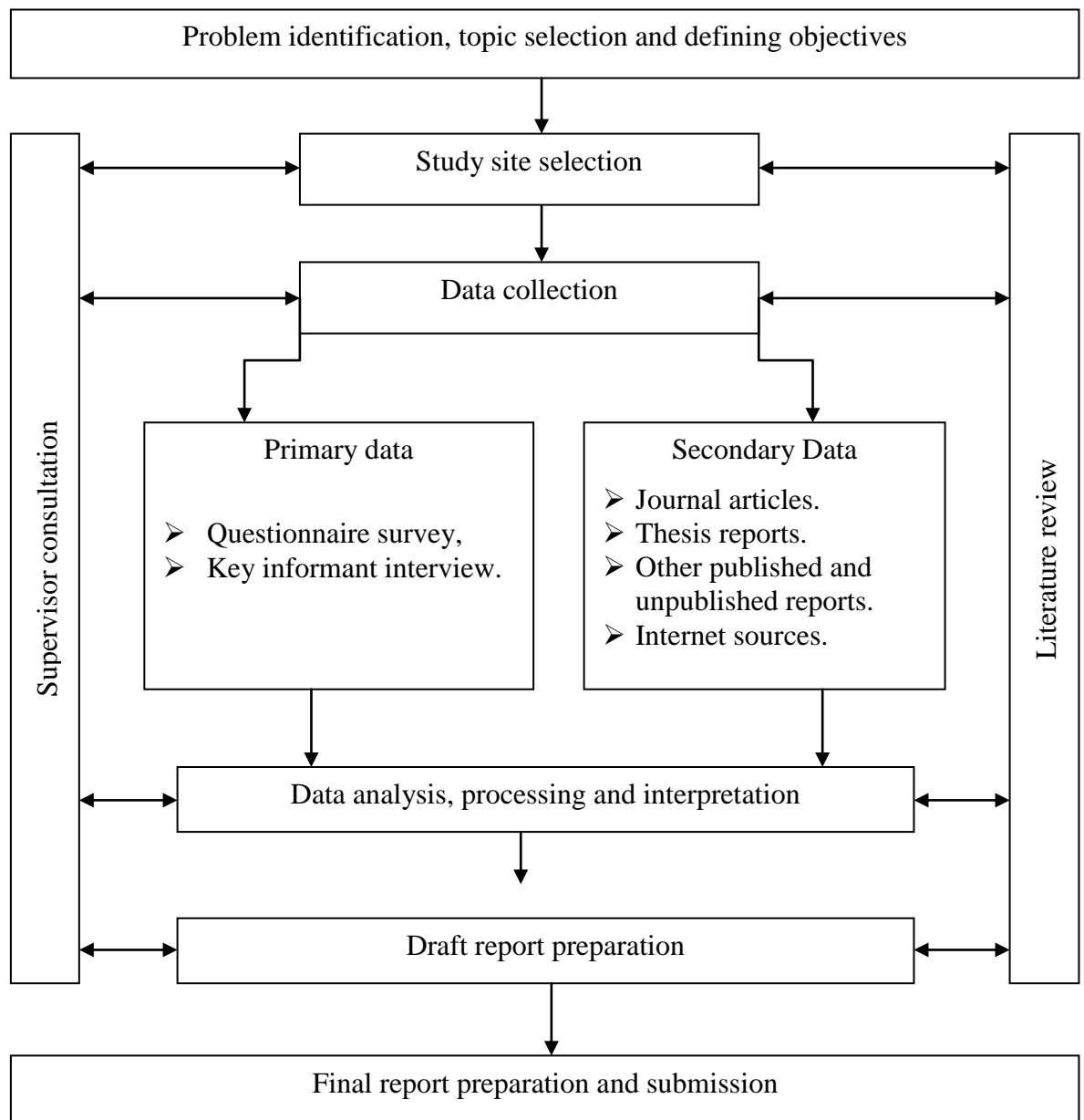
3.2 Study area

The study was carried out in potential snow leopard availability area in Samdo village of Samagaon VDC (28^0 75' N to 28^0 51' N latitude and 84^0 48' N to 84^0 70' E longitude) in Manaslu Conservation Area.

Figure 2: Location of the study area.
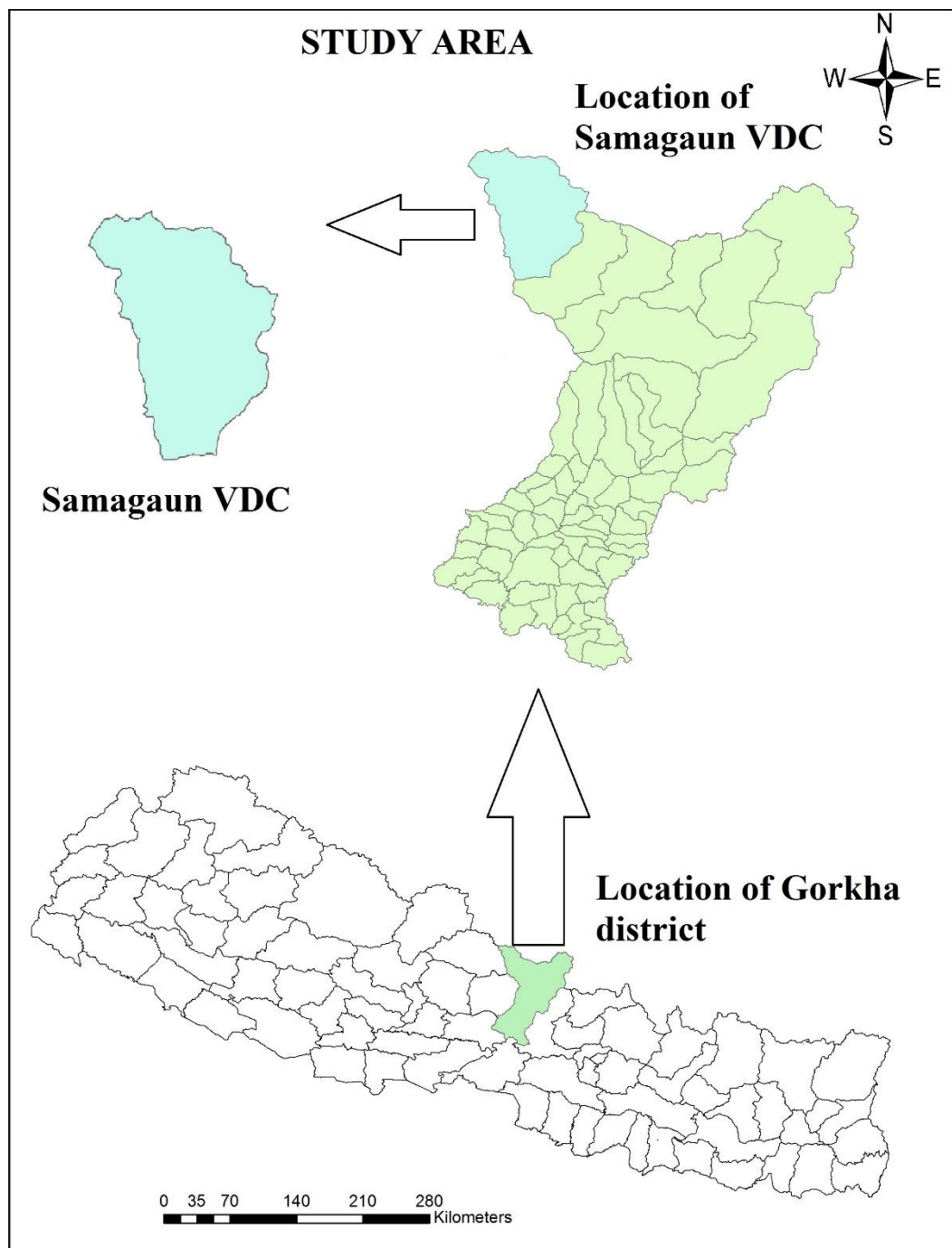
3.3 Nature and Sources of Data

Both primary and secondary data have been used to fulfill the set objectives of the research. The quantitative data are presented in the form of different charts, graphs and figures while the qualitative data are in descriptive form. The data have been collected from field visits, libraries, internet facilities, etc.

3.4 Sampling Procedure

There were 40 households in total in Samdo village as counted during the field survey. Census survey was carried out to include the data from all the households available. However, no members from four households (HH) were available at the time of research. Therefore, 36 out of 40 households were surveyed to acquire the necessary and reliable data. Priority was given to the respondents from each HH with more information on snow leopard and its activities around the vicinity of the study area. The field visit was made in the month of November, 2015 to collect the data.

3.5 Data Collection Techniques and Tools

The primary data required to fulfill the research objectives were collected from household survey and key informant interviews. In addition, direct field observation was carried out to validate the data obtained where necessary. Furthermore, the required secondary data have been obtained from different online journals, published and unpublished research articles, books, reports, other internet facilities, etc.

3.5.1 Household survey

The household survey was carried out in 90 percent of households of Samdo village. A well-designed questionnaire with both open and close ended questions (Annex II) was prepared to list down the livestock holding data, livestock loss from snow leopard predation, to understand the local people's attitude towards snow leopards and the protected area status and to determine the threats to snow leopard conservation. The survey was conducted after building up a strong rapport with the respondents to minimize the bias resulting from the response they provided.

3.5.2 Key Informant Interview

The key informants were interviewed with semi or unstructured questionnaire (Annex III) to gather information on loss of livestock from snow leopard predation and other threats to snow leopard conservation. Two local people were selected for the interview based on their knowledge and experiences regarding the information on snow leopards. One of them was a local primary school teacher and the other was a local citizen who had been involved in other snow leopard research projects in the study area.

3.6 Method of Data Analysis

Computer tools like SPSS, MS Excel have been used to record and analyze the obtained quantitative data and presented in graphs, tables, figures as relevant whereas the descriptive methods have been applied for qualitative data.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF SURVEY DATA

4.1 Socio-economic Status of the Respondents

4.1.1 Birth Place

Eighty percentage of the respondents were born in Gorkha district wherein the conservation area lies. However, 20 % of the respondents have migrated from Tibet and have been living in Samdo village (Figure 3).

Figure 3: Birth place of the respondents.
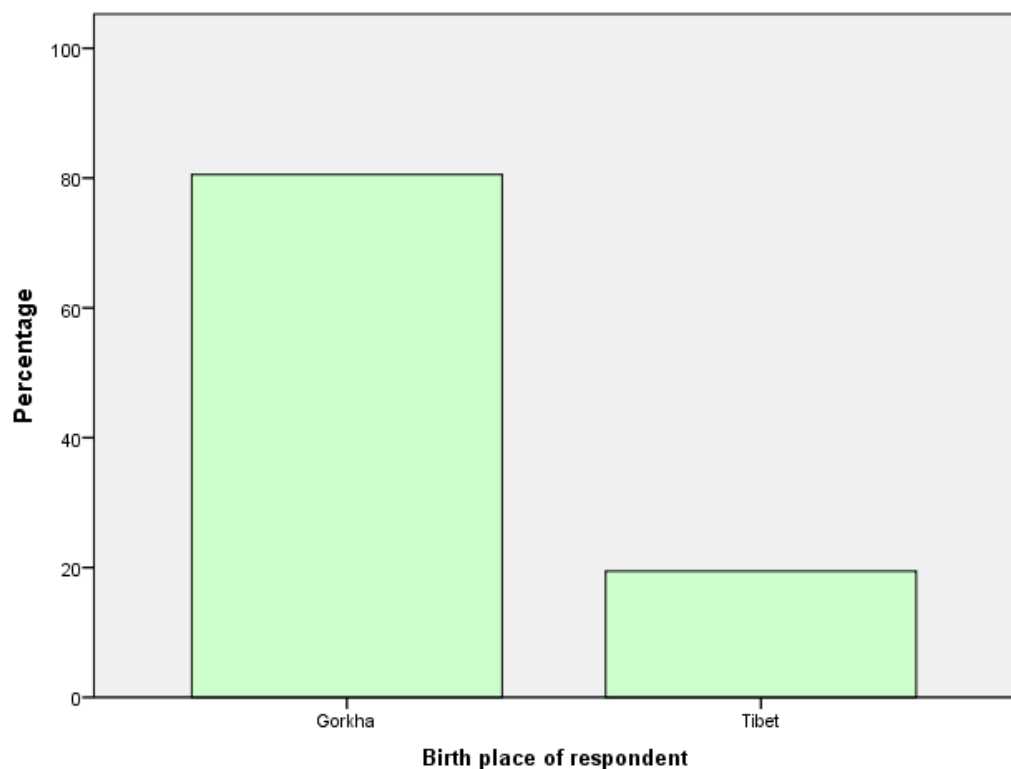
4.1.2 Age Group

More than two-third of the respondents interviewed fall in the age group of 31-60 years of age. Fourteen percentage of the respondents were of 16-30 age group while 17 percent were above sixty years of age (Figure 4).

The respondents with more knowledge on snow leopards were picked purposively to obtain more reliable data.

Figure 4: Age group of the respondents.
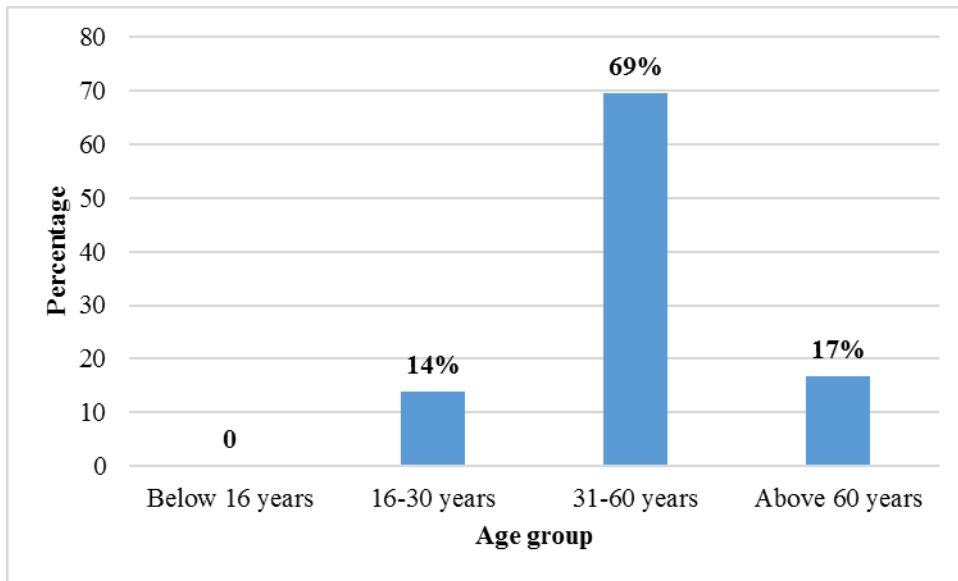
4.1.3 Religion

All the respondents from Samdo village follow Buddhism as their religion.

4.1.4 Occupation

Majority of the respondents (83%) were farmers while 11% were indulged in hotel business and the remaining six percentage earned their livelihood from teaching (Figure 5).

Figure 5: Occupation of the respondents
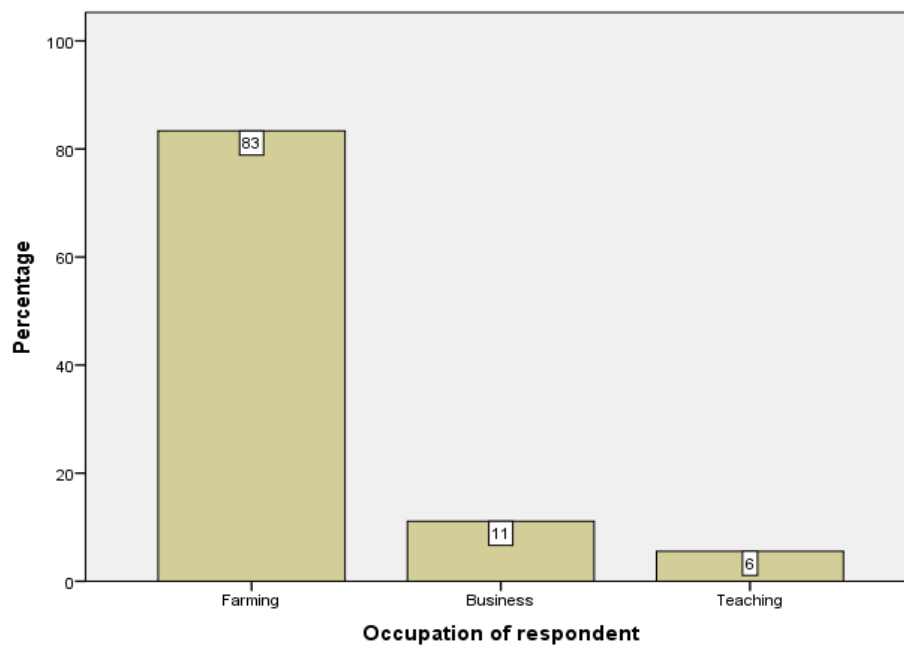
4.2 Livestock Data

4.2.1 Livestock Holding Data

The results obtained from questionnaire survey revealed that 25 individuals of yak and eight individuals of horses were lost from the past year (Table 1). The causes for loss have been depicted below (Table 2). However, an increment in the population of hybrid (known as 'jhoppa' in local language which is an offspring produced from cross breeding of yak and cow) was noted.

Table 4.1: Livestock holding data

Previous holding (2014)			Current holding (2015)			Loss		
Yak	Horse	Hybrid	Yak	Horse	Hybrid	Yak	Horse	Hybrid
213	118	39	188	110	46	25	8	-7

(Source: Field Survey Data, 2015)

Nineteen percent of the respondents reported loss of livestock from snow leopard predation while 17% lost their livestock in the wild which were not recovered.

4.3 Status of Human-Snow Leopard Conflict

4.3.1 Human-Snow Leopard Conflict

Predation by snow leopard and accident combined were determined as the major factors for the loss of the domestic livestock with both contributing as much as 39.39% each. This accounted to an average loss of 0.36 livestock individual per household each from predation and accident. As per the information provided by the respondents, 12.12% of livestock have been lost in the wild and not recovered accounting to an average loss of 0.11 livestock individuals per household (Table 2). The loss of livestock loss explains the conflict that exists between the felids and the local people.

Table 4.2: Causes for loss in number of livestock.

Reasons for decline in number of livestock	Yak	Horse	Hybrid	Total loss (no)	Total loss in percentage	Average loss per household
Predation (snow leopard)	13	-	-	13	39.39	0.36
Accident	8	5	-	13	39.39	0.36
Sold	1	2	-	3	9.09	0.08
Lost (in pasture land)	3	1	-	4	12.12	0.11
Total	25	8	0	33	100	

(Source: Field Survey Data, 2015)

Predation from snow leopard and accidents accounted for the major reason for the loss of livestock with average household loss from predation calculated to be 0.36 livestock per household. In similar studies across the country, a loss of 1.6 animals per household (HH) at average was observed in Shey Phoksundo National Park (SPNP) (Devkota et al., 2013) while the loss was 0.7 animal per HH in ACA (Oli et al., 1994). Furthermore, disease was identified as the second cause of livestock loss in the SPNP (Devkota et al., 2013) whereas accidents resulted for the livestock loss up to 39.39% of the total livestock lost in this study area. However, there are instances where the unknown losses have been reported due to the predation of snow leopards to claim the compensation schemes wherever available (Devkota et al., 2013).

4.3.2 Compensation Schemes

There were no facilities of compensation schemes for the livestock lost from predation at the time of study. However, an initiation was already made to form a Snow Leopard Conservation Committee (SLCC) which would deal with the conservation of snow leopard and proceed with the establishment of compensation schemes for the livestock lost from snow leopards.

The communities benefitted with conservation incentive program tend to become more tolerant towards the snow leopard even if the predation rate is high (Bagchi and Mishra, 2005). This highlights the essence of such incentive schemes to reduce the human-snow leopard conflict.

4.3.3 Responsible Agencies for Addressing the Loss of Livestock

All the respondents felt that such loss of livestock from wild predators must be addressed as soon as possible with acceptable compensation schemes. However, there were different views regarding the agencies that should be responsible for addressing such issues which is depicted below (Figure 6):

Figure 6: Responsible agencies for compensating livestock loss.
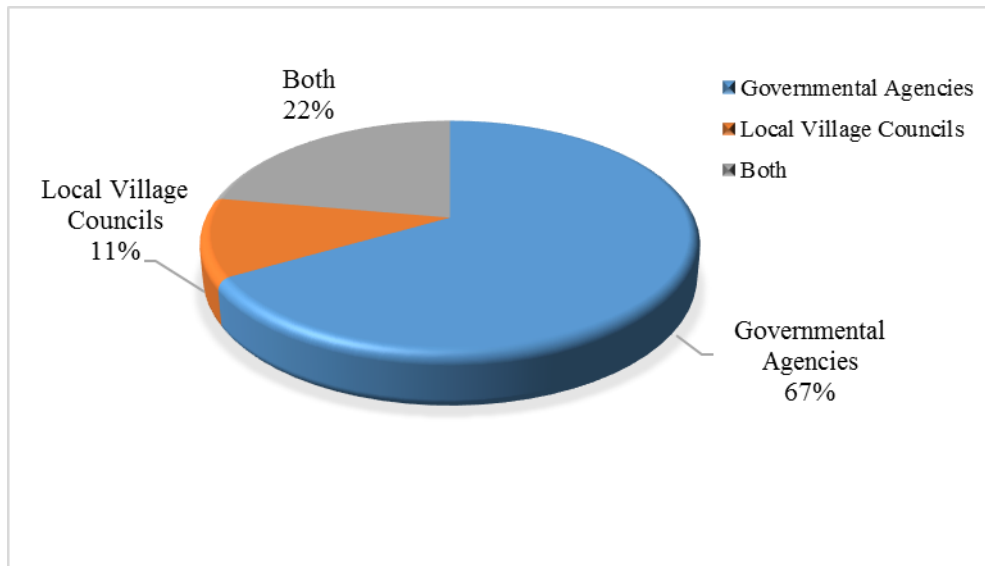
The locals had varied views regarding the responsible agencies for compensating their livestock lost from predation. Sixty seven percent of the respondents thought that it is the responsibility of the governmental agencies to respond to such issues while 11 percent felt that the local councils should initiate such schemes. The remaining 22 percent respondents believed that the issues could be solved by the local councils with assistance from governmental agencies.

4.3.4 Awareness on Legal Protection of the Wildlife

Only 25 percent of the respondents were aware regarding the legal protection of wildlife under the law of Nepal government while the rest seventy five percent of the respondents were found to be unaware of such provisions by law.

4.3.5 People's Attitude on the Snow Leopard

Fourteen percent of the respondents showed positive attitude towards the snow leopard, while 31% disliked the charismatic felid. Fifty five percent of the respondents have expressed with no strong opinion on the snow leopard (Figure: 7).

Figure 7: People's attitude towards snow leopard.
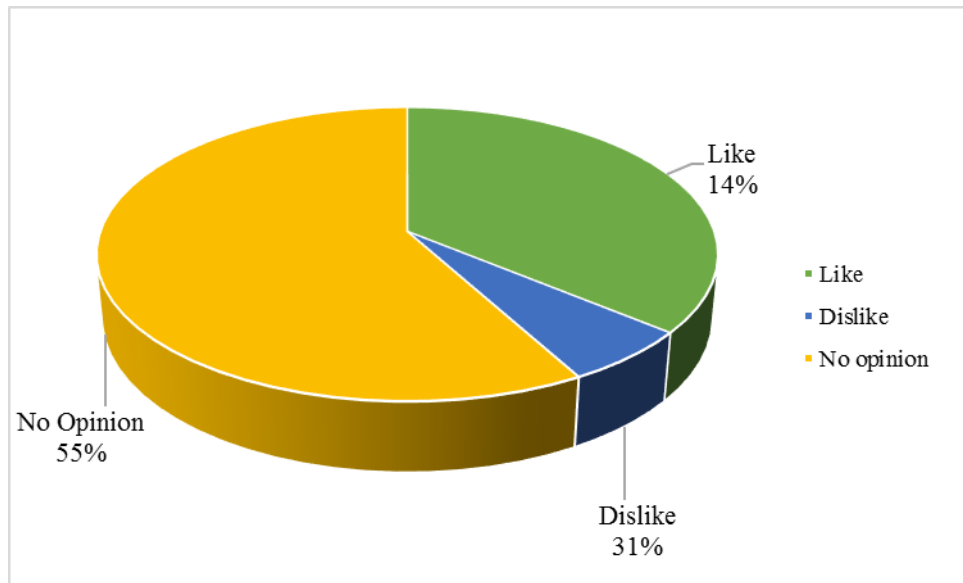
4.3.6 People's Perception on the Protected Area

Thirty six percent of the respondents opined that they were benefitted due to the inclusion of their village in the protected area while six percentage expressed negative attitude towards the protected area. Rest of the respondents (58%) had expressed no strong reasons for either liking or disliking regarding the protected area (Figure 8).

Figure 8: People's perception on protected area.
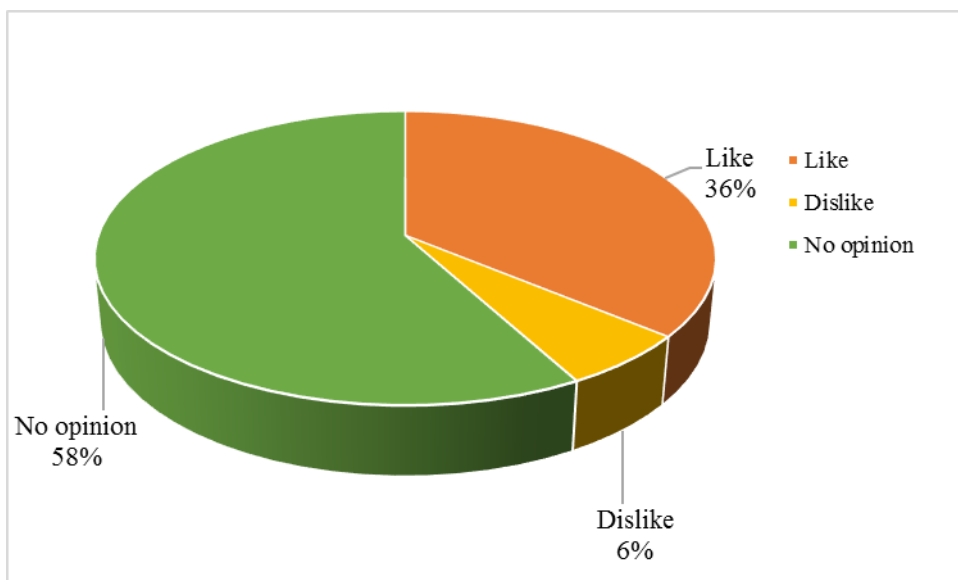
Thirty one percent of the respondents had negative attitudes towards the snow leopard citing the livestock loss from predation as the sole reason. Similar perceptions from the local of ACA were reported by Oli et al. (1994). Fourteen percent of the respondents were fond of snow leopard of which 40% were local teachers. Similarly, 36% of the respondent had positive attitude towards the conservation area status as they realized the received benefits.

4.3.7 Hunting of Wildlife

All the respondents reported that hunting activities was not prevalent in the study area. The religious beliefs prevented them from doing so as they all follow Buddhism. The people from other parts of snow leopard range countries do not actively persecute the snow leopards due to their religious and cultural practices as well (Mishra and Fitzherbert, 2004; Bagchi and Mishra, 2005).

4.4 Major Threats to Snow Leopard Population

The major threats to the snow leopard population identified from the field survey and the local people information are as follows:

4.4.1 Presence of Free Roaming Stray Dogs

The presence of stray dogs was observed roaming freely in herds during the field visit to Samdo village. The dogs can become competitors to the snow leopards in the region. The locals reported that there were instances where the dogs hunted down the natural prey of snow leopard, blue sheep (*Pseudois nayaur*). Therefore, increase in competition for food with such unnatural predators could further aggravate the plight of the declining snow leopard population.

4.4.2 Decline in Natural Prey Base

Blue sheep is the most abundant natural prey of snow leopard in the study area (Bhattarai, 2016). The mass avalanche that occurred in September, 2012 killed around a hundred of blue sheep in the region as reported by the local residents. In addition, the stray dogs present in and around the study area have also been amongst the reason for mortality of the blue sheep. Therefore, the declining natural prey base is another significant threat to snow leopard population.

4.4.3 Lack of Conservation Knowledge among the Local People

Two third of the respondents from Samdo village either disliked or had no strong opinion on inclusion of their residential area in the conservation area. Furthermore, only 25 percent of them were aware of legal protection of wildlife and only 14 % showed positive attitude towards snow leopards. This shows the level of understanding and awareness on various facets conservation amongst the local people of Samdo village.

Assessing the extent of predation on domestic livestock cannot solely promote effective conservation planning, as understanding people's attitude on snow leopards is important before implementing such strategies (Bagchi and Mishra, 2005). Therefore, sharing conservation knowledge and empowering the local people to initiate the conservation strategies must be promoted to address the declining snow leopard population from the local level itself.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

Different findings have been inferred from the research carried out with prime focus to assess the threats to snow leopard population. The study was carried out in the month of November, 2015 in Samdo village of Samagaun VDC lying in Manaslu Conservation Area. Based on the different objectives the summary of findings is summarized below:

Eighty percent of the interviewed respondents were born and raised in Gorkha district wherein the conservation area lies while the rest (20%) have migrated from Tibet. Majority (80%) respondents earn their income from farming and all of them follow Buddhism as their religion.

The current livestock holding of all the surveyed 36 out of 40 households was 188 yaks, 110 horses and 46 jhoppa (hybrid). This accounted for a loss of 25 yaks and eight horses from the previous year livestock holding. Predation from snow leopard and accidents (39.39% each) were identified as the major reason for the mortality of the livestock and the average livestock lost from snow leopard predation was calculated to be 0.36 individual per household. No compensation schemes were available at the time of study. However, Snow Leopard Conservation Committee was due to formation in order to introduce compensation schemes and implement other conservation strategies.

Majority of the local inhabitants (75%) were unaware of the legal protection of wildlife and very few respondents (14%) were fond of snow leopards. However, a relatively higher percent (36%) of the local people have positive thinking about the protected area. Three-fourth population felt that governmental agencies should be responsible for addressing the human-snow leopard conflicts arising from livestock loss due to predation. The local people do not participate in hunting activities as the religious and cultural beliefs avert them from doing so.

The major threats to snow leopard population identified from this research are as follows:

➢ Presence of free roaming stray dogs.

➢ Decline in natural prey base.

➢ Lack of conservation knowledge among the local people.

5.2 Conclusions

Majority of the inhabitants of Samdo village were born in Gorkha District and their main occupation is farming.

The analysis of livestock holding data revealed that predation from snow leopard was the major reason for the loss of livestock. The snow leopard predated only on yak. There were no compensation schemes for the loss of livestock at the time of study although an initiation was being made for it. The residents were not very fond of the snow leopards due to the conflict that arose from the livestock killing by the snow leopards. Majority of them felt that it was the duty of the governmental authorities to solve the issues emanating from human-snow leopard conflicts.

The major threats to the snow leopard were identified as the presence of stray dogs which directly compete with snow leopards, loss of natural prey and lack of conservation knowledge amongst the local people.

5.3 Recommendations

Based on the findings of the study, the following recommendations are proposed for the conservation of snow leopards and mitigation of human-snow leopard conflict:

1. Formation of Snow Leopard Conservation Committee amongst the locals is an essence along with orientation on conservation goals.

2. Broader research on human- snow leopard conflict in MCA should be conducted.

3. The detailed ecological study of snow leopards along with the diversity of wild prey species should be assessed in detail so as to understand the sustainability of snow leopard population in MCA.

4. Monitoring compliance of compensation schemes against livestock depredation for its effective functioning to minimize economic loss and human- snow leopard conflict.

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ANNEXES

Annex I: Distribution Map of Snow Leopard in its Range Countries
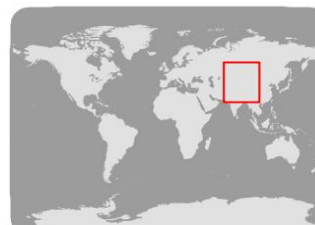

Panthera uncia

Range

■ Extant (resident)
■ Probably Extant (resident)

Compiled by:
International Snow Leopard
Trust and the Wildlife
Conservation Society

(Jackson et al, 2008)

Distribution map of snow leopard

Annex II: Livestock Holding and Conservation Threats Questionnaire

(For interviewing local residents on livestock holding and

conservation threats to snow leopard population in Manaslu Conservation Area)

INFORMED CONSENT

Dear respondents: Namaste!!

This questionnaire is being filled to find out people's perception and difficulties faced due to livestock depredation. You do not have to answer these questions if you do not want to. Your name will not be mentioned on the questionnaire and no one will know which answers are yours. Answering the questions will take about 30 minutes. You can skip any questions you like by asking me to stop at any time you choose. If you have any questions you can ask me now or after you finish answering questions.

Would you like to participate in this survey?

      [   ] Yes   → PROCEED

      [   ] No   → END

IDENTIFICATION AND GENERAL INTRODUCTION

Interviewer Name _____Date: _____(DD/MM/YY)

Name of village (or approximate location) _____

GPS Reading _____   _____

Elevation(m) _____

Respondent Details

Age: _____Years   Sex: | M | F |

 District of Origin/Birth: _____Occupation_____

Religion: _____   Marital Status _____

Primary source(s) of livelihood _____

Q.N.1		Livestock ownership and trend				
1.1	Current livestock holdings	**Type**	**Total Number**	**Adult Male**	**Adult Female**	**Juvenile**
		Yak/Dzo (hybrid)				
		Cattle				
		Sheep				
		Goat				
		Horse				
		Cow				
		Others				
1.2	What is the status of your herd from the past year? (Please indicate what your herd size was last year, preferably by kind of livestock.)	**Type**	**Total Number**	**Adult Male**	**Adult Female**	**Juvenile**
		Yak/Dzo (hybrid)				
		Cattle				
		Sheep				
		Goat				
		Horse				
		Cow				
		Others				
1.3	Reasons for mortality of livestock.	**Type of Mortality**	**Ranking (1-5)**		**Remarks**	
		Lack of forage				
		Winter snow				
		Disease				
		Accident				
		Predation				
		Other				

1.4	Mortality of livestock (Source and number of individuals lost by kind)	Source of Mortality	Number of individuals lost by kind of livestock						
			Yak/ hybrid	Cattle	Sheep	Goat	Horse	Cow	Others
		Lack of forage							
		Winter snow							
		Disease							
		Accident							
		Predation							
		Other							

Q.N.2	Threats and conservation issues

2.1	Has Snow Leopard ever hunted down your livestock? Yes _____ No _____ Don't know _____	**If yes** please list out the kinds in order from most to least commonly killed Sheep_____ Yak/hybrid_____ Cattles_____ Goat _____ Cow _____ Horse _____ Others (specify) _____

2.2	List down the types of livestock killed within the past 12 months and their number.	**Type of livestock**	**No of dead individuals**
		Yak/Dzo (hybrid)	
		Cattle	
		Sheep	
		Goat	
		Horse	
		Cow	
		Others	

2.3	Is there any compensation scheme for the killed livestock? **(If no go to Q.N 2.7)**	**(If yes**, mention the types of livestock which are compensated for) Sheep_____ Yak/hybrid_____Cattles_____Goat _____ Cow _____Horse _____ Others (specify) _____
2.4	Mention the entire procedure to claim the compensation	
2.5	Duration of procedure for compensation	_____ (Days/Months)
2.6	Are you satisfied with the compensation amount received	Yes _____ No _____
2.7	Do you think that such losses are severe and need to be addressed immediately? Yes _____ No _____	If yes, who should be responsible? Governmental agencies _____ Self or local village and tribal councils_____ Both _____ Others (please specify) _____

Q.N.3	People's perception towards wildlife and conservation	
3.1	Please indicate your attitude towards Snow Leopard	a) Dislike (should be exterminated) _____ a) Indifference (no strong opinion) _____ b) Like (should be conserved) _____
3.2	Are you aware regarding the legal protection of the wildlife around you?	Yes _____ No _____
3.3	Please express your attitude towards the protected area status around your village.	a) Dislike (legal status should be dissolved) _____ b) Indifference (no strong opinion) _____ c) Like (legal protection should be continued) _____
3.4	Is wildlife hunted in your area?	**If yes**, who does the hunting? _____ **If no**, what dissuades people from hunting? Legal protection of wildlife _____ Religious considerations _____ Others (specify) _____
3.5	What according to you are the major threats to Snow Leopards population?	

Thank You

Annex III: Key Informant Interview Questionnaire

INFORMED CONSENT

Dear respondent: Namaste!!

My purpose in talking with you today is to learn about the snow leopard and its activities, the local people attitude on snow leopards around the Samdo village where you reside.

Any information you provide me will not be personally attributed to you in any reports that result from this evaluation. All the reports will be written in a manner that no individual comment can be attributed to a particular person.

Your participation in the interview is completely voluntary. Do you wish to participate in the interview?

      [ ] Yes → PROCEED

      [ ] No → END

IDENTIFICATION AND GENERAL INTRODUCTION

Interviewer Name _____Date: _____(DD/MM/YY)

Name of village (or approximate location) _____

Respondent Details

Age: _____(Years)   Sex: M   F

District of Origin/Birth: _____Occupation_____

Religion: _____   Marital Status _____

Primary source(s) of livelihood _____

Q.N	Queries	Answers	
1	Have you noticed any activities of snow leopard around the village?	Yes _____ No _____	If yes what kind of activities?
2	Has snow leopard hunted livestock within the village?	Yes _____ No _____	If yes, which livestock is hunted commonly?
3	Have you witnessed retaliatory killing of snow leopard or any other hunting activities?	Yes _____ No _____	If no, what dissuades them from doing so?
4	Is there any compensation scheme for livestock lost due to predation from snow leopard?	Yes _____	(What type of scheme? Explain.)
		No _____	(Is there any initiation taken for such schemes? Explain in detail)
5	What do you think are the major threats to snow leopards in this area?	………………………………………………………………….. ………………………………………………………………….. ………………………………………………………………….. …………………………………………………………………..	
6	What do you suggest for conservation of snow leopards in the area?	………………………………………………………………….. ………………………………………………………………….. …………………………………………………………………..	

Thank You

Annex IV: Photographs

Study area (Samdo village)

A juvenile yak attacked by snow leopard

Questionnaire survey

Field research team