

**CROP DEPRADATION BY WILDLIFE IN TARAKESHWOR
MUNICIPALITY OF SHIVAPURI NAGARJUN NATIONAL PARK,
KATHMANDU, NEPAL**



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**A thesis submitted in partial fulfillment of the requirement for the award of the
degree of Master of Science in Zoology with
special paper ecology and environment.**

**Submitted to
Central Department of Zoology
Institute of Science and Technology
Tribhuvan University
Kirtipur, Kathmandu
Nepal
August, 2018**

DECLARATION

I hereby declare that this thesis entitled “**CROP DEPRADATION BY WILDLIFE IN TARAKESHWOR MUNICIPALITY OF SHIVAPURI NAGARJUN NATIONAL PARK, KATHMANDU, NEPAL**” has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by references to the authors or institutions.

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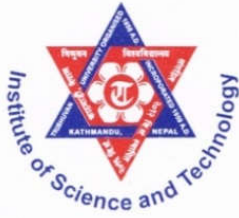
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RECOMMENDATION

This is to recommend that the thesis entitled "**CROP DEPRADATION BY WILDLIFE IN TARAKESHWOR MUNICIPALITY OF SHIVAPURI NAGARJUN NATIONAL PARK, KATHMANDU, NEPAL**" has been carried out by Ms. MANISHA JOSHI for the partial fulfillment of Master's Degree of Science in Zoology with special paper "Ecology and Environment". This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted to any other degree in any institutions. I recommend that the thesis has been accepted for partial fulfillment and of the requirements for the degree of Master of Science in Zoology especially in Ecology and Environment.

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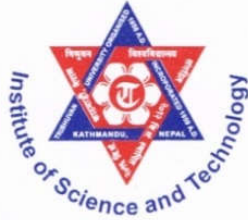
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LETTER OF APPROVAL

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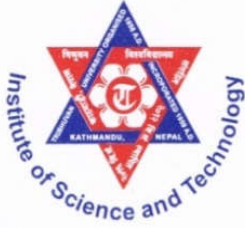
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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by Ms. MANISHA JOSHI entitled “**CROP DEPRADATION BY WILDLIFE IN TARAKESHWOR MUNICIPALITY OF SHIVAPURI NAGARJUN NATIONAL PARK, KATHMANDU, NEPAL**” has been accepted as a partial fulfillment of the Master’s Degree of Science in Zoology with special paper ‘Ecology and Environment’.

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LIST OF ABBREVIATIONS

BNP	Bardia National Park
BZ	Buffer Zone
BZMC	Buffer Zone Management Committee
FAO	Food and Agriculture Organization
GoN	Government of Nepal
HEC	Human Elephant Conflict
HH	House Hold
KCA	Kanchanjunga Conservation Area
KTWR	Koshi Tappu Wildlife Reserve
MBCA	Makalu Barun Conservation Area
PPC	Park People Conflict
SNNP	Shivapuri Nagarjun National Park
SNP	Sagarmatha National Park
VDC	Village Development Committee
WTLCP	Western Terai Landscape Conservation Project
WWF	World Wildlife Fund

ABSTRACT

Park-People Conflict (PPC) is defined as any event in which park inhabiting animals injure, destroy or damage human life or property (including the destruction of crops) and are killed, injured, captured or otherwise harmed as a result – i.e. both humans and animals suffer from the interaction with each other. Retaliatory killing and loss of habitat are threats to the survival of many species around the world. This thesis explain the various aspects of PPC in the residing village of Shivapuri Nagarjun National Park. During March and April 2016 data were collected using combination of semi-structured questionnaire survey methods, focal group discussions, formal and informal interviews and key informant interviews. The major crops grown in the area were Maize, Wheat, Paddy and Vegetable. The average yield of maize per Household (HH) per year was 836.8 kg which was highest, than that of Wheat and of Mustard. The average yield of these crops indicates that the land was highly fertile. The people in Tarkeshwor Municipality, specially two study sites (Kavresthali and Dharmasthali) perceived that crop depredation was the major problem caused by the wild animals. Most destructive wild animals were Wild Boar, Monkey, Porcupine and Common Leopard. The average number of livestock per Household (HH) was around 12. The average number of goat and chickens was highest along with cattle and buffalo. Most respondents believed that the populations of these problem animals like monkey were increasing and incident of human-wildlife conflict was also increasing. Among crops, the damage to Maize was the highest. Regarding the measures to mitigate PPC, most of them have applied different local technologies. Conservation awareness program and public participation are other major aspects that should be considered to mitigate the PPC.

Key words: Crop Depredation, Conflict, Livestock, Wild animals, Protected areas

INTRODUCTION

1.1 Background

Park-People Conflict (PPC) is defined as any interaction between people and wildlife that results in negative impacts on social, economic or cultural life, on the conservation of wildlife populations, or on the environment (WWF, 2004). It affects both wild animal and human being and also in economy. People lose their crops, livestock, property and sometimes their lives. Any event in which animals injure, destroy or damage human life or property (including the destruction of crops) and are killed, injured, captured or otherwise harmed as a result i.e. both humans and animals suffer from the interaction with each other refers to Human Wildlife conflict (HWC). Retaliatory killing and loss of habitat are threats to the survival of many species around the world. Conflicts arise when the activities of wild animals coincide with those of people (Treves, 2007). Park-people conflict is the major problem in almost all the protected areas of Nepal. According to Mishra (1984) the tug of war between wildlife and park management versus local people is not restricted to Nepal, but is going on in parks and reserves throughout most of the developing world. We know how to manage the resource but not the people which means Park-people conflict is the challenges for management of the reserve. Many indigenous peoples inhabit areas in or adjacent to national parks or protected areas (Guthiga, 2008). When local people's access to resources is cut off because of the creation of national parks, their attitudes toward park authorities turn negative. There are many cases of confrontation between park officials and local people regarding resource restriction (Shrestha, 1994).

1.2 Causes of the Park-People conflict

PPCs arise primarily because of competition between People and wildlife for shared, limited resources. The conflicts can be particularly controversial when the resource concerned has economic value and the wildlife involved is legally protected (Pandey, 2000). The frequency of conflicts has grown in recent decades, largely because of the exponential increase in human populations and the resultant expansion of human activities (Oli, 2001). PPC is a serious challenge to conservation world-wide and is spreading as human population and development increase. This increase in human population and the resulting loss, degradation and fragmentation of habitats through

human activities such as logging, animal husbandry, agricultural expansion and development projects has led to an increase in HWC (WWF, 2008).

1.3 Consequences of Park-People Conflict

Consequences of Park- People conflict can be both direct, including injury and death from encounters with dangerous animals and indirect, including loss of crops and livestock and damaged infrastructure (Bhattraai and Basnet, 2004). Park-People conflicts have become more frequent and severe over recent decades as a result of human population growth, extension of transport routes and expansion of agricultural and industrial activities which together have led to increased human encroachment on previously wild and uninhabited areas (Kharel, 1993). Competition for the available natural habitats and resources has increased. In times of progressive loss and degradation of natural habitats and biodiversity, wildlife populations are declining in many areas where human-wildlife conflicts occur – sometimes as a result of indiscriminate retaliation following conflicts with humans, as well as through unregulated hunting exceeding sustainable harvest levels. A decline in populations of prey species of large predators may attract carnivores towards domestic livestock, further aggravating human-wildlife conflict. It is therefore fundamental to monitor wildlife populations and maintain them at adequate levels, and to restore natural habitats and the balance between predator and prey species (Kasu, 1996).

1.4 Management of Park – People Conflict

The socio economic impacts of PPC can be minimized through different methods. Physical barriers to prevent the animal movement into the human settlements may be feasible only in few cases. Electric fencing has been reported one of the most effective preventive measure for protect the farmer's crop, property and life around the corridors and protected areas from herds of wild elephants. The impacts of wildlife on people can be reduced to some extent through proper management of its habitat. Such management has to be balanced between the need of wildlife and local people (Soti, 1995). Wildlife populations that came into severe conflict with human interests may have to be directly managed to keep their levels below tolerable limits. To mitigate the impacts of wildlife on people, a variety of social security schemes should be made as part of conservation plans (Sukumar, 1994). With the aim to minimize human-wildlife conflict and motivate local communities towards biodiversity conservation in Nepal, Western Terai Landscape Conservation Project (WTLCP) provided cash support of 350 thousand rupees each to

Buffer Zone Management Council (BZMC) of Shuklaphanta Wildlife Reserve (SWR) and Bardia National Park (BNP) for wildlife damage relief funds. The formulation of the Wildlife Compensation Policy, 2065 is another effort done by Government of Nepal to mitigate the PPC.

1.5 Statement of the problem

The established National Parks are not free from conflicts with local people who inhabit the area, either inside the National Parks or in the buffer zone. Almost everywhere, protected areas are the breeding ground of conflicts. This happens especially when the traditional resource use rights of the people who are residing in the region since time immemorial, before the creation of park and National park is revoked or their property is damaged by the wildlife. Further, economic losses of the local people due to crop and livestock depredation is one of the major issue that triggers park people conflict and causing problem in achieving long term conservation of biodiversity. Different studies were undertaken indifferent protected areas of Nepal on HWC. No similar studies to assess PPC have been undertaken in the vicinity of Shivapuri- Nagarjun National Park regarding to the sites of Tarkeshwor Municipality. Therefore it is realized to carry out study of this kind in and around Shivapuri Nagarjun National Park. This study will give the base line information on extent of PPC (socio-economic, energy consumption, people perception on conservation). Outcomes of this study will be useful for the management of the park and in reducing Park-People Conflict around the Shivapuri Nagarjun National Park.

1.6 Objectives of the study

The overall objective of this study was to explore extent and impact of Park-People conflict in Tarkeshwor Municipality, Kathmandu.

The specific objectives of study were:

- To identify crop depredation by wild animals in Tarkeshwor Municipality.
- To explore the methods and techniques adopted by the local people to reduce park people conflict.
- To assess the perception of local people towards national park conservation

1.7 Limitations of the study

- Actual measurement of damages caused by wildlife were not undertaken, such data were based on respondents view.
- Only the major crops were identified.
- Tarkeshwor Municipality usually consists the urban area, so adequate conflicts were not identified.

2. LITERATURE REVIEW

2.1 Crop Depredation

Since the establishment of National Parks and Reserve, conflict has been observed between local people and park. Crop depredation by wildlife is very common in neighboring villages of protected areas in Nepal and other countries. It is one of the main causes of wildlife human conflict both in mountain and terai parks of Nepal. Studies in terai parks are such as Chitwan National Park (Jnawali 1989, Mishra and Margaret 1991, Sharma 1991, Nepal and Weber 1993, Shrestha 1994, Upreti 1995, Regmi 1999, Gautam 1999, Shrestha 2002 and Bhattarai and Basnet 2004), Bardia National Park (Khatri 1993, Baral 1999, Adhikari 2000 and Jnawali 2002), Koshi Tappu wildlife Reserve (Adhikari 2000), Suklaphanta Wildlife Reserve (Pandey 2000, Limbu and Karki 2003) and mountain parks such as Shivapuri National Park (Kattel 1993, Soti 1995, Poudyal 1997, Gurung 2002, Bashyal 2005, Bajrachaya 2005 and Nepal 2005), Dhorpatan Hunting Reserve (Kharel 1993), Makalu Barun Conservation Area (Jackson 1990, Chalise 1998, Chalise and Johnson 2005), Annapurna Conservation Area (Shrestha et. al. 1993), Langtang National Park (Upreti 1985, Kharel 1997, Chalise 2001), Rara National Park (Upreti 1985), Sagarmatha National Park (Upreti 1985, Shrestha 2002, Shrestha 2004).

In Chitwan National Park, wild ungulates such as rhinoceros (*Rhinoceros unicornis*), boar (*Sus scrofa*), and spotted deer (*Axis axis*) are chief crop depredators of rice, maize and mustard (Jnawali 1989, Mishra and Margaret 1991, Sharma 1991, and Regmi 1999). According to Nepal and Weber (1993), crop raiding by wild ungulates continued from May to March in any cropping cycle. Upreti (1995) found rhinoceros as a number one crop raider followed by spotted deer, wild boar and parakeet. Bhattarai and Basnet in 2004 estimated Rhinoceros caused 70 percent damage and the lowest 0.2 percent by Barking deer (*Muntiacus muntjak*). Wild boar (Baral, 1999), Elephant (*Elephas maximus*) (Adhikari, 2000), Blue bull (*Boselaphus tragocamelus*) (Khatri 1993), Monkey (*Macaca mulatta*) and Spotted deer were crop raiders in Bardia National Park. The depredators raid varieties of crops, such as rice, maize, wheat, lentil and vegetables grown in kitchen garden (Jnawali, 2002).

In Koshi Tappu Wildlife Reserve, wild buffalo (*Bubalus arnee*) and wild boar raided paddy, wheat, and jute (Adhikari, 2000).

Spotted deer, wild boar, elephant, blue bull, monkey, porcupine (*Hystrix indica*) and peacock were identified as pests in Suklaphanta Wildlife Reserve (Pandey, 2000).

In Shivapuri and Gokarna wild boar, monkey, porcupine, and bird species were identified as crop pests (Kattel 1993, Soti 1995, Poudyal 1997, Gurung 1997, Bajracharya 2005, Basyal 2005, Nepal 2005) that affected crops like maize, millet, rooted crops, rice and wheat.

In high mountain region the identified crop pests were two species of monkey (*Macaca mulatta* and *Semnopithecus entellus*), barking deer and porcupine at Shankhuwa Valley, Makulu Barun National park (Chalise, 1998). In addition to these pests, Kharel (1997) identified wild boar as the major pest in Langtang National Park. Monkeys, bears (*Selenartia tibetanus*), musk deer (*Moschus chrysogaster*), blue sheep (*Pseudois nayaur*) at Langtang National Park (Chalise et al., 2001) as well as Porcupine, and rodents were identified as major crop wildlife pest in Shey Phoksundo National Park (Basnet, 1998), and Himalayan tahr (*Hemitragus jemlahicus*) at Sagarmatha National Park (Shrestha, 2004).

Many studies of wildlife human interaction have been conducted. It should be conducted in every affected area because the interaction issue and its solution differ significantly depending on places. Regular recording of the crop and livestock depredation is necessary for better management of protected areas.

2.2 Methods and techniques adopted for conflict management

Most of the techniques to reduce the HWC were manual and human based. The application of the techniques singly or in a combination with others depends upon the severity of the problem and number of wild animals approaching to cropland and houses. The major techniques applied were noise making by people, noise making by using tools, dog releasing during encounter with wild animals and regular watching of the wild animals from high point.

Ayadi (2011) in Banke national Park showed that villagers tried many techniques to chase away monkeys, including red-pepper bombs, loud-speakers broadcasting barking dogs, and radio transmitters on monkeys to aid in detecting raiding monkeys. In Lelep and Tapethok VDC of KCA using questionnaire method, Khatiwada (2004) showed that local people adopted the different techniques to protect croplands from wild animals. Fencing, Scarecrow, stone throwing and sound producing were common techniques to protect the

crop land from wild animals. Local people guard their crop field during crop ripening seasons.

WWF (2007) showed that Jhapa and Bardia were the most severely and about equally affected by human-elephant conflict in terms of crop damage, as households here had lost nearly a quarter of their total annual income from crop production. The qualitative and quantitative analysis showed that the severity of the problem is reflected by various measures undertaken at the community level to mitigate HEC in all the sectors. Most people applied one or more measures to cope with HEC. Among them, chasing with fire, use of noise and explosives, and regularly guarding the fields were the most widely used measures in all the sectors. Apart from this, high voltage electric fence in Jhapa and improved fencing (mainly, digging trenches and planting hedgerows) in Shukla were also commonly practiced. Despite the wide spread application of measures viz. chasing with fire, use of noise and explosives, and regularly guarding fields, these were not considered to be effective in mitigating HEC by the people of Bardia and Jhapa.

A report on “Common Ground-Solutions for reducing the human, economic and conservation costs of human wildlife conflict” by WWF (2008) showed that in Namibia different methods both traditional and modern were employed at a field level to keep wildlife away from humans and human property, with varying levels of success. The major methods were artificial barriers (electric fences, protection of water points, chilli pepper fences, chilli bombs), alternative water points for elephants, elephant trip alarms and improved livestock husbandry. This also showed that one technique alone will not be sufficient – a package of different techniques should be designed that is specifically tailored to meet the needs of the local situation. A Report on “human-elephant conflict in Transmara district in Kenya” by IIED (2003) showed that community employed many different methods to keep the elephants away from their fields. These are included fencing, noise from tins and pipes, shouting, bee hives, tobacco, fire, burning elephant dung, communal farming and guarding, premature harvesting of maize, and use of used oil. Other methods used included blowing a whistle, throwing embers, use of a sling and driving a tractor into the field. The use of fire, tin drums and more intensive guarding appeared to reduce the chance of successful crop raiding. In contrast, farms near houses (settlements) had more chance of being raided than farms far away. Farms that were planted early (January) stood a greater risk of being attacked than farms planted later in

the season, due to earlier maturation. Most farmers did not report the incidences of crop raiding to concerned authority. Human-wildlife conflict can be managed through prevention strategies at the initial stage and take action towards addressing its root causes, a protection strategy are implemented when the conflict is certain to happen or has already occurred and mitigation strategies attempt to reduce the level of impact and lessen the problem. The main approached programs for this are community awareness at local level, direct and/or indirect compensation in the event of loss, voluntary relocation of local communities, guarding animals, translocation of problematic animals and human-wildlife education toolkit for farmers and communities (WWF, 2002). The application of these techniques was to threaten the wild animals to come to the crop land and house. The effectiveness of these is varied and different for different wild animals. The effectiveness of noise making by people and by using tools was higher than the other techniques applied.

3. MATERIALS AND METHODS

3.1 Research Design

The methodology include the use of primary and secondary information, field observation, key informant interview, focus group discussion and face to face interaction. The study area was in the Shivapuri Nagarjun National Park in South Western part. The household questionnaire survey was conducted in the study site. Interview was also done with different key persons. Microsoft Excel was used for the analysis of the collected data.

3.2 Study Area

3.2.1 Shivapuri Nagarjun National park

Shivapuri Nagarjun National Park was gazetted as the country's 9th National Park in 2002. It is situated on the Northern fringe of Kathmandu valley and lies about 12 km away from the centre of capital city. Shivapuri Nagarjun National Park is situated in the north of Kathmandu valley. The park encompasses two separate forest patches viz: Shivapuri and Nagarjun. Shivapuri Nagarjun National Park has covered area is 159 Km². Geographically, Nagarjun is located between 27° 43' to 27° 46' north latitude and 85° 13' to 85° 18' east longitude and occupies an area of 16 km². The area extends from around 1350 m asl. to 2100m asl.

The overall study was focused in Tarkeshwor Municipality of Kathmandu Districts. It is recently being municipality of Kathmandu district. It covers the total 21 wards. Its coordinates 27°45'3" North and 85°17'39" East. The study area located in Kavresthali and Dharmasthali.

3.2.2 Biodiversity and Habitat of Shivapuri Nagarjun National Park

Forests in Nagarjun can be categorized into four types: *Schima wallichii* forest, pine forest, mixed broadleaved forest (*Phoebe lanceolata*, *Machilus duthiei*, *Michelia kisopa* as major species) and dry oak forest. There are few small patches of grassy meadow. The fauna present inside Nagarjun forest includes many species of birds, sixteen species of herpeto fauna, two primate species Assamese macaque (*Macaca assamensis*) and Rhesus macaque (*Macaca mulata*) many species of bats, squirrels, Chinese Pangolin (*Manis pentadactyla*), Barking Deer (*Muntiacus vaginalis*).

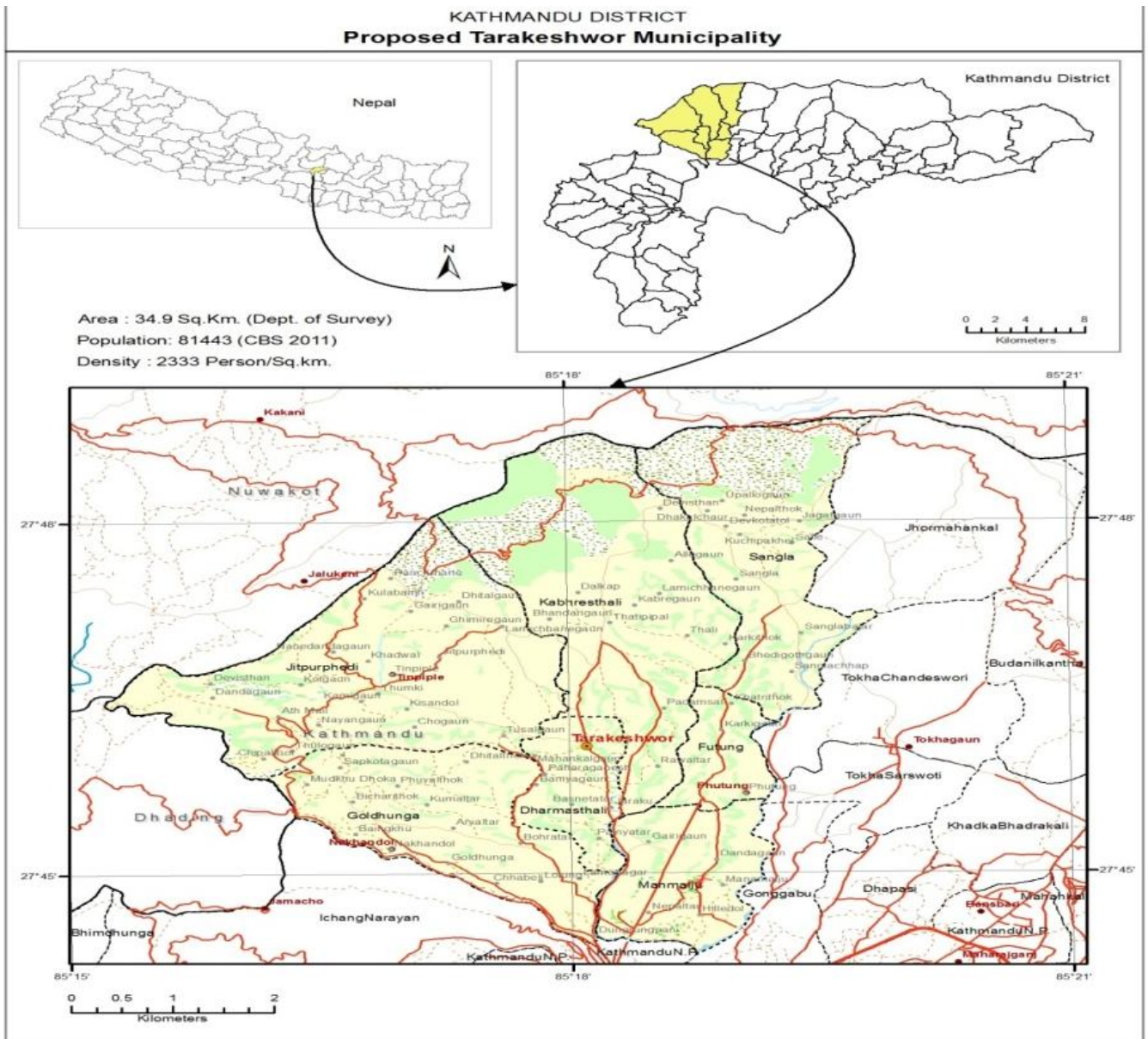


Figure 1: Map showing the study area (SNNP)

3.2.3 Climate

Nagarjun forest area is a typical Mahabharat hill and bears mostly sub-tropical type of climate and partly temperate climate. The climatic data of the Nagarjun area is not available. So, according to the nearest meteorological station at Panipokari, Kathmandu; average monthly relative humidity (at morning) of the area ranges from 80.73% (April) to 87.42% (August) and average monthly relative humidity (at evening) ranges from 78.73% (April) to 87.73% (September). Similarly, the mean monthly minimum temperatures ranges from 3.9°C (January) to 20.35°C (July) and the mean monthly maximum temperatures ranges from 18.63°C (January) to 29.56°C (June).

3.2.4 Social Characteristics

There are about 20,158 households with 81,443 populations residing in Tarkeshwor Municipality (AMDP, 2015). Indigenous Newar community, Brahmin, Chhetri, Magar, Tamang and Gurung are living in this area. Most of the economy of people depends on business, jobs and some are vegetable farming, and cow husbandry (CBS, 2014).

3.3 Data Collection

The study was based on the primary as well as on the secondary data. The major primary and secondary sources were as follows:

3.3.1 Primary Data Collection

Primary data were collected from the study site by employing combination of social survey methods involving one hundred and fifty local people for the participatory techniques, semi-structured questionnaire survey of households and on-site observations. The methods were applied to extract the information such as Socio-economic condition, energy consumption pattern, major conflicting animal, crop loss, major season and time of conflict, local techniques to mitigate the PPC, attitude of local people towards future prospects effectiveness of present techniques and local people's ideas on PPC mitigation.

3.3.1.1 Household Survey

The household survey was conducted in Kavresthali and Dharmasthali of Tarkeshwor Municipality. A semi structured questionnaire was used to elicit information from the respondents. Semi-structured questionnaire survey was done with the help of local assistants for information gathering. The Household survey questionnaire survey began by explaining them the purpose of the study and their willingness to contribute. Interview was done only with the persons who had expressed their willingness to contribute. Each interview lasted for about 20–30 minutes.

Table 1: Total number of sampled households

	Kavresthali	Dharmasthali	Total
Male	25	41	66
Female	48	36	84
Total	73	77	150

3.3.1.2 Focus Group Discussion

Focal group discussion was organized with local people in each village to extract various opinions through research questions and also help to check the reliability of the answers obtained from other methods. One focus group discussions was conducted in each village comprising 10-15 people together to engage in guided discussion.

3.4 Data Analysis

Qualitative and quantitative analysis methods were applied to analyze the data in this research. All the information was collected in the form of semi-structure forms, diaries and photographs were taken. All the data collected were checked, refined and scrutinized as per the objectives. Finally data were analyzed using Microsoft Excel program.

The economic loss of crop per year per household was determined by the following method,

Economic value of crops per year per Household = *Average damage per year per HH in Kg X Local market value of each crops per kg*

Average damage per year per HH (in Kg) = $\frac{\text{Total damage of crops of sampled HH}}{\text{Number of sampled HH}}$

Now,

Total damage of crops of sampled Household= Sum of total damage of crops each sampled Household

4. RESULTS

4.1 Occurrence and Abundance of Major Pest Species

The major pest species identified in study area around the park were Rhesus Monkey (*Macaca mulatta*), Assamese Monkey (*Macaca assamensis*), Common Leopard (*Panthera pardus*), Wild Boar (*Sus scrofa*), Barking Deer (*Muntiacus vaginalis*), Jackel (*Canis aureus*) and Wild Cat (*Felis chaus*). Rhesus monkey was very frequently visiting pest species in all the study sites where as Wild Boar and Barking Deer were very frequently visiting pest species in the season of maize and wheat crops respectively. Jackal and Wild Cat were also frequently visiting pest species all the year around. Leopard, Bear, Porcupine were rarely behaving as pest species.

Table 2: Wildlife Visiting in Village and Number of Individuals in visit

S.N.	Species	Abundance	Number
1	Rhesus monkey	Very Frequent	5-10
2	Wild boar	frequent	Single or group
3	Leopard	Rare	Single
4	Barking deer	Rare	1-5
5	Jackal	Frequent	Single
6	Porcupine	Rare	Single
7	Bear	Rare	Single

The problems created by the wildlife are crop damage, livestock depredation and local harassment. The wild animals from the park frequently visit the nearby village and damage the usually crops than the livestock. The most preferred crops include paddy, wheat, maize, pulses, potato, kitchen vegetables and also occasionally goats, calves and chickens become preys. Vegetable farmers were seen more serious from the wild animals like monkey and wild boar.

4.2 Crop Depredation

4.2.1 Agricultural Activities

According to the Annual Municipality Development Plan 2015 of Tarkeshwor Minucipality nearly 68% of the total people were engaged in subsistence agriculture for their basic livelihood. Maize, wheat, mustard and paddy were major crops and were grown once a year. Paddy was grown in July and harvested in November, while Maize was grown April and harvested in June. The average yield of maize per HH per year was

836.8 kg which was highest, than that of Wheat and of Mustard. The average yield of these crops indicates that the land was highly fertile. In monetary terms, Maize accounted for about 48% of total economic yield. Among the others crops Wheat and Mustard accounted for about 20% and 23% of the total economic yield respectively.

Table 3: Total crop production in studied household and its contribution (in Kg)

Major Crops	Paddy	Maize	Wheat	Mustard	Potato	Vegetable
Total production/year	6810	125520	47655	11265	2100	5256

Table 4: Total crop production, annual average production and economic value

Major crops	Average production per year per household (Kg)	Average annual income per HH(NRS)	Contribution of each crop in Monetary value (%)
Paddy	45.4	1135	3.58
Maize	836.8	15062.4	47.55
Wheat	317.7	6354	20.06
Mustard	75.1	7510	23.71
Potato	14	560	1.76
Vegetable	35.04	1051.2	3.31
Total		31672.6	100

4.3 Livestock Population

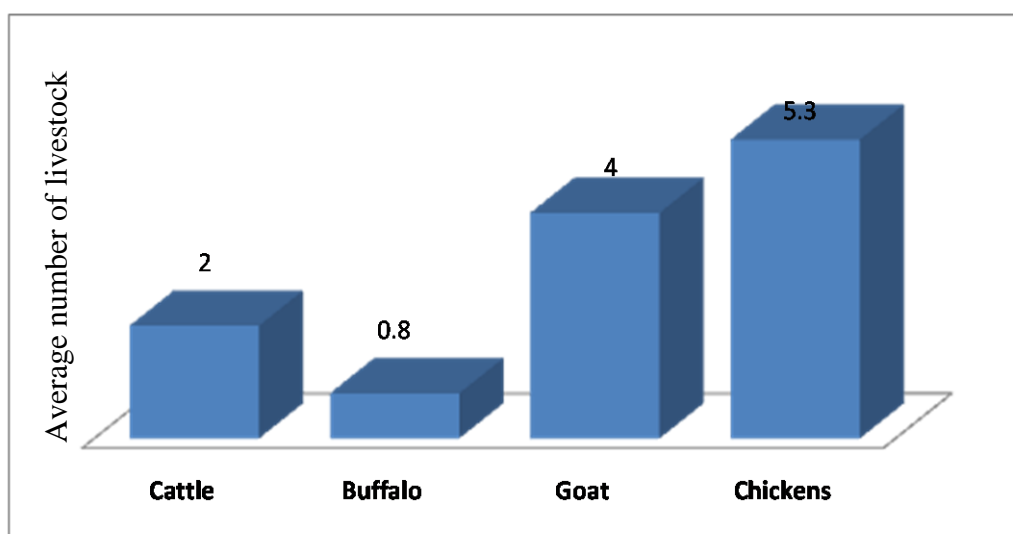


Figure 2: Average no of livestock per House hold in study area

All of the households had multiple livestock's comprised by Cattle, Buffalo, Goat and Chickens. The average number of livestock per House Hold was around 12. The average number of Goat and chickens was highest along with cattle and buffalo.

4.4 Crop Raiding and Depredation

Several crops were damaged by the wild animals. Maize and wheat were the most severely damaged crops in the study area. All respondents faced the crop damage problem by the wild animals. Wild boar, porcupine and monkeys were the main destructive animals. The crop raiding by the wild animals was continued almost throughout the year.

4.5 Human-Wildlife Encounter

More than 75% of the respondents encountered with wild animals. About 5% were also encountered with Bear, People were encountered most frequently with Monkey (88%), wild boar (68%) and porcupine 37% respectively. About 80% of the respondents encountered with the wild animals during night time. The respondents expressed their opinion that crop raiding was more destructive during night time because of the detection difficulty. Respondents mentioned that the frequency and attempts of visit of wildlife was found high during the growing and harvesting period of crop.

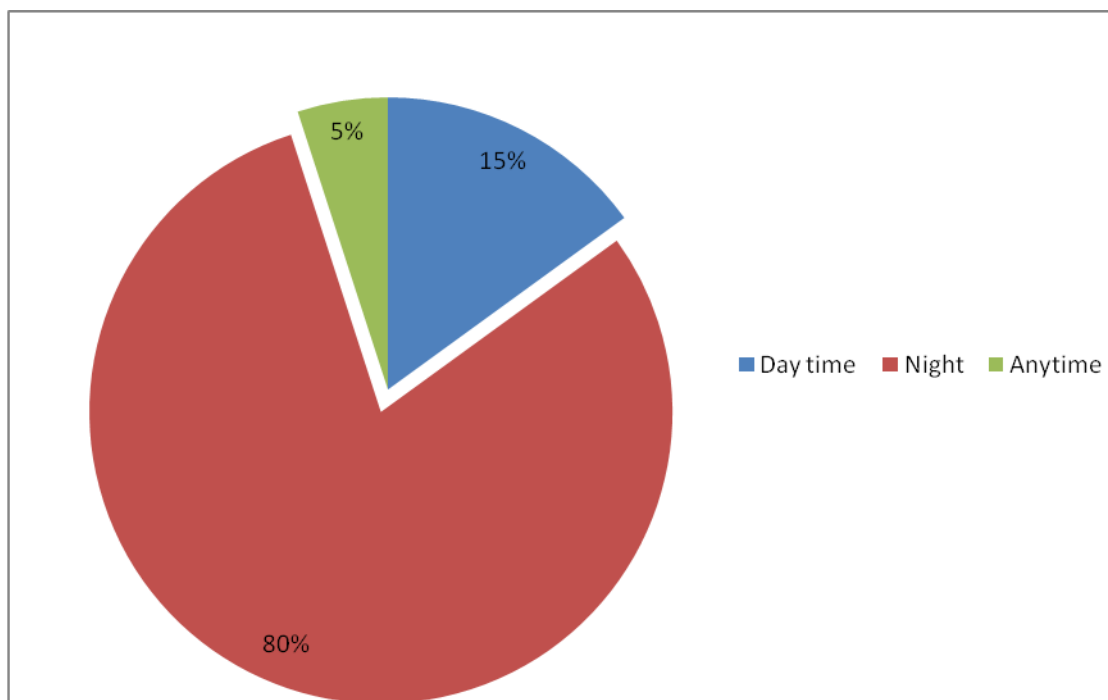


Figure 3: Time of visit of wild animals in the study site.

4.6. Crop damage by wild animals

Nearly 58% of the total people were engaged in agriculture. The damage per HH per year of maize was highest, than of wheat and of paddy. Average damage each HH per year of maize was 584.4 kg and that of wheat was 240.21 kg. In monetary terms, maize damaged accounted for about 55.18% of total economic yield. Among the others crops wheat and paddy accounted for about 24.4% and 9.06% of the total economic yield respectively.

Table 5: Economic loss of crops per year per HH

Major crops	Average damage per year per HH (Kg)	Total damage per year (Kg)	Average damage per year per HH(NRs)
Paddy	40.2	6030	80.4
Maize	584.4	87660	17532
Wheat	240.21	36031.5	3843.36
Mustard	26.70	4005	2136
Potato	9.6	1440	384
Vegetable	5.78	867	289.0
Total		136033.5	24264.76

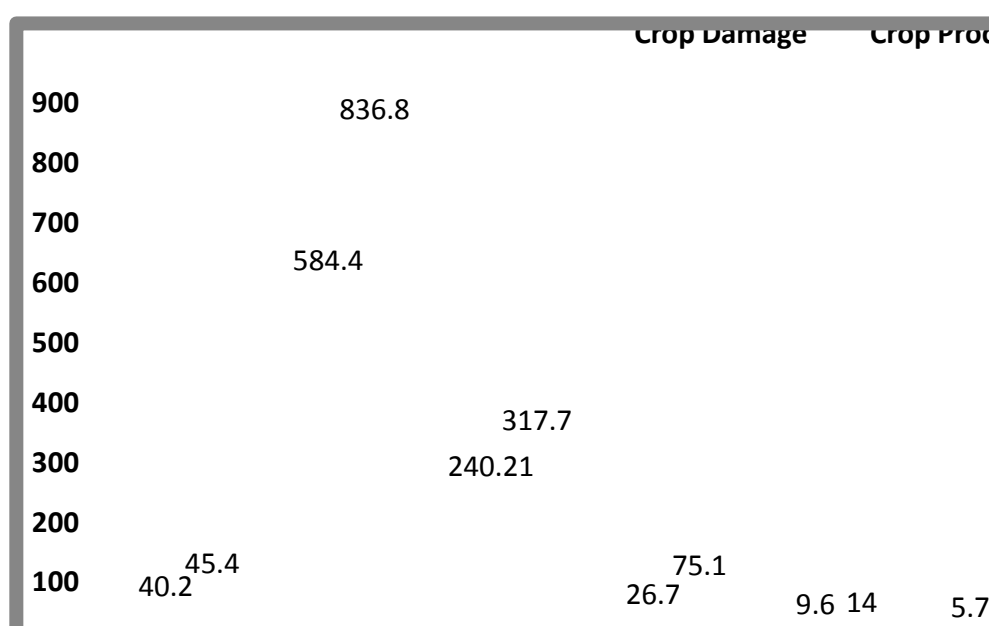


Figure 4: Average no. of crop damage and production per year per HH (Kg).

4.7 Methods and techniques adopted by the local people to reduce crop depredation

Most of the people applied one or more measures to cope with crop depredation. One common feature observed in the cultivated area was the vocal sound by the people (shouting with loud singly or in group, clapping in group). Other methods were noise making tools such as clapper and tin box, stone throwing, chasing with fire, regular watching wild animal through high point and dog releasing during encounter with wild animals. During certain period of high crop depredation, farm HH members would take the turns to guard the field crops. Some of the respondents preferred to kill the crop raiding animal than chasing and chasing with fire.

Table 6: Method of crops protection by local people

Methods	Respondents	
	Number	Percent
Using noise by people	67	44.66%
Chasing	24	16%
Chasing with fire	5	3.33%
Dog releasing	8	5.3%
Stone and dust throwing	2	1.3%
Noise making tools	33	22%
Guarded at night in crop land	11	7.3%
Total	150	100

4.8 People's perception on the causes of visiting cropland

Most of respondents (>70%) believed that food deficiency to the wild animals in their habitat was main cause for the wild animals to visit the crop land. This statement is supported by the fact that, the nearby forest was degrading in recent year than previous year. Increase in the number of wild animals, search for palatable food and search for water were other major causes for this fact. Deforestation, forest fire and forest encroachments were minor factors as said by the respondents.

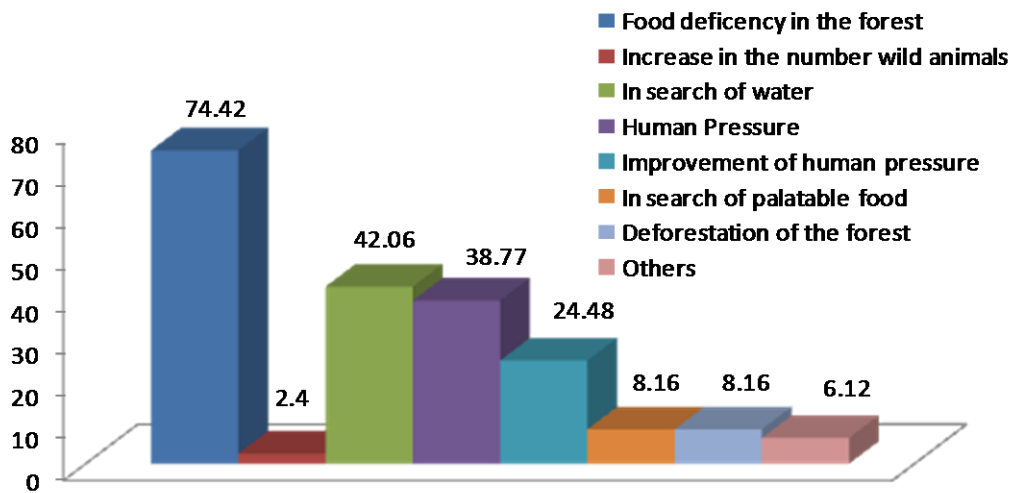


Figure 5: Respondent's opinion on why the wild animals were coming frequently

4.9 Perception of local people towards park conservation

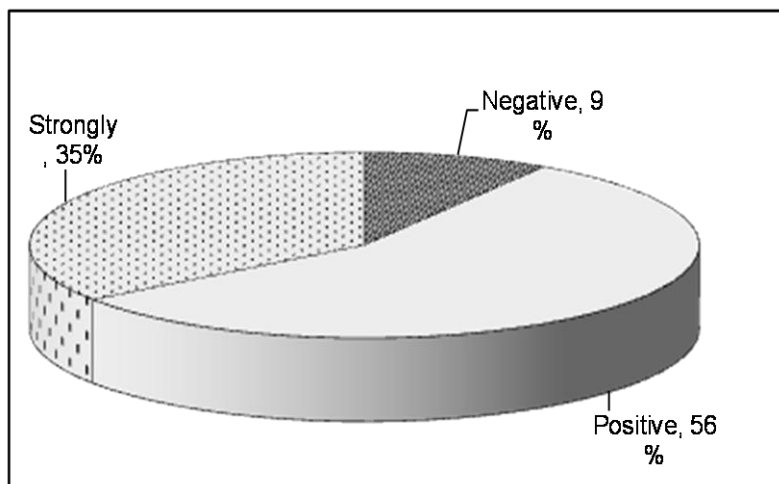


Figure 6: Attitude of people towards park and its management

Attitude of people were categorized into three aspects i.e. strongly positive, positive and negative. It was found that about 35 percent of total respondents expressed strongly positive attitude, 56 percent of total respondents expressed positive attitude and about 9 percent respondents were not in favor of park conservation and its management.

5. DISCUSSION

5.1 Crop depredation

The urbanization rate is rapidly increasing in the study area due to migration of people from different areas for better purposes. The excessive pressure on forest for firewood and fodder collection and other activities (Housing, fencing around the crop land) influences the extent and nature of the conflict in that area. According to Sukumar (1994), when the carrying capacity of people or wildlife is exceeded, the interaction between people and wildlife is intensified in many ways. High number of wild animals in the forest creates intra and inter species competition for space, food and mating (Upreti, 1985). Such situation forces the movement of the wild animals to the cropland.

Mishra (1984) enumerates four basic causes of conflict between the park authorities and local people (loss of life, livestock, and crops to animals from the park, and difficulties and resentments arising from the park regulation), and emphasizes crop loss as the most serious problem. Kharel (1993), Soti (1995) and Poudyal (1997) identified wild boar as main very frequent pest species in Shivapuri National Park (SNNP) and maize is the most raided crop by wildlife. Similarly in Lantang National Park wild boar was important crop raiding animals followed by Himalayan black bear, monkey and deer species (Kharel, 1993). But Nepal and Weber (1993) found rhinoceros, chital and wild boar as principal crop raider in CNP. Shrestha (1994) described clearing of forest for agriculture, grazing of livestock, lopping of trees, burning of grasses, collection of thatch grasses, harmful fishing methods and development projects are major factors of conflict in BNP. Limbu (1998) found that, most notorious animal to damage the crop was wild buffalo and wild boar in KTWR. Shrestha (2004) observed that crop depredation in Sagarmatha National Park (SNP) by Himalayan Tahr was due to their habituation with human and increasing mobility towards agricultural field. This study revealed that wild boar, monkey, porcupine and bird species as principal crop raider in this study area which were also reported by (Kattel 1993, Soti 1995, Poudyal 1997, Gurung 1997, Bajracharya 2005, Basyal 2005 and Nepal 2005) in their study on the BZ of Shivapuri Nangarjun National Park. The average total economic was estimated to be loss of Rs. 24264.76 per annum per household based on 150 household surveys (Table 6). Kasu (1996) estimated the total loss of Rs 3,470.70 per household in Parsa Wild life Reserve. His estimated loss per household (Rs. 3,470.70) is lesser than my estimation (Rs. 24264.76 per household) as I

concentrated in the BZ area of Tarkeshwor municipality only which is near the national park and another reason might be probably due to the price different of crops at that time.

Paudel (1995) calculated loss of paddy was 2.06 percent of total production in Sundarijal VDC adjacent to Shivapuri National Park. Similarly, total loss of wheat, maize and millet were 30.41 percent, 35.21 percent and 47.36 percent of the expected production. He calculated that wild boar (*Sus scrofa*) destroyed maize, wheat and millet by 85 percent, 70 percent and 90 percent of total loss respectively.

Soti (1995) is Kakani VDC adjacent to Shivapuri National Park, calculated the loss of maize was 999.88 quintal. Likewise, the total loss of millet, wheat and paddy were 55.57, 23.65 and 23.06 quintal respectively. He found the wild boar as the main crop raider. He found wild boar destroyed maize, wheat, millet and paddy by 80 percent, 45 percent, 90 percent and 40 percent respectively.

Kasu (1996) in PWR, found the loss of 23,857 kg for paddy, which was 77.52 percent of the total paddy damage. Likewise, total loss of wheat and maize were 4,896 kg or 15.91 percent and 2,022 kg or 6.57 percent respectively. He found that deer, boar and elephant destroyed 52.2 percent, 32.61 percent and 15.19 percent respectively of the total crop damage.

Limbu (1998) found a total 117,517 kg crop loss consisting 65,240 kg of paddy, 37,967 kg of wheat and 14,310 kg of potato were damaged in Kusaha VDC, area adjacent to KTWR. The study found the economic loss of Rs. 831,966. Highest economic loss 54.89 percent was estimated of paddy followed by wheat (36.51 %) and potato (8.60 %)

Baral (1999) found the loss of Rs. 2,095,346 of which 52.73 percent in Thakurdwara and 47.27 percent in Shivapur VDC. Highest loss (28.32 %) occurred to paddy, followed by potato (15.40%) maize (15.21%), wheat (13.80%), lentil (12.42%) and yam (7.57%). The loss of crop to wild boar ranged from 166.39 kg to 205.51 kg per household.

Gautam (1999) found the loss of Rs 947,470.19 in ward no 13, 14, 15, 18 and 19 of Mahendranagar Municipality adjacent to Suklaphanta Wildlife Reserve (SWR). Highest economic loss 74.28 percent was estimated to paddy crop followed by wheat (17.08%) and maize (8.62%). Among the wild animals, highest economic loss was estimated by wild elephant followed by wild boar (28.67%), chital (24.09%), (43.29 %) and bluebell

(3.92%). The reported loss of crop to wild animals ranged from 61.62 kg to 126.33 kg per household.

Gurung (2002) found a total 46,872.40 kg crop loss consisting 12,085.83 kg of paddy followed by 11,531.46 kg of maize, 11,281.50 kg of potato, 6,421.85 kg of wheat, 5,119.01 kg of millet and 432.75 kg of mustard in Sunkhani VDC of ShNP. The study found the economic loss of Rs. 554,989.31 of which the loss were 33.24 percent of maize, 19.59 percent of paddy, 17.35 percent of wheat, 16.26 percent of potato, 10.14 percent of millet and 3.39% of mustard. The estimated economic loss was Rs. 4,586.68 per household on an average.

Chalise (1998) and Chalise et al. (2001) reported that crop depredation proportion by monkey is different in different crops. In MBCA they recorded highest loss of maize (32%), followed by potato (24%), rice (14%), fruits (12%), millets (11%), wheat (4%), buckwheat (2%) and pulses (1%). Chalise (2001) stated that out of total loss of cereals 55.41 percent shared by three monkey species while 25.7 percent to deer, 11.26 percent by porcupine, 3.63 percent by small mammals and 3.99 percent by birds species.

Above studies show that there are considerable loss of crops due to wildlife adjacent to the reserves and parks of Nepal. In this study also, crop loss worth 136033.5 kg was found in 150 households . Out of the total damage of the crops, maize came to be first with 87,660 kg (64.4%) followed by wheat 36,031.5 (26.48%) kg, paddy 6,030 kg (4.43%), mustard 4,005 kg (3%), potato and vegetables 2307 kg (1.6%) by weight.

5.2 Local adopted techniques and their effectiveness

The severity and extent of the problem was determined by the application of different techniques for the reduction of the HWC in different geographic locations. One of the major techniques in the cultivated area was the using noise by the people (Crying with loud singly or in group, clapping in group) which is widely used technique in most of the Country but in contrast to this vigilance method, it include the use of watchtowers (WWF 2007). Constructed at half-kilometer intervals these can be used to spot approaching wildlife and raise the alarm to their presence (Ayadi, 2011). This method is, used widely in Zimbabwe, Mozambique and Zambia (WWF 2005). Most people applied one or more measures to cope with Human Elephant Conflict and among them, chasing with fire, use of noise and explosives, and regularly guarding the fields were the most widely used measures in Bardia, Shukla and Jhapa in all the sectors (Pandey, 2000). Limited resource,

low income and subsistence agriculture were the root reason for the application of such techniques (Bhattarai and Basnet, 2004). They were unaware about the application of the other scientific techniques. Application of such techniques to the mass population of the wild animals reduces the effectiveness of the techniques. But application of local technology in combination with new self sustaining techniques had the good effectiveness (Kattel, 1993). Chasing with fire, noise making by people and by using tools , dog releasing , stone and dust throwing, guarding at night were not quite ineffective to chase the wild animals(Kasu, 1996). Repeated application of the same techniques for a long period of time also influences the effectiveness (Ayadi, 2011). In Namibia the major methods used to reduce the human wildlife conflict were electric fences, protection of water points, chilli pepper fences, chilli bombs, alternative water points for elephants, elephant trip alarms and improved livestock husbandry (Khatri, 1993). This also showed that one technique alone will not be sufficient – a package of different techniques should be designed that is specifically tailored to meet the needs of the local situation (WWF 2008). This agrees with the application of chasing with fire, use of noise and explosives and regularly guarding fields, these were quite effective to the new and inexperienced crop raider not to the veterans (WWF 2007). The ineffectiveness of techniques was high because of the poor visibility during night time .

5.3 Perception of local people towards National park conservation

Many study respondents expressed the view that conservationists and the government are more concerned about wildlife than about human well-being, as has also been reported for Amboseli National Park in Kenya (Roque, 2009). However, the majority of total respondents expressed a positive view of national park conservation. Livestock losses, together with crop damage, are considered major causes of negative attitudes toward conservation policy around protected areas (Wang et al., 2006). Although only a small proportion of respondents about 9% had negative attitudes toward conservation, this proportion is significant because the small number of people who oppose conservation can substantially hamper conservation initiatives by getting involved in illegal activities. Among participants gender, crop damage, livestock damage, and total livestock owned were the main factors that shaped attitudes toward wildlife conservation. Other factors like including occupation and age, number of family members, number of earning members, income, and amount of land owned did not play a significant role in predicting attitudes.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The case of Human-Wildlife conflict is increasing in recent year. The direct causes of the conflict were huge pressure on the nearby forest, increase in the number of wild animals, deforestation and open grazing. Crop damage was the major problem faced by the people. Contribution of maize in total damage was higher than the others. Only few cases of the human casualties were reported. At present conflict between the human and herbivore wild animal was high and crop damage was high in study site. Most of the techniques to reduce the PPC were manual and human based. The application of the techniques singly or in a combination with others depends upon the severity of the problem and number of wild animals approaching to cropland and houses. The major techniques applied were noise making by people, noise making by using tools, dog releasing during encounter with wild animals and regular watching of the wild animals from high point. The application of these techniques was to threaten the wild animals to come to the crop land and house. The majority of respondents expressed a positive attitude toward National park conservation but said that conservationists and the government seemed to care more about wildlife than about human well-being. This perception needs to be challenged by displays of goodwill from park management, which could help build trust and improve relationships between the park and local people.

6.2 Recommendations

1. Local people of SNNP and its BZ should be involved in the conservation and management of biodiversity.
2. The problem of conflict should be resolved by compensating farmers directly in cash for their actual loss of crops.
3. Crop depredation by wildlife should be altered growing unpalatable, less preferable crops in study area.
4. Good and effective physical barrier (Strong wall with wire fencing on it) should be constructed in the point of entering wild animals to prevent them to enter inside the crop fields

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8. ANNEXES

Annex 1: Questionnaires survey for households

Name of the respondent Age

Sex..... Address: Ward No..... Village

Municipality..... Education Family size.....

1. Are you, permanent resident of this area or migrated from elsewhere?
If migrated from where and when?

2. What is the reason of your migration?
() Low economy () for Education () Natural calamity in earlier place
() other

3. Do you have your own land? If yes, how much land do you have?

4. What are the major sources of your income?
.....

5. What are your major crops ?

6. What are your major sources of cooking energy?
.....

7. What is the status of the forests that you used for collecting forest products?
Dense Thin..... Same as before

8. Have you encountered with the wild animals in your territory?
Yes..... No.....

If yes, which wild animals?

9. When did the animal reach to your house or crop land?

During day time.....At nightAny time.....

10. How often do they visit?

DailyOnce a weekTwice a week.....Any time

11. What kinds of problems do the wild animals create?

- Crop Damage
- Human harassment (Injured and Killed).....
- Livestock depredation
- Damage properties
- Others (Specify).....

12. Which wild animals reach your house or crop land ?

.....

13. What is the amount of crop damage by wild animals?

Major crops	Total production if not damaged per year	Total production at present	Total damage

14. Do you chase or repel wild animals approaching your house or crop land? Give the nature of method and frequency of its use.

A. B. C.

15. Have you complained about the crop or animals loss due to wildlife?

If yes, where did you complain

16. In your observation, do you think that the incident of human wildlife conflict is?

A. Increasing B. Decreasing C. Same as before

17. In your opinion, why the wild animals are coming out more frequently from the park than before?

18. Could you suggest how this problem be solved?

19. Do you think Park people conflict will increase in the near future?

Yes (.....) No (.....)

Annex ii: Checklist for Focus Group Discussion

1. What are the situations of the Park people conflict in the community?
2. What are the causes of the Park people conflict?
3. Which animal is the problem animal?
4. What are the methods and techniques adopted to reduce the Park people conflict in your community?
5. What are the solutions for the reduction of the park people conflict?
6. What are the problems that you are facing in such type of conflict?
7. What are your expectations from government body?

Annex III: Checklist for Key Informant Survey

1. What are the main causes of the conflict?
2. Does the government have any new kinds of techniques under consideration for the future?
3. What are the solutions to reduce the conflict?
4. How should go conservation and natural resource management with fulfillment of necessity of local people?
5. What are the major crops and their local market prices?
6. What are the major agricultural problems in the village?

Annex II. Photo plates

1. Questionnaire survey



Photoplate 1: Interaction with farmers



Photoplate 2: Interaction with housewives



Photoplate 3: Questionnaire survey



Photoplate 4: Interaction with Key persons



Photoplate 5: Timber collection



Photoplate 6: Crop loss due to monkeys

Annex III. Supporting Results

1. Demographic and Social Characteristics

Of 150 respondents questioned during this study, 66 were male and 84 were female. More than 60% of the inhabitants came from Nuwakot, Kavre, Arghakhanchi, Sindupalchwok and Gorkha districts; among them 32% were migrated from Nuwakot and 28% from Gorkha. They were living in this area for more than 20 years.

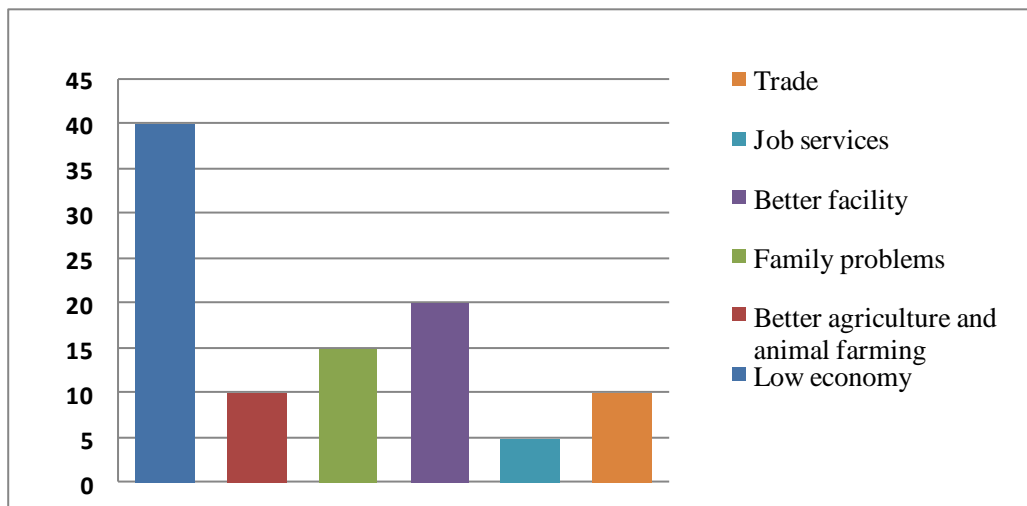


Figure I: Cause of migration in percentage

More than 60% of the respondents fell into the age group of 30-49. More than 50% of the respondents were female. The age variation of respondent was from 15-69 years. Only 10% of the respondents were older than 59 years.

Table I: Household size and age of respondents

Age in year	F	%
20-29	21	13.9%
30-39	35	23.3%
40-49	55	36.6%
50-59	29	19.3%
60-69	10	6.6%
Total	150	100%
Household size by number of family members		
<5	35	23.3%
5-10	111	74%
>10	4	2.6%
Total	150	100

About 56.6% of the respondents were illiterate which is higher than the national average of 45.9% in 2001. Only 10.6% of the respondents had primary level education and only 13.3% of the respondents had a secondary level education.

Table II: Educational profile of respondents

Education level	Frequency	Percentage %
Illiterate	85	56.6%
Primary level	16	10.6%
Lower secondary level	18	12%
Secondary level	20	13.3%
Higher Secondary level (+2) above	11	7.33%
Total	150	100%

2. Forest pressure

This study area is linked with the urban areas; therefore People consume the LPG gas as the major source of cooking energy. Some of the local villagers collected the firewood from the nearby community forest and the National Park. People said that the forests that were collecting the firewood are decreasing at present.

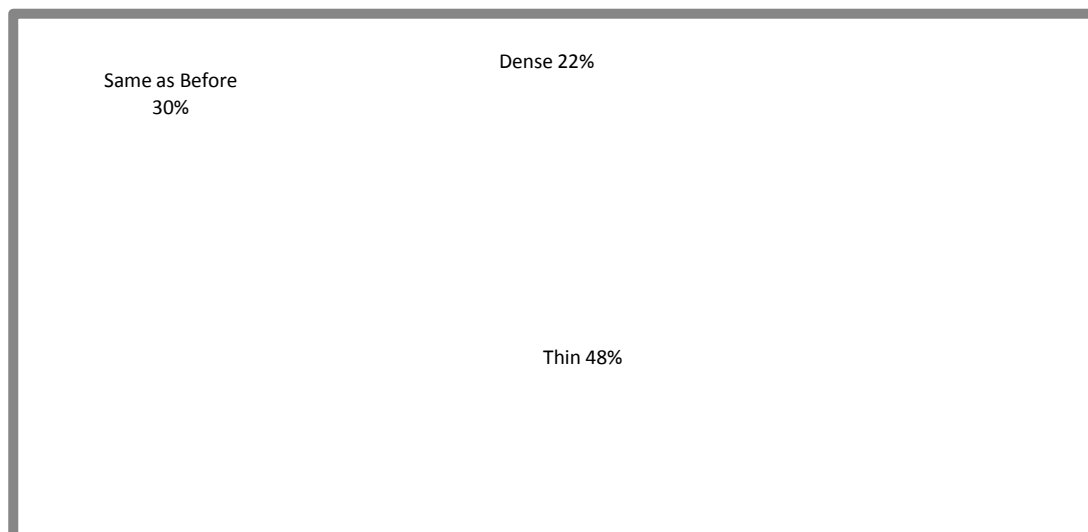


Figure II: Forest situation of study area at present