POPULATION STATUS, DISTRIBUTION OF NILGAI (*Boselaphus tragocamelus*, Pallas, 1766) AND IT'S CONFLICT WITH HUMAN IN RUPANDEHI DISTRICT, NEPAL

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Batch: 2070/2071

A thesis submitted in partial fulfilment of the requirements 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
November, 2016

DECLARATION

I hereby declare that the work presented in this thesis 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 reference to the author(s) or institution(s).

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RECOMMENDATION

This is to recommend that the thesis entitled "**POPULATION STATUS, DISTRIBUTION OF NILGAI (*Boselaphus tragocamelus*, Pallas, 1766) AND IT'S CONFLICT WITH HUMAN IN RUPANDEHI DISTRICT, NEPAL**" has been carried out by **Ms.Srijana Khanal** 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 our supervision. To the best of our knowledge, this thesis work has not been submitted for any other degree in any institutions.

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RECOMMENDATION

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LETTER OF APPROVAL

On the recommendation of supervisor "Prof. Dr. Nanda Bahadur Singh" this thesis submitted by **Ms. Srijana Khanal** entitled **"POPULATION STATUS, DISTRIBUTION OF NILGAI (*Boselaphus tragocamelus*, Pallas, 1766) AND IT'S CONFLICT WITH HUMAN IN RUPANDEHI DISTRICT, NEPAL"** is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for **Master's Degree of Science in Zoology** with special paper Ecology and Environment.

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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by **Ms. Srijana Khanal** entitled " **POPULATION STATUS, DISTRIBUTION OF NILGAI (*Boselaphus tragocamelus*, Pallas, 1766) AND IT'S CONFLICT WITH HUMAN IN RUPANDEHI DISTRICT, NEPAL**" has been accepted as a partial fulfillment for the requirements of Master's Degree of Science in Zoology with special paper Ecology and Environment.

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ACKNOWLEDGEMENTS

I express my sincere gratitude to my supervisor, Prof. Dr. Nanda Bahadur Singh, for his continuous encouragement, support and valuable comments from the project formulation phase to completion of the thesis. I am also thankful for my co- supervisor, Dr. Achyut Aryal for his constant guidance with important suggestions towards improving the thesis from the outset to the end of the project.

I am eminently thankful to Prof. Dr. Ranjana Gupta, Head of Central Department of Zoology for her kind support, suggestions and encouragements.

I would like to express my sincere thanks to Mr. Bhim Basnet, Senior Staff of Lumbini Development Trust (LDT) who has given valuable suggestions and support during the study.

I heartily thank Mr. Abdul Waffa, Chief Security Guard of LDT area who has given valuable time and all kind of help during the period of the field visit.

I would like to pay my heartfelt thanks to local people who helped me during the period of population count.

I am deeply indebted to the respondents within my study site, Rupandehi district and other stakeholders who provided me with the information and shared ideas. I am indebted to Mr Liladhar Dhakal who helped me in using SPSS and statistical analysis.

I am indebted to all my friends who directly or indirectly helped me for my work.

At last but not least, I am grateful to my parents and family for the encouragement, support, and love which finally lead to the successful completion of the research work. Finally, I thank my brother Dr. Vishnu Khanal. I would like to dedicate this dissertation to my late father Mr. Ram Prasad Khanal.

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ABBREVIATION/ACRONYMS

IUCN	International Union for Conservation of Nature and Natural Resources
DNPWC	Department of National Park and Wildlife Conservation
BPP	Biodiversity Project Profile
RBNP	Royal Bardia National Park
RSWR	Royal Sukhlaphanta Wildlife Reserve
PWR	Parsa Wildlife Reserve
KTWR	Koshi Tappu Wildlife Reserve
BBZCF	Baghmara Buffer Zone Community Forest
KNP	Kanha National Park
Km^2	Square kilometer
kg	Kilogram
LDT	Lumbini Development Trust
VDC	Village development committee
ShNP	Shivapuri Nagarjung National park
US$	United States Dollar
CBS	Central Bureau of Statistics
GPS	Global Positioning System
WWF	Worldwide Fund
NTNC	National Trust for Nature Conservation
CDZ	Central Department of Zoology
ANOVA	Analysis of Variance

ABSTRACT

Nilgai conservation in Nepal has created challenges as most of its population outside the protected area and having conflict with local community interest due to crop damage. Here, I have attempted to study on these issue with the entitled of **"Population Status, Distribution of Nilgai (*Boselaphus tragocalelus*, Pallas, *1766*) and its Conflict with Human in Rupandehi District, Nepal"**. The study aimed at determining the population ecology, conflict with local people and economic loss due to crop damage. I have also attempted to understanding the perception of local people towards Nilgai conservation, level of tolerance and assess the mitigation measures to proper management of Nilgai especially outside the protected area. The field work was conducted from 6 March to 12 April, 2016. Line transect method was implemented to find out the population status and distribution and house hold questionnaire survey were conducted to find out human-Nilgai conflict.

The total population of 303 Nilgai (individual) was counted in the study areas. This study revealed that the number of Nilgai was highest in community forest and lowest in the cultivated land. Distribution pattern of Nilgai was found to be clumped type with average herd size of 5.61 animals per herd.

Mainly crop raiding/damage by Nilgai creates serious problem in most of VDCs/ Municipalities near-by their potential habitat. The total projected value of crop yield losses due to Nilgai in the study area was NRs 17,649,996.38 (US$ 166,501.074) during one year period (March 2015 to March 2016). Vegetables were found to be maximum damage contributed to 37.07% of total loss followed by paddy.

The perception on Nilgai was found negative, positive and different level in the study area such as mixed and people could tolerate the crop loss to some extent only. Appropriate solutions such as awareness program need to be undertaken and suitable protective measures to minimize the crop loss. Change in cropping pattern and crop composition, particularly cultivation of medicinal plants was suggested as priorities. The study has noted there were many threats to Nilgai including illegal hunting, poisoning, and power fence and habitat deterioration.

Key words:- Nilgai, Crop damage, Perception, Level of tolerance, Mitigation, Threats

1. INTRODUCTION

1.1 Background

The Nilgai (*Boselaphus tragocamelus*) known as Bluebull or Ghodgadha is the largest of the Asian Antelope (Raffery, 2011; Padhi *et al*., 2004). The animal has intermediate appearance between horse and cow, especially male. The name 'Nilgai' is said to come from a combination of Nepali and English 'nil' means 'blue' and 'gai' means 'cow'. The sole member of the genus *Bosephalus*, the species was described and given its binomial name by German Zoologist Peter Simon Pallas in 1766. The animal looks like an Asian Version face to a large, sleek body more like Zebu cow than an antelope (Kyle, 1987). Nilgai has a long neck, a bony narrow head, and a barrel-like chest. They have long and strong legs. The color of the legs is darker than the body color. Both sexes have a mane on the neck and develop a tuft of long hair on the throat. Males are larger than females. Calves are pale brown in color.

Classification

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Artiodactyla

Family: Bovidae

Subfamily: Bovinae

Genus: *Boselaphus*

Species: *B. tragocamelus*

Nilgai is a social animal. They are found in herds and sometimes large herds also. They are found in single or mixed- sex herds. Nilgai is an herbivorous animal (Primary Consumer) so that they feed on various types of grass, leaves, shrubs, herbs, buds, flowers, seeds and fruits. The animal is shy and sensitive in nature. They have strong eyesight and hearing but don't have a good sense of smell.

They are found in different types of habitats from level ground to hillsides. They prefer arid areas, grassy steppe woodlands, scrub areas, flood plain, dry deciduous forests, riverine forest and agricultural land areas. They avoid dense forest and deserts. They are both browers and grazers (Rahmani, 2001). But in Rupandehi district they are found in riverine forest, community forest, plain grasslands and agricultural fields. The Rupandehi district provides a significant habitat for Nilgai. So the study concerns about the ecology of Nilgai in Rupandehi district.

Nilgai is a Schedule- III animal, according to wildlife (protection) act, 1972 and categorized as Least Concern (LC) of IUCN red list of threatened species (IUCN, 2015). It was previously kept under hunting species, but according to the Department of National Park and Wildlife Conservation (DNPWC, 1995) guidelines the animal is excluded from the general and supplementary hunting due to their small population in Nepal (BPP, 1995).The animal is considered as a religiously protected animal, and it is not harmed by local people even though it is a serious pest of their crops. It is endemic to peninsular India and small parts of Pakistan and Nepal and also has been extirpated from Bangladesh and has been introduced in the United States (Texas), Mexico, South Africa and Italy (Leslie 2008). The animal is scattered all over from the foothills of Himalayan Mountains to southwards through central India to Mysore (Shankhala, 1964). In Nepal, Nilgai domicile from foothill of Churia and Mahabharata range, occasionally in the area of low hills scrub jungle (Shrestha, 1997). Few years ago the animal is common in riparian habitats of terai region of Nepal (Dinerstein, 1976). Today they are confined to some protected areas such as Royal Bardia National Park (RBNP), Royal Suklaphanta Wildlife Reserve (RSWR), Parsa Wildlife Reserve (PWR) and Koshi Tappu Wildlife Reserve (KTWR) and also found in some isolated pockets outside the protected area such as Rupandehi, Kapilbastu, Bardia, Kailali, Kanchanpur and Nawalparasi districts (Shrestha, 1997). So this study concerns about the distribution of Nilgai in Rupandehi district.

The present study assessed the distribution pattern and crop damage by Nilgai and conflict between local people and Nilgai. Human-Nilgai conflict is the interaction between people and Nilgai that cause a negative impact on people, Nilgai and environment is one of the obstacles to biodiversity conservation. Nilgai has a direct effect on the local livelihood of the farmers in the research area, as they have always been closely associated with farmland.

The population of Nilgai in Rupandehi is in increasing order that farmer having started the mitigation measures. The reason behind this is that the herds of Nilgai raid and trample crop fields across the Nilgai habitat area and thereby causes shortage of food across these areas. The raiding of crops causes serious problem to the local people of Rupandehi district. Reliable and objective information on crop depredation by Nilgai is lacking and it is not possible to devise effective control measures unless scientific studies are undertaken on population and behavior of the species as also on various aspects of crop damage. Thus, this study concerns about the Human-Nilgai conflict which occurs due to crop depredation in Rupandehi district.

1.2 Objectives of the Study

1.2.1 General Objective

General objective is to assess the population status, distribution of Nilgai and its conflict with human in Rupandehi District, Nepal.

1.2.2 Specific objectives

1. To determine the population status and distribution of Nilgai in Rupandehi District.
2. To assess the conflict of Nilgai with a human due to crop depredation.
3. To understand the perception of local people towards Nilgai Conservation and level of tolerance to Nilgai.
4. To explore the mitigation measures adopted by local people to reduce Human-Nilgai conflict.
5. To assess threats to Nilgai.

1.3 Significance of the Study

Nilgai, the most common ungulate species in Rupandehi, is increasing in number day to day. The site is the significant habitat of Nilgai hence this area is globally recognised as an important Nilgai habitat area in Nepal, less understood by the local communities. Also, there are much important flora and fauna are found here. But only limited studies have been carried out about population characteristics, distribution and its conflict with human particularly outside the protected area of Nepal. There is an immediate need for the conservation of Nilgai through people's participation in the conservation of economic, cultural and religious beliefs and also share benefits with them.

1.4 Limitation of the Study

This research has been conducted for the requirement of master's degree and has its time boundary. Proposal development, field work, data analysis and thesis writing was done in a very limited frame with no additional resources. Therefore, there are a number of limitations need to accounted while interpreting the findings of this study. Behaviour pattern of Nilgai couldnot be collected. Due to security problem, night observation couldnot be done.

2. LITERATURE REVIEW

Research in Nepal is very rare particularly outside the national park and the wild life reserves, although there are many dwelling places of Nilgai outside the protected area.

Global Context

Shriwastava and Kushwah (2015) studied about the distribution pattern of wild mammals for their conservation planning in Madhya Pradesh that ungulates such as Spotted Deer *(Axis axis),* Sambar (*Cervus unicolor*), Nilgai *(Boselaphus tragocamelus),* Gaur *(Bos frontalis),* Chinkara (*Gazella bennetti*), Four-horned Antelope *(Tetracerus quadricornis*), Blackbuck *(Antilope cervicapra*), Wild Buffalo *(Bubalus arnee) (bubalis*) and Wild Boar *(Sus scrofa*) were recorded through direct observation. Apart from these, a small population of Barasingha (*Cervus duvaucelii branderi*), which is also thestate Animal of Madhya Pradesh, resides in the Kanha National Park. The Population structure of wildlife of the state is also quite encouraging and large plateau has presence of wildlife attractions in abundance.

Bagehi *et al*. (2008) studied grouping characteristics and population structures of spotted Deer, Samber, Nilgai and Chinkara in Ranthambhare Tiger Reserve in semi-arid Western India. Mean group size was highest for Spotted Deer (winter 4.7 and 9.2, summer 4.5and 7.9) followed by Samber (winter 3.4 and 4.2, summer 4.2 and 6.8), Nilgai and Chinkara population structure biased towards male while in Spotted Deer and Samber it bias herd towards female. Samber showed highest young to female ratio followed by Chinkara, Spotted Deer and Nilgai. Samber was found to have the highest tendency of forming large groups in open habitat whereas Spotted Deer didn't show any change in group size and composition between the habitats across the seasons. Habitat and seasons were the factors for the variation in grouping patterns of ungulates.

Masum (2014) identified that Nilgai mostly lives in herds and in winter, male Nilgai of 30 to 100 animals shifted in Northern India.

Bista (2011) studied the distribution and population size of ungulates in philibit forest division. Total 713 Spotted deer, 70 Wild Boar, 3 Shamber and 2 Barking Deer were encountered during the transect work. The estimated global density of ungulates for the forest was 40.5 individual/km^2, highest density was recorded in edge habitats. Spotted deer and Nilgai showed biased towards the female, adult male to fawn ratio was found to be 1: 0.2 for spotted deer and 1:0.4 for Nilgai. Wild boar and spotted deer distributed well across the area while hog deer in grassland only.

Khan *et al*. (1995) studied the grouping characteristics and population structure of spotted Deer, Samber and Nilgai in Gir Lion Sanctuary. Mean group size was highest for Spotted Deer and lowest for Samber. The mean group size varied significantly among the season for Spotted Deer and Nilgai. All the three species showed biased sex ratio in favour of female in different seasons and years. Spotted Deer showed the lowest adult male to female ratio (4:100) and highest in Nilgai (71: 100). Mean group size showed the clear

pattern of seasonal variation being highest during monsoon and lowest in the summer season. Seasonal variation was significant for Spotted Deer but not for Samber.

Khan *et al*. (2014) studied about the mountain ungulates in Pakistan that the studied was conducted to investigate current population, distribution,conservation and condition of six major ungulate species. The species were Himalayan ibex *(Capra ibex sibirica*), Blue sheep *(Pseudois nayar*), markhor (*Capra falconerifalconeri),*Ladaki urial*(Ovis vignei),* Marco Polo sheep (*Ovis ammon polii)* and Himalayan deer *(Moschus chrysogaster)*. Bi-annual surveys using direct and indirect counting method held in 86 potential habitats (Sub catchments) during 2005 to 2010. Questionnaire based interviews were held with local hunters and herders. Results showed that *C. ibex* is the most common species, followed by *p. nayar* and *C. f. falconeri* whereas Marco Polo sheep was limited to KNP. The study also showed that the population of trophy animals has increased whereas a non-trophy animal has fallen down to the verge of local extinction.

Narasimmarajan *et al*. (2014) estimated the population density and biomass of the wild prey species in a tropical deciduous forest at central India in the Melghat Tiger Reserve that the 225 Km^2 intensive study was found to have high prey species density(69.5±8.3 individuals/Km^2). The gray langur being the abundant prey species (42.9±7.2 individuals/Km^2), followed by samber (10.5±3.5 individuals/Km^2), Gaur (5.8±1.7 individuals/Km^2), Barking Deer (2.7±0.3 individuals/Km^2) and Peafowl (7.6±0.6 individuals/Km^2) and the biomass was found to be 6501.8 Kg/Km^2.The estimation of population density of wild prey species was done by using distance sampling method from September, 2010 to April, 2011.

Singh (2013) studied about the human-wild life conflict at eastern Vidarabha region of Maharashtra that Crops like paddy, sugarcane, banana, pulses and vegetables etc. are badly damaged mostly by wild boar, deer and Nilgai.

Chauwan (2014) carried the research on the Agricultural crop depredation by Nilgai antelope (*Boselaphus tragocamelus*) and mitigation strategies in India that in low-density Nilgai areas; losses of wheat (*Triticum aestivum*), gram (*Cicer arietimum*) and moong (*Phaseolus mungo*) crops were (20-30)%, (40-55)% and (40-45)% respectively. Damage to gaur (*cyamopsis tetragonoloba*) and cotton (*Gossypium arboretum*) was (20-35)% and (*25-40)*% respectively. Whereas in high density areas, damage to wheat, gram and moong was (35-60)%, (50-70)% and (45-60)% respectively. Mustard was seldom eaten by Nilgai but it was damaged by trampling. By managing Nilgai population, crop damage by Nilgai should be controlled.

Patel and Dharaiya (2014) carried out their research in the North Gujarat region of Gujarat state, Western India that Human wildlife conflicts are intensifying owing to increase in human population and destruction of wildlife habitats. The result depicts that 80% of total damage in seasonal crops is caused by Wild ungulates .Wild animals like Blue bull, Wild boar and porcupine are reported as a chief crop raider. The leopard is the

only big cat occurring in the region reported to cause human injury and livestock predation. Sloth bear attacks on human are very common in some parts of the study area.

Naughton-Treves (1998) studied about the predicting patterns of crop damage that five wildlife species namely; Baboons, Bush Pigs, Red Tail Monkeys, Chimpanzees and Elephants were responsible for 80% of crop damage events in Uganda of Kibale National park.

Guinnes and Taylor (2014) studied about the farmer's perceptions and actions to decrease crop raiding by forest-dwelling primates around a Rwandan forest Fragment, Western Rwanda that substantial losses of crops were reported, with replacement costs possibly reaching (10-20)% of household income. The main crop raiders are Chimpanzees (*Pan Troglodytes*) and Cercopithecus monkeys which mainly affects Maize and Legumes. Mitigation was restricted to guarding of crops. Modifications of farming practices have significant dietary consequences for subsistence farmers.

Karanth *et al*. (2012) studied about Assessing patterns of Human-Wildlife conflicts and compensation around a central Indian Protected Area that they modeled self-reported household crop and Livestock loss as a function of agricultural, demographic and environmental factors and mitigation measures.73% of households reported crop loss and 33% livestock loss in the previous year, but less than 8% reported human injury or death. Average estimated crop loss was 0.93 and livestock loss was 0.60 for surveyed households.

Ansari (2015) designed to find out the dynamic changes from last four decades in cropping pattern in Gautam Budh Nagar District of Uttar Pradesh that 35020-hectare agriculture lands belonged to fifteen villages. Six types of crops Rice, Wheat, Pea, Bajra, Jowar and Vegetables were grown by these villages. Most of the selected villages recorded similar cropping pattern from last 20 years that farmers follow organic farming and apply fertilisers, pesticides to increase their crop yields. Farmers of that villages do not agree to change the cropping pattern because of many problems like, hiking of prices of fertilisers, lack of irrigation, high cost of fuel.

Pranhanth *et al*. (2013) studied about crop raiding by Guar (*Bosgaurus*) in a Mookambika wildlife sanctuary that maximum crop raiding cases were reported in the months of March, April and May i.e. during summer (56.84%) and minimum cases during June, July and August i.e. during monsoons (9.79%) by a medium sized herd (9-12 individuals) and most damages was caused to paddy crops. Crop protection strategy was also applied such as guarding overnight (71%), pipe or stone fencing (10%), Dogs (7%), electric fencing (8%) and (4%) use other miscellaneous methods like scaring the Guars away, twigs and thorns fencing etc.

Gilleland (2010) investigated that which landscape, ecological and social factors contribute to home owner conflict with wild animals on their property so that social factors were also significant contributors to human-wildlife conflict as revealed through personal interviews with suburban homeowners. This also collectively defines the

relationship between variables existing in urban, suburban and exurban residential areas and human-wildlife conflict and also planning new residential areas to minimise human-wildlife conflict.

Mhlanga (2001) analyse the findings of a questionnaire survey to establish the relationship between wildlife and the people of Karbia town in Zimbabwe that elephants and buffaloes damage and destroy property and frighten or kill people. Baboons vandalise homes. Residents were not compensated for death, injury or property damage by animals so that people drive elephants away from residential areas using stones and burning fire logs. Buffaloes were killed or injured by using snares and also raised conflict between residents and the department of National park and Wildlife management officials over illegal procurement of resources from the national park. Over 50% indicated that animals and people should be isolated to alleviate the existing problems.

Schley *et al*. (2008) mentioned that in many European countries suffered by Wild Boar (*sus scrofa*) for crop damage. During the 10-year periods in Luxembourg an area of 2586 km^2in western parts of Europe 13,276 cases of agriculture damage by Wild Boar was reported.

Beasley *et al*. (2008) reported that in the United States alone annual economic losses caused by wild animals currently exceed $ 22 billion, with wildlife damage to agricultural crops comprising a substantial portion of these losses. In the United States the population of sub urban White-Tailed Deer (*Odocoileus virginianus*) increased in last 20 year period causes increase Deer- vehicle collisions attack on humans, diseases, and damage to vegetation.

Rao *et al*. (2002) reported that in India around the Nanda Devi Biosphere Chamoli district of Himalaya, several wildlife species were responsible for substantial damage both to crop (Wild Boar, Bear, Porcupine, Monkey, Musk Deer, and Partridge (choker).The monetary losses to be high Rs.5, 38, 620 (US$15,389) and livestock loss at prevailing market price about Rs. 10, 24,520 (US$29,272) in the study village. Goat and Sheep are the major livestock killed by Leopard. Due to present existing conservation policies and laxity in implementation of the preventive measure, the problem in the study area increasing.

Hafeez *et al*. (2011) studied that in Pakistan, *Hystrix indica* had been identified as a serious pest of traditional as well as non-traditional crops, fruit orchards, vegetables, flowering plants and grass. Crops of economic importance such as wheat, maize, sugar cane, groundnut and melon were severely damaged in the irrigated plains and rain-fed Pothohar belt. Among the vegetables, okara, pumpkin, bitter gourd and onions were badly damaged. Porcupine damage was found in 41 fields' wheat crops out of 105 fields.

National Context

Manandhar (2006) used pellet count method to study relative abundance and distribution of ungulates in SWR. Analysis of recorded 5,581 pellet groups showed the clumped type

of distribution. Spotted Deer although preferred Sal forest showed the almost similar type of adaptation in all kind of habitat. Wild Boar and Barking Deer preferred Sal forest and mixed forest. Degrading forest, invasion of exotic species in lakes and wildlife disease were the major threats for the ungulates in the study area.

Khadka (2004) observed the highest distribution of ungulate abundance in grassland and flood plain of BNP. Spotted Deer was found to be most abundant and most frequent followed by Wild boar. Spotted Deer highly preferred grassland but riverine forest least preferred by them. Barking Deer was common in dense forest whereas Wild boar preferred wooded grassland forest and dense forest. Highest mean pellet group's abundance of wild ungulates was observed in grassland followed by wooded grassland, mixed forest and riverine forest (Khadka, 2004).

Nagarkoti (2012) observed Spotted Deer and Hog Deer abundant in the riverine forest of the BNP than in the Khata corridor. The pellet of Barking Deer was not recorded in the park. Wild Boar occurred most abundant in the mixed hardwood forest whereas, Spotted Deer evenly distributed across all habitat types. Wild Boar diggings were more frequently recorded in the forest near cultivation and settlement.

Sharma *et al*. (2012) encountered 12 resident Barking Deer, 2 Hog Deer, 23 Samber, 182 Spotted Deer, 3 Rhino and 5 Wild Boar in grassland, forest and wetland of BBZCF. Adult female was observed highest than the adult male in the case of Spotted Deer and Samber. But in the case of Barking Deer, adult male populations were higher than an adult female. Among 3 Rhinos, 1 was an adult female and 1 sub-adult.

Gautam (2013) recorded the high density of spotted Deer and lowest density of Blue Bull in Bardia National Park (BNP). Ungulates most utilised the grassland among the habitats except Blue Bull probably due to the presence of suitable diet in that habitat. Habitat factors determined the distribution and abundance of ungulates. Higher concentration of ungulates pellets was observed in the area close to water resources. As per the pellet, density spotted Deer was observed highest. Both barking Deer and Samber completely avoided the riverine forest. Ungulates showed clumped type of distribution.

Adhikari and Khadka (2009) studied distribution, an abundance of wild ungulates and their link to habitat characteristics at a landscape level conservation at Khata Corridor. Total 2043 wild ungulates were counted within the mean pellet group abundance of 0.75 pellets per plot. Mean pellet group abundance of Spotted Deer, Wild Boar, Monkey, Hog Deer, Barking Deer and Blue Bull were 0.63, 0.06, 0.05, 0.02, 0.00 and 0.00 per plot respectively. Species wise ungulate abundance showed that Barking Deer was highest in low-Density Mixed Forest, Spotted Deer in Grassland, Hog Deer in both Grassland and low-Density Mixed Forest, Blue Bull only in Low-density Mixed Forest, Monkey in riverine Forest and Wooded Grassland, and Wild Boar in Wooded Grassland. Out of four habitat types, flood plains with riverine forest and grasslands were considered important habitats. Distribution pattern of wild ungulate species was of Clumped type ($\frac{S^2}{\bar{X}}$=93.10).

Aryal (2007) estimated that 41 Nilgai were counted in the Lumbini development trust area, where there were ten males, fifteen females and 16 juveniles. The sex ratio of male to female is 2:3 and they were closely associated with farmlands. About 5% of total rice production was damaged by them and 2% was damaged in areas 1-3 km from LDT boundary. Local people used night guarding, fencing and scarecrow to reduce the impact. Disease transmission, Firewood collection and grazing pressure were the threats of Nilgai.

Pokhrel and Thapa (2008) studied distribution, abundance, and habitat preferences of wild ungulates that spotted deer, hog deer, swamp deer, barking deer, wild boar, and blue bull were recorded as main ungulate species occupying the western part of SWR. Spotted deer was more abundantly distributed (2.28 ± 2.23) among all ungulate species whereas blue bull was least abundant (0.002±0.05). The distribution pattern of wild ungulates was clumped type among studied samples.

Lasiwa (1999) studied about population status, habitat mapping of Nilgai and vegetation analysis that total of minimum 52 to maximum 64 animals was estimated to exist in twelve different sub-population groups. The high degree of habitat deterioration both inside and outside the park, illegal hunting, tiger hunting and harassment due to local people in the peripheral area were responsible for the decrease of Nilgai population.

Kharti (1995) identified the combination of high poaching, tiger predation and habitat deterioration as major causes of the decline of Nilgai in RBNP (Royal Bardia National Park).

Subedi (2001) studied status and ecology of Nilgai in Nepal with particular emphasis to Bardia National park. He estimated a minimum 241 and maximum of 388 animals in the whole country and in Parsa Wildlife Reserve (29-35 animals), Bardia National Park (36-54 animals), Suklaphnata Wildlife Reserve (35-47 animals) and about 10-15 in Lumbini garden.

Dinsertein (2003) studied that habitat preferences by Nilgai in Royal Karnali – Bardia Wild Life Reserve is a flood plain, Savana and several riverine forest association integrated with stand of the dominant *Shorea robusta* forest.

Sapkota and Chalise (2015) studied about the population Status of |Spotted deer in Baghmara Buffer Zone community Forest at Chitwan National Park by using direct count method that total 255 individuals of spotted deer were counted with the crude density of 118.6 deer/km2.male to female sex ratio varied seasonally and the largest herd of 41 individuals were observed in summer.

Aryal and Chalise (2013) conducted research in the Arkhale and Nayagaun VDCs in Gulmi district and found that crop raided reported by 64% but the extent of crop damage in variation in the studied VDCs. Maize was a highest preference (53%), followed by wheat (23%), paddy(16%), and others (8%) by the Monkey. The monetary loss of maize occurred highest among another crop.

Bajhracharya (2009) mentioned that in Kabresthali and Sangla VDCs near ShNP during the one year period (2007/2008) crop raided by wild animal caused, a total of 16234 kg of crop loss per annum, maize (8928.5 kg) followed by paddy (2955 kg), wheat (2859.5kg) and Millet (1491kg). The people have positive attitude about wildlife conservation and followed different preventive methods such as overnight guarding, drumming, shouting, and pit construction.

Paudel (2007) conducted research on Chandeshowori and Jhormahankal VDCsof ShNP. About 1303.24 quintals of different crops were lost per annum due to wild animals and the highest amount of paddy and wheat was lost. Besides crop depredation grazing and scarcity for fodder and firewood collection were also the causes for negative interaction between wild animal and local peoples.

Pokhrel and Shah (2008) mentioned that local people suffered from economic loss due to increasing number of the wildlife in the community forest as they damage crops and killed their livestock. The highest depredated livestock and poultry were Goat (33.82%) and Chicken (33.82%) followed by Cattle (19.56%), Pig (8.68%), Buffalo (2.72%) and Sheep (1.36%).

Shrestha (2012) reported that in the Panchakanya community forest adjoining area of ShNP was found that wild animal's causes local farmers lost 270. 27 quintals of different crops per year. Crop lost include 70.40, 49.59, 65.54, 40.17 and 44.57 quintals of paddy, wheat, maize, millet and others respectively. The loss per HHS was 1.14, 0.80, 1.06, 0.65, 0.72 quintals of Paddy, wheat, maize, millet and others. The major crop raided animals were Wild Boar and Deer and loss also done by Monkey and Porcupine.

Bajhgain (2012) reported that in Sundarijal VDCs near ShNP during one year period (2010/2011) the total monetary loss was NRs. 18, 03,982.68. Average per HHS was calculated NRs. 14, 908.95 by the different wild animal. The main pest was Wild Boar followed by Porcupine, Rat, Monkey, Deer, Bear and birds. The total livestock and avian stock were NRs. 293400 (per HHS was NRs. 2446.44 in the same period).

Pandey *et al*. (2015) investigated that crop damage by wildlife in Thanpati Village adjacent to shivapuri Nagarjung National park, Nepal that out of the seven wildlife groups evaluated, they identified Wild boar as the primary crop raider. Approximately US$24,000(9% of the expected profit) were lost to wildlife damage annually, with c. 0.28 km^2 (8% of the farmlands) of crops were damaged.

Regmi and kandel (2008) found that Assamese macaques spoiled more crops than they actually eat; Juveniles and infants damage by playing on the ground. The major crops: maize, potato, wheat, buck wheat, millet and others were found to be raided of which maize cobs were found to be highly preferred (62%) followed by potato tubers (23%). The estimated crop damage was about NRs. 150,000 Per annum with an average of NRs. 2,000 per household. Presence or absence of macaque damage is significantly related to

the distance from the farm from the forest. Therefore the crop-raiding incidents were highly clustered near the forest.

Pant (2013) examined the aspects of human-elephant conflict in the buffer zones of Chitwan National Park and Parsa Wildlife Reserve that property damage (53%) is the most common type of reported damage and crop damage is reported less. There were human casualties, including 21 deaths and 4 serious injuries. 70% of the respondents have the perception about the increment of human-elephant conflict and 37% showed a positive attitude towards elephant conservation.

Awasthi (2014) studied about the human-wildlife conflict in Gaurishankhar conservation area that the total projected value of crop yield losses due to wildlife damage was about Rs.20,70,806 (US$ 21,422.5) during one year period. The maize and potato crops were suffered from maximum damage which is contributed to 38.9% and 29.6% of the total loss. Major wildlife animals responsible for crop damage were monkey followed by Porcupine, Ghoral, Barking Deer, Jackal and Bear. The perception relative to wildlife conservation was found to be negative and people had started different mitigation measures.

3. MATERIALS AND METHODS

3.1 The Study Area

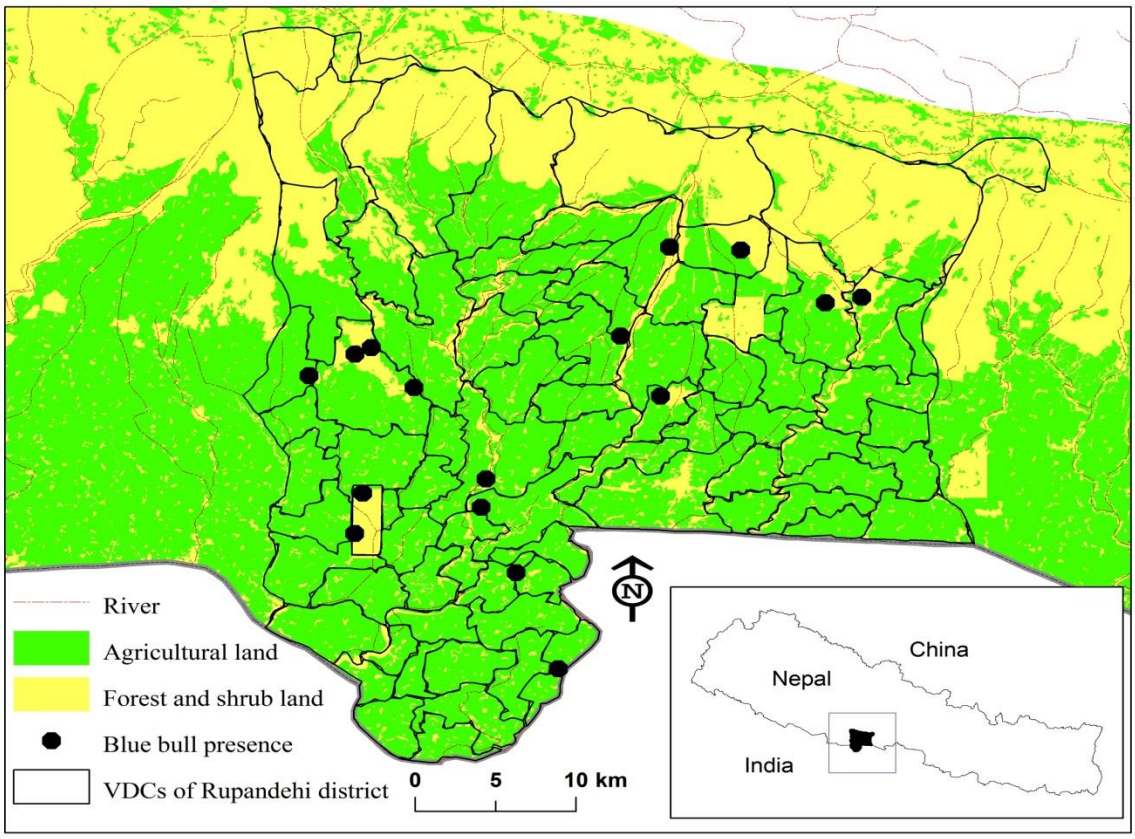

Figure 1:- Map Showing Distribution of Nilgai within Rupandehi District

3.1.1 Rupandehi District

Rupandehi district is one of the 75 districts which lies in terai region of Nepal and covers an area of 1,360 km^2. It's headquarter is Bhairawaha (Siddharthanagar). Geographically, Rupandehi district lies at longitude 83º 12'16''east to 83º 38'16" east and latitude 27 º 20'00" north to 27 º 47'25" north with the borders Nawalparasi in the East, Kapilbastu in the West, Palpa District in the North and India in the South. The altitude of Rupandehi district is 100m to 1229 m from the South Sea. The total area of the district is 1360 sq.km. Politically. Rupandehi district is divided into one sub-metropolitan, five municipality and 48 VDCs. The population of Rupandehi was 880,196 (male= 432,193 and female= 448,003) and total household was 163,916 (CBS, 2011).

3.1.2 Location and Physiological Feature

Rupandehi district lies on the southern and western pert of Nepal. On the east it shares border with Nawalparasi district, on the north with palpa district and on the south with India. The elevation of the district lies between 100m to 1229m from sea-level. The total area of the district is 1,360 km^2 with 16.1% in Churia Range and rest in the terai region.

3.1.3 Climate

Rupandehi district experience tropical sub-tropical type of climate according to the altitudinal variation. The temperature fluctuates from season to season. Temperature in Bhairawaha fluctuates from 7.10ºC (in January) to 40.20 ºC (in May) based on DHM temperature records for the past 30 years. December, January and February are the coldest months i.e. the minimum temperature ranges from 7.10 ºC to 10.50 ºC and the maximum temperature ranges from 21.26 ºC and 27.9 ºC during these months. April, May and June is the hottest months.

3.1.4 Land Use

In Rupandehi, 87.37% of land is agriculture, forests, and pastures and more those 10% of land is allocated for other purposes including residential and real state. All of the 85,122 hector of cultivable land is khet (low-land) and is under cultivation. 56% (3387.80 hector) of the cultivable land is seasonally irrigated, only 3.98% of the land is covered by year round irrigation, and the rest (34067.20 hector) is rain-fed. Irrigation facilities and infrastructures in the district is mostly developed (District Profile, 2014/15).

Forest cover 21.56% (30484 hector) of the district. The major timbers were Sal, Khyar, Satisal, Jamun, Karma, Sankhu, Teak, Bombax, Marmelos, Tooni, RaajBrikshya, Botadhyaro, Sirish, Kadam, Saaj, Fadiyar, Sisaun, Chanp and Sahadavan. Non-timber forest products are Harro, Barro, Bijayasal, Khajurpatta, Naagbeli, Sarpagandha, tejpaat, Eucalyptus and Bojho. Forest area in this district is declining; the district lost 6,000 hector of forest in last 21 years. Currently 49 community forests groups are active in the district (District profile, 2014/15).

3.1.5 Water Resources

Major rivers of the Rupandehi districts are Tinau, Rohini, Daanav, Kothi, Mahav, Baghela, Danda, Ghagara and Koyilijhang. Currently, more than 180 Km of irrigation channels provide irrigation facilities to 13406 hector of total land in 25 VDCs (District Profile, 2014/15).

3.1.6 Agriculture

Agriculture is mostly developed in Rupandehi district. It is a food surplus district. Cereal production in the district was 0.4 million tons in 2012-2013 (District Report, 2012/13) while the requirement for the year was estimated at 0.16 million tons. Rupandehi produced the highest amount of rice in 2011 sharing 15.7% of total production of the country. According to the (District Report, 2014/15), the district is ranked in the third position in average rice production for 5 years.

The major crops produced in the district are paddy, wheat, corn and finger millet and pulses. Among horticulture crops, the major fruits are mango, banana, litchi, jackfruit and the major vegetables are onion, potatoes, cabbage, cauliflower, tomatoes, radish,

cucumber, bottle gourds and pumpkin. In addition to that, some spices and condiments are grown in the district such as turmeric, chilli and garlic. Tulsi is the major herb of the district.

3.1.7 Human Settlement in Study Area

The total population of Rupandehi district with in 17 Illaka, one sub- metropolitan, five municipalities and 48 VDCs within their 163,916 households was 880,196 whereas the male population is 432,193 and female population is 448,003 (CBS, 2011). Tharus are the major ethnic group of the studied area. Mainly, Brahmin, Kshetry, Gurung, Magar, Kami, Damai, Lodh, Yadhav, Gupta, Kewat, Harijan etc. are settled. They follow Hinduism, Buddhism, Muslim and Christian religion.

3.2 Materials

- Measuring Tape
- GPS (Global Positioning System)
- Binocular
- Camera
- Questionnaire

3.3 Methods

3.3.1. Preliminary field Survey

Prior to detail ecological and socio-economic survey, a preliminary field visit was carried out. In this regard, information was generated through local people by direct interview, seminar discussion and direct observation of their livelihood activities. The survey was made during the first week of March, 2016 and investigated the core research sites, general location, distribution and major conflicted areas. The field was surveyed by vehicular travelling and trekking.

3.3.2 Field Survey

The detail field survey was initiated from 23 Falgun to 30 Chaitra, 2073 (i.e: 6March, 2016 to 12 April, 2016).

3.3.3 Data collection

The study was based on the primary and secondary data collection. The primary data were collected through line transect method along the population distribution and through household questionnaire survey for the Human-Nilgai Conflicted areas.

3.3.3.1 Primary Data collection

The primary data collection followed following procedure:

3.3.3.1.1 Population Status of Nilgai

The preliminary survey conducted throughout the district suggested that 38 locations were reported as most affected areas in different part of the district.ForPopulation status of Nilgai probable location of Nilgai habitat areas was found by preliminary survey throughout the Rupandehi district. Line transect method was used as the tool for finding out the population of Nilgai. Altogether 38 line transects were made ranging from 500m to 3000m which covers main Nilgai habitat areas. The main habitats were categorised as: (i) Grassland, (ii) Community forest, (iii) Riverine forest and, (iv) Cultivated land.

Nilgai was observed based on head count were recorded with their sex on either side of transects. To reduce biases in the recorded data, I took help of local people for counting of the population of Nilgai. Before counting the population of Nilgai, 43 local people were trained/ Mobilised about the counting method to cover the whole study area. Among 38 line transect, two transects were made in grassland habitat, 13 were in community forest, 14 were in the riverine forest and nine were made in cultivated land.

The Global positioning system (GPS) coordinate of the location of Nilgai was recorded and a prepare distribution map was created on the basis of these GPS points. The population count was done at 7am to 9am at morning and 4pm to 6pm at evening on 9April 2016 on Saturday.

3.3.3.1.2Distribution Pattern of Nilgai

Distribution pattern of Nilgai among 38 studied samples was analysed by calculating ratio of variance and mean value ($\frac{S^2}{\overline{X}}$) (Odum, 1996) as follows:

If $\frac{S^2}{\overline{X}} = 1$, it refers random distribution of Nilgai in Rupandehi district.

If $\frac{S^2}{\overline{X}} < 1$, it refers regular distribution of Nilgai in Rupandehi district.

If $\frac{S^2}{\overline{X}} > 1$, it refers clumped distribution of Nilgai in Rupandehi district.

Where; $S^2 = Variance = \frac{1}{n}\sum(X - \overline{X})$ $with\overline{X}$ = mean value.

Chi-square contingency test was used to find out significance difference in distribution of Nilgai in different studied samples.

Chi-square $(\chi^2) = \sum\frac{(O-E)}{E}$

Where, O = Observed value and E = Expected value.

3.3.3.1.3 Household Questionnaire Survey for Human-Nilgai conflict

A set of questionnaires were developed to collect data from the local community of the conflicted areas. The majorities of questions were in multiple-choice form, and were

verified by the supervisor to make them suitable for the field situation. The questionnaire survey was used to collect status of Human-Nilgai conflict in the study area and crop depredation which causes economic losses to the local communities. And also used to gather information of perception of local people towards Nilgai conservation, Mitigation measures and threats.

Household questionnaire surveys were conducted to gathered information about Human-Nilgai conflict in the Rupandehi district during the time of field survey.

3.3.3.1.4 Key Informant Survey

Key person interviews were conducted exclusively with those who were available during the household survey. The interviews were conducted to know the status of Human – Nilgai conflict in their area, their role in Human-Nilgai conflict mitigation and to know the causes of conflict. Questionnaire regarding the status of conflict, causes of conflict, conflict management, were used and their role in conflict management especially for local teachers, Students and local politician's interviews were conducted.

3.3.3.1.5 Focal Group Discussion

During the field survey, focus group discussions were organized forming two focus group at the LDT Staff's at Lumbini Cultural Municipality and District forest office at Bhairawaha. The main objective of the group discussion was to collect varieties of information regarding the status of Nilgai and its conflict. Also for verification of the information collected from the questionnaire survey and discussion about the livelihood strategies.

3.3.3.1.6 Direct Observation

Crop depredation by Nilgai was assessed through direct observation and the household survey.

3.3.3.2 Secondary Data Collection

The secondary data were collected through different literatures and journals, reports and dissertation works. For general information data were collected through different relevant institutions like WWF, NTNC, DNPWC, CDZ and the population status of people was obtained from the CBS. For this research, different website was consulted and the important document related to Nilgai was downloaded from the internet. Different researcher were contacted and various fact related to Nilgai were collected and noted.

3.3.4 Sampling of Household Survey

Of the three Municipalities and VDCs of Rupandehi district, three Municipalities and 11 VDCs were selected according to their conflicted level. Among these, two Municipality and three VDCs were selected as highly conflicted areas and one Municipality and eight VDCs were selected as low conflicted areas. The areas were selected according to their conflicted level. From these Municipalities/VDCs, approximately 10% of the total

households were chosen using a random selection process. These numbers were later selected using random number table. The lists of households were achieved from CBS (2011) and their respective Municipalities/VDCs. The total numbers of households selected by random selection process in each Municipality/VDC are represented in the following table:-

Table 1:- Household Sampling

S.N.	Municipality/VDC	Sampled HH Number	Total HHs	Sampling intensity (%)
1	Gonaha-4	26	269	9.66
2	Kamahariya -5	41	412	9.95
3	Bishnupura-4	38	367	10.35
4	Tilottama Municipality-2	53	1950 (only 528 HH are Agrarian)	10.03
5	Lumbini Cultural Municiality-7	68	672	10.11
6	Butwal sub-metropolitan-19	20	948(only 189 HH are Agrarian)	10.58
7	Sau-pharsatikar-3	20	186	10.75
8	Paschim Amuwa-1	17	146	11.64
9	Mainaiya-6	13	122	10.65
10	Bagauli-4	16	158	10.12
11	Bogadi-1	22	216	10.18
12	Bairghat-8	8	79	10.12
13	Suryapura-4	13	129	10.07
14	Rudrapur-2	33	330	10
	Total	388	3803	10.20

Geographically, 26(6.7%) respondents from Gonaha, 41 (10.56%) respondents from Kamahariya, 38 (9.79%) from Bishnupura, 53 (13.65%) from Tilottama, 68 (17.52%) from lumbini cultural municipality, 20 (5.15%) from Butwal sub-metropolitan,20 (5.15%) from Sau-pharsatikar, 17 (4.38%) from P-Amuwa, 13 (3.35%) from Mainaiya, 16 (4.12%) from Bagauli, 22 (5.67%) from Bogadi, 8 (2.06%) from Bairghat, 13 (3.35%) from Suryapura and 33 (8.5%) from Rudrapur were included.

Table 2:- Age Wise Distribution of Respondents

Age group	No. of respondents	Percent
16-25	15	3.9
26-35	45	11.6
36-45	**115**	**29.6**
46-55	109	28.1
56-65	74	19.1
66-75	30	7.7

3.3.5 Data Analysis

The quantitative data obtained from the field was first coded, then the data entry process was done using an appropriate computer package, namely "Statistical Package for Social Sciences (SPSS)", which facilitates the process of data analysis in a more precise and appropriate way (SPSS, Version 20). Simple statistics such as percentage and frequency count were used to analyse the data gathered from the household survey. Microsoft Excel was also used. The data was presented in a descriptive form as well as in a suitable table, pie chart and tabular form.

Crop loss calculation:

To find out per household loss in kg:

$$\text{Per household loss in Kg} = \frac{\text{Total loss of crop in kg}}{\text{Total number of surveyed household}}$$

$$\text{Per household loss in NRs} = \frac{\text{Total loss of crop in NRs}}{\text{Total number of surveyed household}}$$

The economic values were calculated on the basis of the local market rate of crops. One way ANOVA test was conducted to find out the relation between crop loss and frequency of Nilgai visit. Pearson Chi-square test was used to find out the perception of people towards Nilgai conservation. Results were presented in bar diagrams, frequency tables and pie charts.

4. RESULTS

4.1 Population status and Distribution of Nilgai

4.1.1 Population Status of Nilgai

The study area was categorised into 38 sampling areas for the generalisation and to make easier for the data collection. Transects were kept according to their potential habitats (Table 3). Therefore relying on those characteristics we could make out 38 different line transects ranging from 500m-3000m. Among 38 different studied samples, Nilgai was found only in 16 studied sampling areas. Total 303 Nilgai population were found in those studied samples. Among them 90 were male, 111 were female and 102 were calves. Out of these sampling areas, Bishnupura VDC has the highest Nilgai population and Bairghat VDC has the lowest population of Nilgai during the observation period.

Table 3:- Number of Nilgai and Their Calves

S.N.	Sampled area	Male	Female	Calves	Total	Habitat Types
1	Inside LDT(behind stupa)	16	14	10	40	Grassland
2	Inside LDT (near Korean temple)	9	6	7	22	Community forest
3	Kamahariya VDC	5	10	9	24	Cultivated land
4	Suryapura VDC	2	4	-	6	Riverine forest
5	Gonaha VDC	9	6	12	27	Cultivated land
6	Bishnupura(I) VDC	5	11	10	26	Riverine forest
7	Bishnupura(II) VDC Jungle	18	13	14	45	Community forest
8	Rudrapur VDC	2	4	1	7	Community forest
9	Bairghat VDC	-	1	2	3	Cultivated land
10	Bagauli VDC	2	9	6	17	Cultivated land
11	Paschim Amuwa VDC	3	5	6	14	Riverine forest
12	Butwal Sub- metropolitan	4	7	7	18	Riverine forest
13	Tilottama(I) Municipality	6	7	8	21	Community forest
14	Tilottama (II) Municipality	5	5	6	16	Riverine forest
15	Devdaha Municipality	1	4	-	5	Riverine forest
16	Chiliya VDC	3	5	4	12	Community forest
	Total	90	111	102	303	
	Percentage	29.70%	36.63%	33.66%	100%	

The proportions of male, female and calves were 29.70 %, 36.63% and 33.66% respectively. The male to female sex ratio was found to be 81: 100.According to above table, the population of Nilgai, which was observed in different studied sample area is shown inFigure 2, which explains the distributions of Nilgai by sexes together with the calves. The sex of male and female was distinguished whereas the sexes of calves were can not be identified.

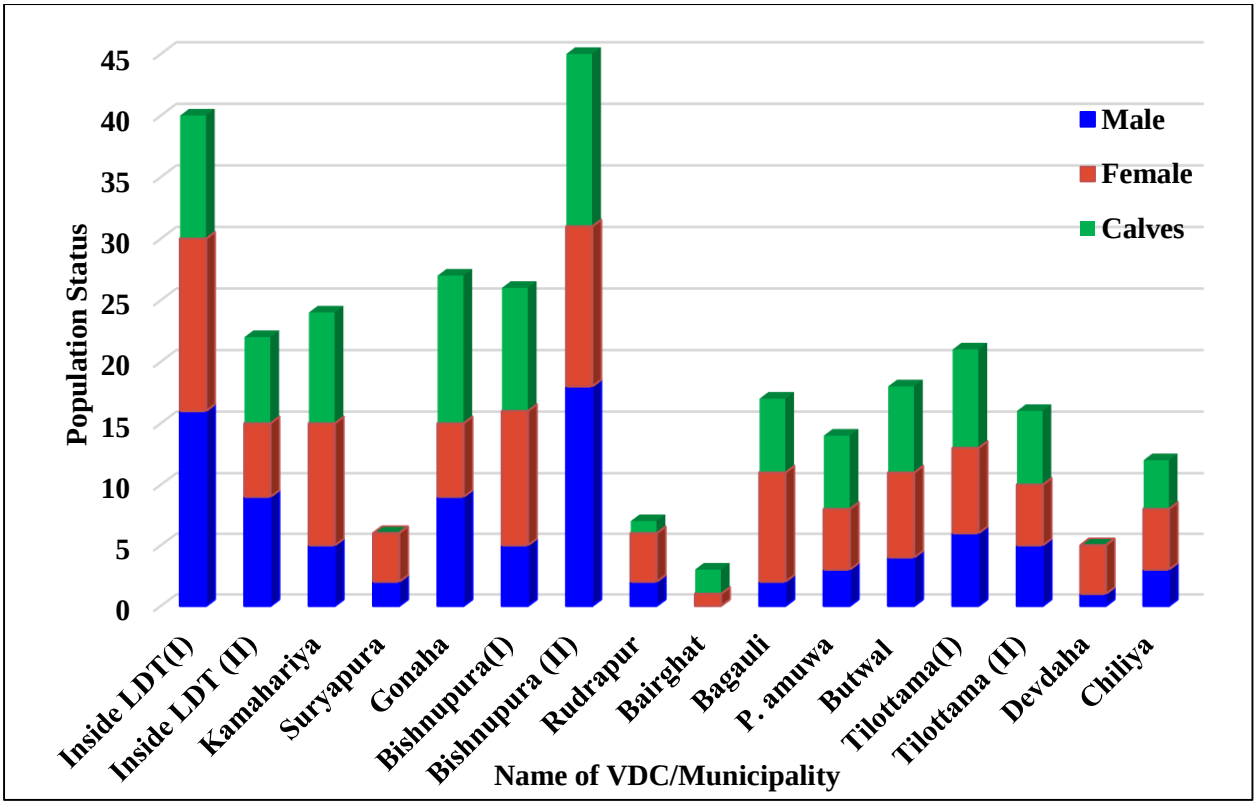

Figure 2:- Population Status of Nilgai

4.1.2 Distribution of Nilgai

4.1.2.1 Distribution Pattern of Nilgai

A total of 303 individuals of Nilgai were observed from 16 different studied sample area of different locations during the field visit. Only one studied sample area was grassland, five were community forest, six were Riverine forest and four were cultivated areas. Among them, highest numbers of individuals were recorded from the Bishnupura VDC and the lowest in Bairghat.

The variance to mean ratio was used to determine the distribution pattern of Nilgai among 38 different studied sample areas. The calculated value of variance to mean ratio was found to be 18.45. Since the value of $\frac{S^2}{\bar{X}} > 1$, the result has shown clumped or uneven type of distribution of Nilgai in Rupandehi district.s

Chi-square test was used to test the significance difference between distributions of Nilgai in the different studied sample area. Thus, this study reveals that the difference between the distribution of Nilgai with different studied areas was insignificant i.e. ($\chi 2$= 38.0, df = 37 and p = 0.424).

Among 16 studied sample area, Nilgai utilised different habitats which are presented in Table 4.

Table 4:- Habitat Used by Nilgai

S.N.	Habitat type	Total population
1	Grassland	40
2	Community forest	107
3	Riverine forest	85
4	Cultivated land	71

Pearson chi-square test revealed that there were significance differences between distribution of Nilgai and community forest habitat ($\chi 2$= 7.91, df = 1, p = 0.005), Riverine forest habitat ($\chi 2$= 9.79, df = 1, p = 0.002) and cultivated land ($\chi 2$= 6.14, df = 1, p = 0.01) whereas there was no significant difference between distribution of Nilgai and grassland habitat ($\chi 2$= 1.41, df = 1, p = 0.23).

4.1.2.2 Herd Size

Nilgai was usually found in herds or groups. This study observed frequent changes in composition. During the survey period through line transect method, 16 sub-groups of the population were observed, herd size ranging from three to seventeen individuals. The mean herd size is 5.61animals per herd. The largest herd size was found in Bishnupura community forest of Bishnupura VDC and lowest herd size was found in Bairghat VDC (Table 5).

Table 5:- Group Composition (Herd Size)

S.N.	Sampled area	Total	Herd/Group
1	Inside LDT(behind stupa)	40	4
2	Inside LDT (near Korean temple)	22	3
3	Kamahariya	24	4
4	Suryapura	6	2
5	Gonaha	27	5
6	Bishnupura(I)	26	4
7	Bishnupura (II) Jungle	45	3
8	Rudrapur	7	2
9	Bairghat	3	1
10	Bagauli	17	3
11	Paschim Amuwa	14	5
12	Butwal (Motipur)	18	5
13	Tilottama(I)	21	2
14	Tilottama (II)	16	6
15	Devdaha	5	3
16	Chiliya	12	2
	Total	303	54
	Percentage	100%	

4.2 Conflict of Nilgai with Human due to Crop Depredation

4.2.1 Characters of Respondents:-

Out of total 388 household heads interviewed, 300(77.3%) were male and 88(22.7%) were female. The mean age of respondents was 47.87 (n=388, SD=12.194) and the

youngest and the oldest respondents were 16 and 75 years respectively. They include 23.7% of Janjati, 17% of Dalit and 59.3% of others. Magar, Gurung, Newar and Tharu were included in Janjati. Bishowkarma, Harijan, and Lodh were included in Dalit whereas Brahmin, Kshettry, Muslim were included in others. The main occupation of the respondents was agriculture (73.2%), teaching (7.2%), government job (3.9%), business (9.0%) and Daily wage labour (6.7%). The total agricultural land of those families was 169,182,820hectare among them all of them had their own land. The different types of crops that they had grown were Paddy, Wheat, Maize, Pulses, vegetables and others. Others crops include Banana, sugarcane and peanut. The VDC/Municipality wise crops cultivation are listed in table below (Table 6):

Table 6:- VDC/Municipality Wise Crops Cultivation

VDC/Municipality	**Crops Cultivated**
Gonaha	Paddy, Wheat, Mustard, Pulses and Vegetables
Kamahariya	Paddy, Wheat, Mustard, Pulses, Vegetables and Peanut.
Bishnupura	Paddy, Wheat, Mustard, Vegetables, Peanut and Sugarcane
Tilottama	Paddy, Wheat, Maize, Mustard and Vegetables
Lumbini	Paddy, Wheat, Maize, Mustard, Vegetables and Peanut
Butwal	Paddy, Wheat, Maize, Mustard ,Banana and Vegetables
Sau-pharsatikar	Paddy, Wheat, Maize, Mustard and Vegetables
Amuwa	Paddy, Wheat, Mustard, Vegetables, Peanut and Banana
Mainaiya	Paddy, Wheat, Maize, Mustard, Vegetables and Banana
Bagauli	Paddy, Wheat, Maize, Mustard, Peanut and Vegetables
Bogadi	Paddy, Wheat, Maize, Mustard and Vegetables
Bairghat	Paddy, Wheat, Maize, Mustard and Vegetables
Suryapura	Paddy, Wheat, Maize, Mustard, Vegetables and Sugarcane
Rudrapur	Paddy, Wheat, Maize, Mustard and Vegetables

About 34.7% of respondents have practice about mix cropping .The mix cropping crops were wheat and mustard (20.9%) and potato and coriander (13.9%). According to respondents all of them were not getting full production from their land. The main cause of them that they were not getting full production was the crop depredation by Nilgai. Nilgai was the main crop raider in the Rupandehi district. Almost all season Nilgai visit their farm.

4.2.2 Frequency of Nilgai visit

Figure 3 reflects that, among 388 respondents, 63 (16.2%) said that Nilgai visit every day, 124 (32.0%) said that Nilgai visit once a week, 97 (25.0%) said that Nilgai visit twice a week, 104 (26.8%) said that Nilgai visit occasionally and nobody answered that Nilgai

never visits on their farm. In addition, Figure 4 shows the time of visit and its presence in the field. Among all respondents, 202 (52.1%) answered that the presence of Nilgai in the field at the night, 70 (18.0%) answered at evening, 65 (16.8%) answered at morning and 51 (13.1%) answered that Nilgai present in the field at day time.

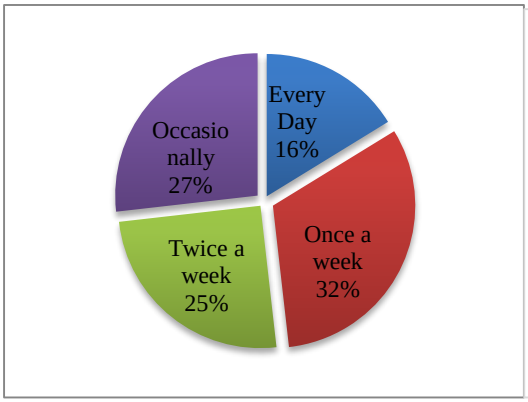

Figure 3:- Frequency of Nilgai Visit the the basis of repetition.

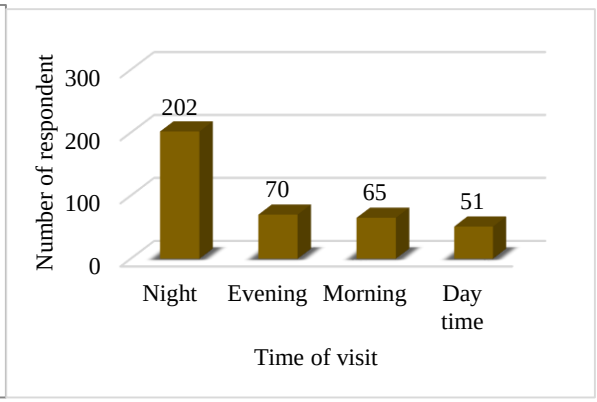

Figure 4:- Frequency of Nilgai visit on the basis of time.

4.2.3 Crop Damage

In my field work, it was found that there were two growing seasons 'summer and winter'. Summer season included from (Jestha to Ashoj) and winter season from (Kartik to Chaitra) months. The summer crops included paddy and vegetables. Winter crops include wheat, maize, mustard, vegetables, and pulses and peanut. Sugarcane and banana were also planted in the summer season and they need one year to grow. According to respondents, it was found that Nilgai damage crops in both seasons when the cropping was in the field in all stage of crops. Damage to different crops was caused not only by foraging but also trampling, resting and daily movements of animals. Damages also created severe conflicts and led to a substantial economic loss for the community.

Through questionnaire survey, 203 (52.3%) respondents answered that they identified the damage made by Nilgai through observation, 66 (17.0%) answered by watching directly, 51 (13.1%) by their dung and 68 (17.5%) by pugmark (Figure 5)

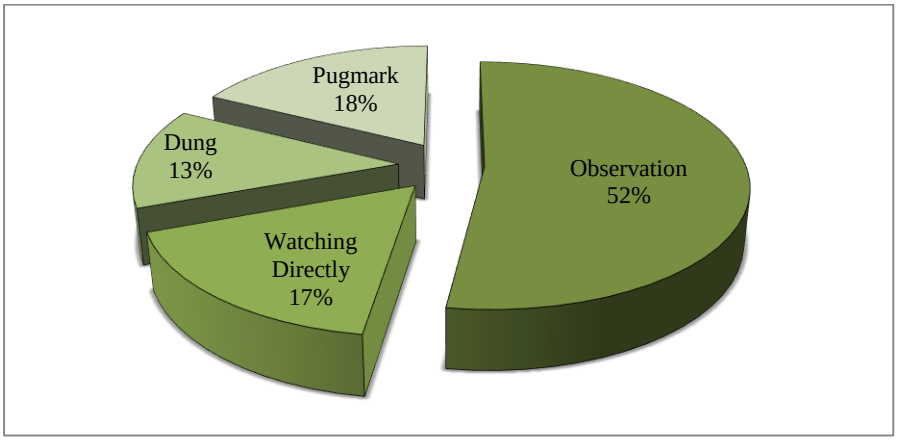

Figure 5:- Identification of Crop Damage by Nilgai

4.2.3.1 Status of Crop Damage in Rupandehi

More than two third 260 (67.0%) replied the crop damage was increased, 60 (15.5%) mentioned that crop damage was decreased and 68 (17.5%) did not know about the status of crop damage (Table 7).

Table 7:- Status of Crop Damage

Status	Number (N)	Percent (%)
Increased	260	67.0
Decreased	60	15.5
Don't know	68	17.5

4.2.3.2 Preference of Crops by Nilgai

Nearly half 186 (47.9%) respondents reported that that Nilgai prefer vegetables, 53 (13.7%) wheat, 51 (13.1%) maize, 48 (12.4%) mustard, 29 (7.5%) paddy and 21 (5.4%) pulses (Figure 6).

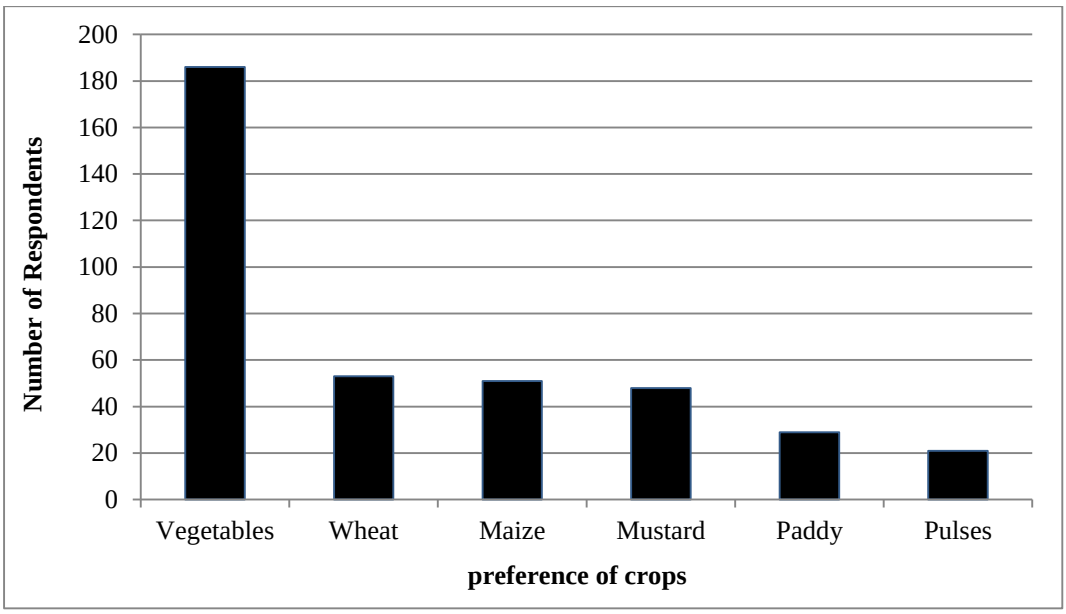

Figure 6:- Preference of Different Crops

4.2.3.3 Quantitative Description of the Crop Damage in Different VDC/Municipality

The total damage of crop loss in the study area was equivalent to NRs1, 76, 49,996 (US$ 1, 66501.075). The average household income and loss in the study area was NRs 3, 33,775.412(US$ 3,148.667) and NRs 45,489.680 (US$ 429.126) respectively (Table 8).

Table 8:- Total Crop Loss, Average, Range and Standard Deviation in Monetary Value (US Dollar)

Damage Type	**Loss (US$)**	**Mean**	**Range**	**SD**	**Maximum**	**Minimum**
Crop damage	166501.075	429.126	2374.069	368.170	2415.904	41.835

1 US$= 106.0053 NRs (Dated 20th April 2016)

Table 9 indicates that the maximum damage to vegetables was approximately NRs. 65, 430, 97 (US$ 61,724.244) per annum.Whereas, average annual loss of total crops in the study area was equal to approximately NRs. 17,649,996.38 (US$ 166,501.075). Similarly, wheat, maize, mustard, vegetables and other crops were depredated by Nilgai (Table 9).

Table 9: Average crop damage in kg and monetary value of damage per year to different crops.

S. N.	**Name of the crop**	**Harvested (kg)**	**Damage (kg)**	**Damage (NRs)**	**Damage (US$)**	**% of crops damage**
1	Paddy	12,61,978	1,47,171	4,194,374	39567.586	23.76
2	Wheat	4,50,607	79,819	18,35,884	17318.417	10.40
3	Maize	44,159	12,249	4,89,966	4622.089	2.776
4	Mustard	1,50,505	26,256	26,25,623	24768.790	14.876
5	Vegetables	20,96,145	2,93,434	65,43,097	61724.246	37.071
6	Pulses	88,433	19,674	13,92,314	13134.385	7.888
7	Others	17,88,156	58,007	5,68,778	5365.561	3.222
	Total	**5,879,983**	**6,36,610**	**17,649,996.38**	**166501.074**	**100**

Among different crops damaged by Nilgai, vegetables have become the prominent crop among fourteen different VDCs/Municipality. Both Lumbini Cultural Municipality and Kamahariya VDC suffers from both vegetable damage of 91034 kg per annum and 65144 Kg per annum respectively (Figure 7).

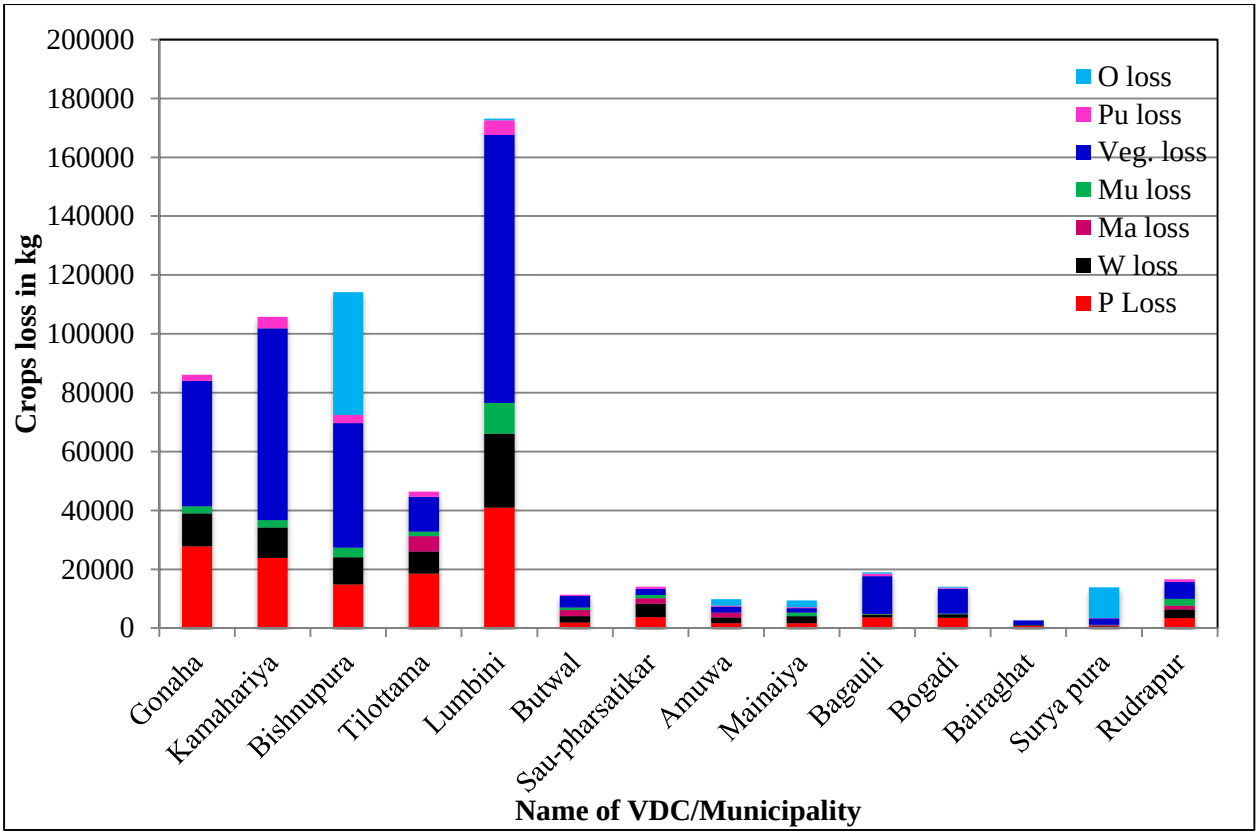

Figure 7:- Comparison of Mean Damage of Different Crops (kg)

Similarly, the Lumbini cultural municipality had the highest monetary loss of crop of NRs. 4,856,232 (US$ 45,811.219) and Bairghat VDC had the lowest crop damage of NRs. 82,693 (US$ 780.084). The average monetary loss of different crop varieties per household per annum in the study area was NRs.45, 489.681(US$ 429.126) (Figure 8).

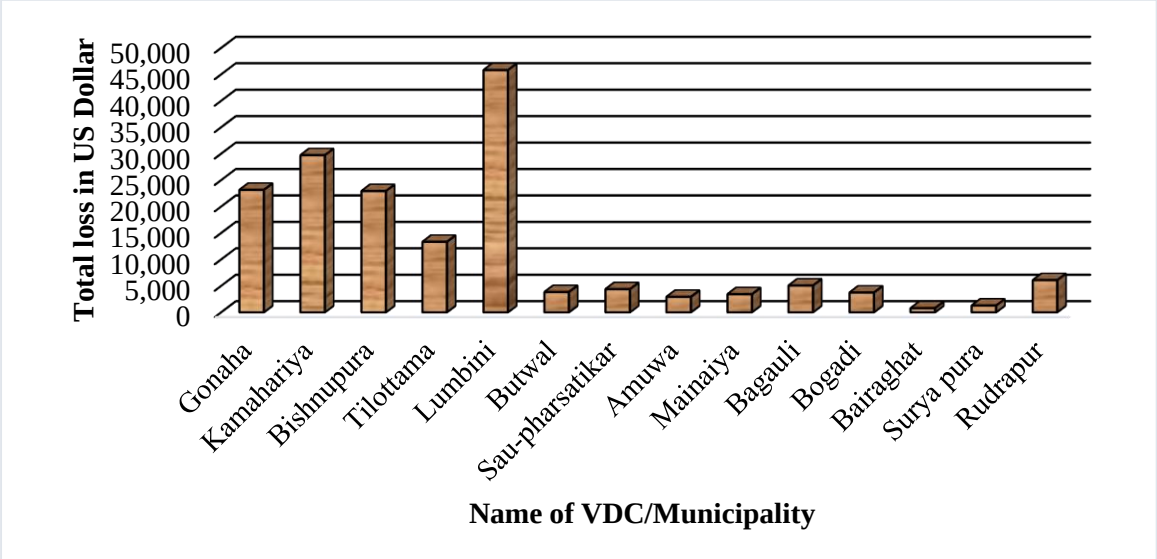

Figure 8:- Monetary Value of Different Crop Loss (in US$)

Likewise, Gonaha VDC has the highest crop loss per household in kilogramme (kg) (3,309.653 kg/household) and Bhairghat VDC had the lowest crop loss per household in kg (345.75 kg/household) (Figure 9).

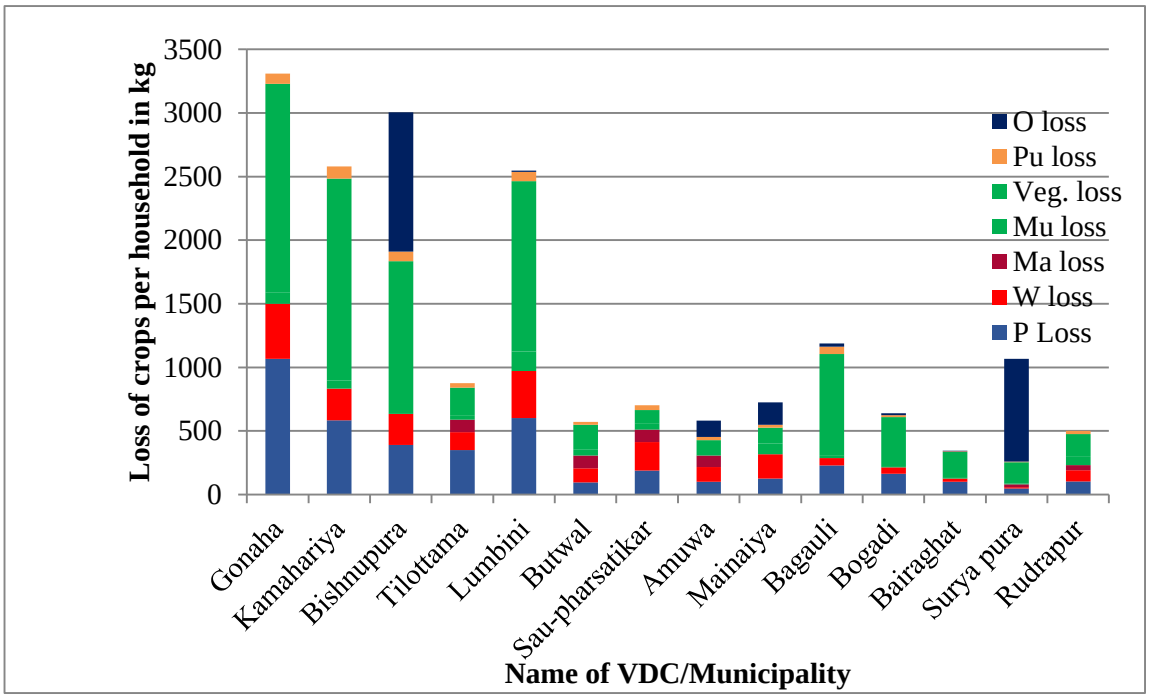

Figure 9:- Per House Hold Average Loss of Different Crops

Moreover, Gonaha VDC had the highest household crop loss per hector of different crops worth NRs 63487.637(US$ 598.910) per annum. The Suryapura VDC had lowest household crop loss per hector of different crops of NRs 17436.776(US$164.489) per annum (Figure 10).

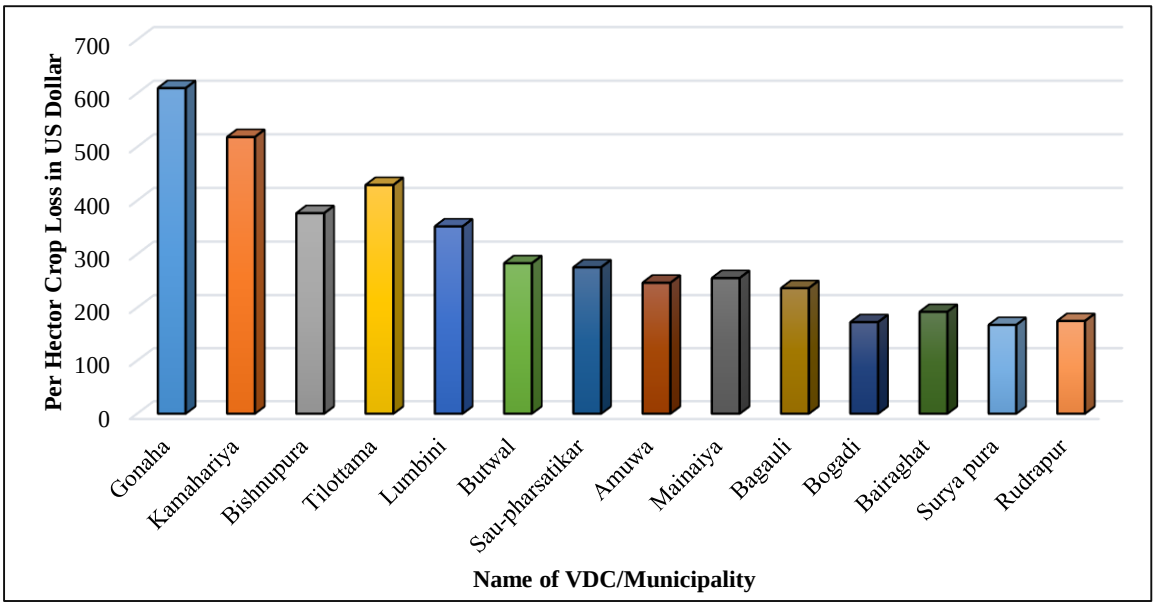

Figure 10:- House Hold Crop Loss per Hector (in US$)

4.2.4 Association of crop loss and frequency of Nilgai visit using ANOVA test

The frequency of Nilgai visit was classified into four categories depending upon their visit. A one way between-group analysis of variance was conducted at alpha =0.05 to explore the impact of Nilgai visit on total crop loss. Descriptive statistics for each visit is found in Table 10.There was a significant difference between crop loss (NRs) among different visits of Nilgai ($F_{3,384}$= 33.838, p< 0.05).

Table 10:- Descriptive statistics for one-way ANOVA for differences in total crop loss at a frequency of Nilgai visit.

Frequency of Nilgai visit	No. of respondents (N)	Mean	Standard deviation	Minimum	Maximum
Everyday	63	67791.720	42223.751	8051.401	256098.618
Once a week	124	36047.898	33712.898	4434.770	161028.021
Twice a week	97	65373.054	43841.520	8051.401	181815.992
Occasionally	104	24692.234	16749.849	4932.300	89314.892

4.3 Perception of local people towards Nilgai Conservation and level of tolerance

4.3.1 Perception of local people towards Nilgai conservation

The respondents demonstrated negative thinking about Nilgai conservation, the majority of respondents 298 (76.8%) did not like Nilgai and wanted to eradicate, while 90 (23.2%) like Nilgai (Figure 11). It meant they were negative towards Nilgai conservation. There was the high degree increased in the presence of Nilgai in the community forest.

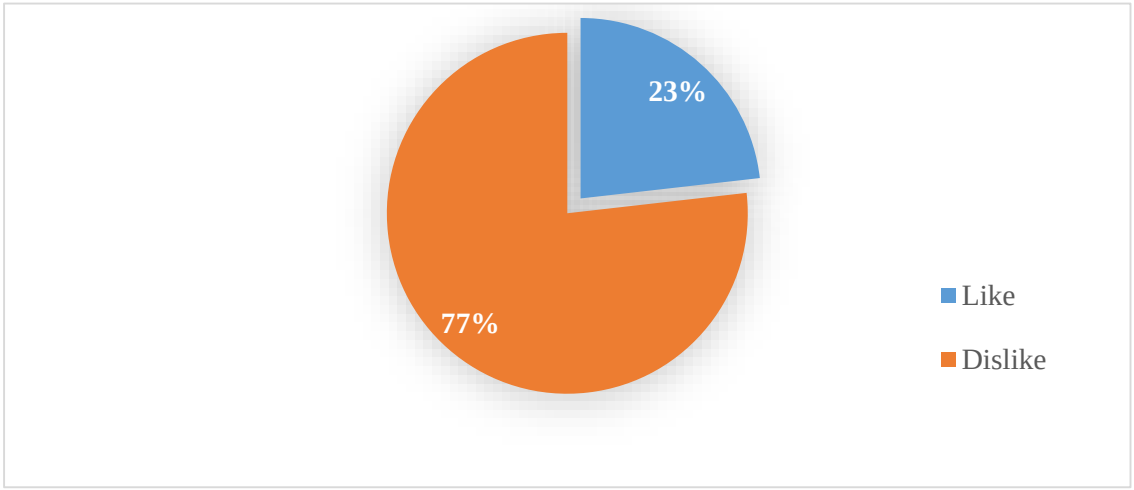

Figure 11:- Nilgai liked/Disliked (N=388)

It showed that majority of people didn't like Nilgai. Perception of local people towards Nilgai conservation according to sex, age, education and occupation were not statistically significant (Table 11).

Table 11:- Perception of Local People towards Nilgai Conservation

Factors	Like (N%)	Dislike (N%)	Statistical analysis
Sex			
Male	75 (83.3%)	225 (75.5%)	$\chi 2$=2.417, df= 1, P = 0.120
Female	15 (16.7%)	73 (24.5%)	
Age			
15-25	1 (1.1%)	14 (4.7%)	$\chi 2$= 2.597, df=1, P= 0.273
26-45	40 (44.4%)	120 (40.3%)	
45 above	49 (54.4%)	164 (55.0%)	
Education			
No education	28(31.1%)	95(31.9%)	$\chi 2$= 2.355, df=3, P= 0.502
Primary	18(20.0%)	54(18.1%)	
Secondary	26(28.9%)	69(23.2%)	
Higher secondary	18(20.0%)	80 (26.8%)	
Occupation			
Agriculture	70(77.8%)	214(71.8%)	$\chi 2$=2.405, df= 4, P= 0.662
Teaching	4(4.4%)	24(8.1%)	
Government job	4(4.4%)	11(3.7%)	
Business	6(6.7%)	29(9.7%)	
Daily wage labour	6(6.7%)	20 (6.7%)	

There were different reasons for local people favour to Nilgai. Among 90 respondents, 56 (62.22%) answered that Nilgai is of religious value, 16 (17.77%) replied that they help in revenue and jobs through eco-tourism, 15 (16.66%) answered that they had an ecological value and their presence indicated as to maintain ecosystem, 3 (3.33%) answered that they were beautiful species and they liked to conserve Nilgai(Figure 12).

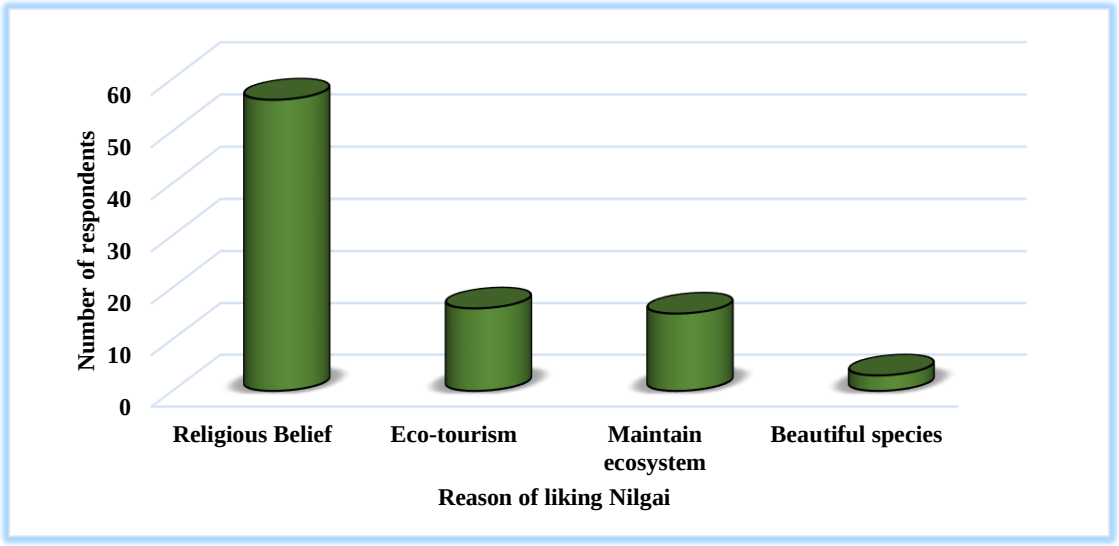

Figure 12:- Reason of Liking Nilgai (N=90)

Out of 388 respondents, 298(76.8%) respondents replied that they didn't like Nilgai. The reason of disliking Nilgai was that they damaged crops of their agricultural land.

4.3.2 Attitude of local people for Human-Nilgai coexistence in this area

According to the questionnaire survey, among 388 respondents, 301(77.6%) people were not in favour of Human-Nilgai coexistence in the same area but 87(22.4%) were in favour of Human-Nilgai coexistence in the same area. The difference between the attitude of local people for Human-Nilgai coexistence with sex, age, education and occupation of the local people were not statistically significant (Table 12).

Table 12: - Attitude of Local People for Human-Nilgai Coexistence in the Same Area.

Factors	**Yes (N%)**	**No (N%)**	**Statistical analysis**
Sex			
Male	70(80.5%)	230(76.4%)	$\chi 2$= 0.631, df=1, P = 0.427
Female	17(19.5%)	71(23.6%)	
Age			
15-25	1 (1.1%)	14 (4.7%)	$\chi 2$= 2.277, df=1, P= 0.320
26-45	36(41.4%)	124(41.2%)	
45 above	50(57.5%)	163(54.2%)	
Education			
No education	27(31.1%)	96(31.9%)	$\chi 2$= 1.828, df=3,P= 0.609
Primary	17(19.5%)	55(18.3%)	
Secondary	25(28.7%)	70 (23.3%)	
Higher secondary	18(20.7%)	80 (26.8%)	
Occupation			
Agriculture	65(74.7%)	219(72.8%)	$\chi 2$= 5.770, df= 4, P= 0.217
Teaching	5(5.7%)	23(7.6%)	
Government job	6(6.9%)	9(3.0%)	
Business	4(4.6%)	31(10.0%)	
Daily wage labour	7(7.8%)	19(6.3%)	

However, Figure 13 showed that there were various techniques to maintain about the Human-Nilgai coexistence in the same area through respondents. The result among 87 respondents, 32(36.78%) answered by managing habitat, 32(36.78%) answered that by developing conservation action plan and 23(26.43%) answered that by providing them enormous food, then the co-existence of Human and Nilgai will possible.

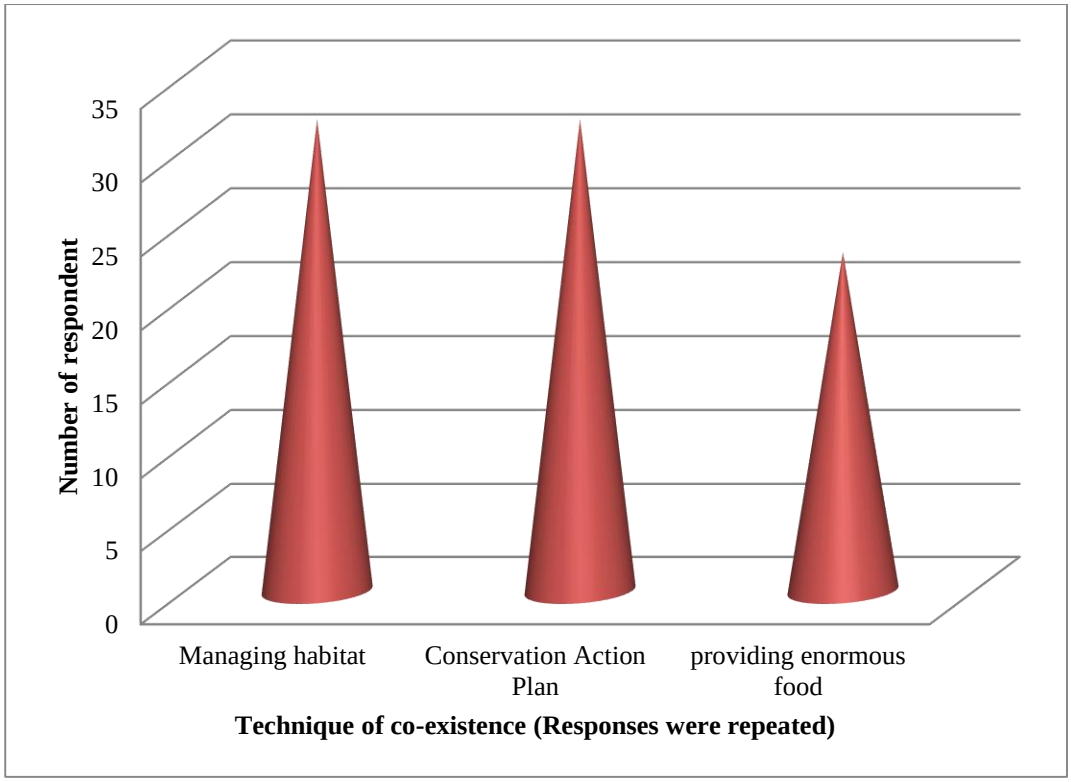

Figure 13:- Management Techniques for Coexistence of Nilgai (N=87)

But there were many other respondents that they did not support about the Human-Nilgai coexistence in the same area. Out of 301 respondents, 20(6.64%) respondents answered that Nilgai must kill and 281(93.35%) respondents answered to relocate Nilgai (Figure 14).

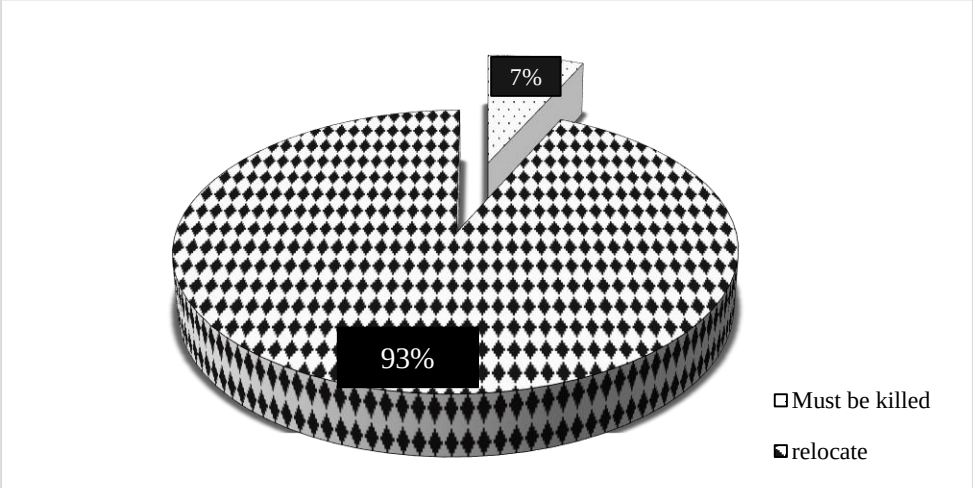

Figure 14:- Respondents who are not in Favour of Coexistence of Nilgai (N=301)

According to questionnaire survey about the relocation of Nilgai, about 164(58.36%) respondents answered to relocate Nilgai in Wildlife reserve, 107(38.07%) respondents answered to relocate Nilgai at National park and 10(3.55%) respondents answered to

relocate Nilgai in the forest among 281 respondents who answered to relocate Nilgai (Figure 15).

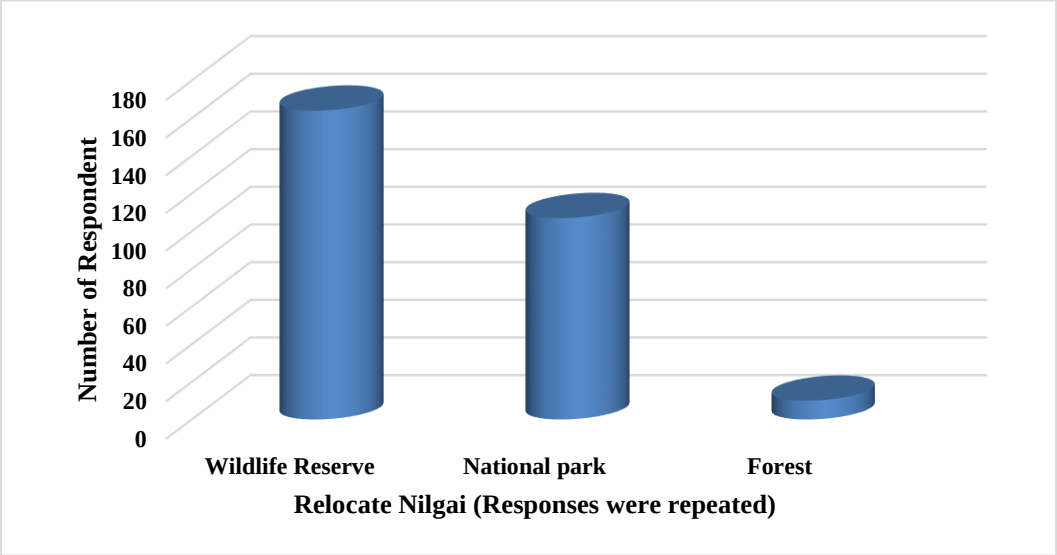

Figure 15:- Suitable Place for Relocation of Nilgai (n=281)

4.3.3 Level of Tolerance of Local people to Nilgai

Three hypothetical questions were asked to examine the tolerance level of local residents in an effort to conserve Nilgai. Questions were for responses as to whether they agreed, either indifferent in supporting Nilgai conservation or one of their family members had been killed or injured by a Nilgai attack.

None of the respondents was agreed that humans were killed by Nilgai, 343(88.4%) disagreed that humans are killed by Nilgai and 45(11.6%) respondents were neutral about humans are killed by Nilgai.

Secondly, more than half 224 (57.7%) were against that humans were injured by Nilgai, 110 (28.4%) were in neutral about that humans are injured by Nilgai and 54(13.9%) were agreed that humans are injured by Nilgai.

Thirdly, among 388 respondents 354(91.2%) respondents agreed that crops were damaged by Nilgai, 21(5.4%) respondents disagreed that crops are damaged by Nilgai and 13(3.4%) respondents were in neutral that crops were damaged by Nilgai (Table 13).

Table 13:- Tolerance Loss of Nilgai (N=388)

Tolerance attitude	N	Agree	Disagree	Neutral	Mean (SD)
I support Nilgai even if Humans are killed	388	0(0%)	343(88.4%)	45(11.6%)	2.12 (0.321)
I support Nilgai even if humans are injured	388	54(13.9%)	224(57.7%)	110(28.4%)	2.14 (0.635)
I support Nilgai even if crops are damaged by Nilgai	388	354(91.2%)	21(5.4%)	13(3.4)	1.12 (0.417)

4.4 Mitigation Measures to reduce Human-Nilgai conflict

4.4.1 Mitigation Measures

Figure 16 shows the various mitigation measures adopted by local people for reducing crop damage. The mitigation measures were common measures used elsewhere in the country. The results showed that almost all of the respondents in the study area had adopted preventive methods against the crop depredation by Nilgai. The majority of respondents 366(94.3%) applied preventive measures such as Deterrents (shouting, noise, a firecracker), 340(87.6%) respondents applied physical barriers(Trench, Fence), 92(23.7%) respondents applied power fence and 199(51.3%) respondents applied scare crow. It was also found that the local people are quite regular about guarding their fields.

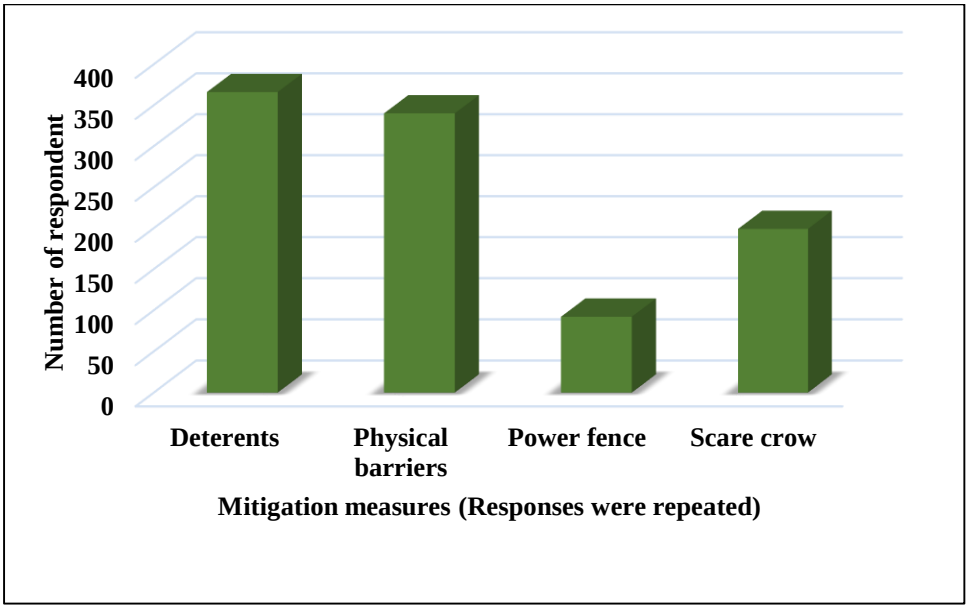

Figure 16:- Mitigation Measures to Reduce Conflict (N=388)

There was a positive correlation between land area and mitigation measures like deterrents, physical barriers and power fence in those VDCs/Municipalities.

4.4.2 Training regarding Nilgai conservation

As the respondents had a different opinion about training related to conservation of Nilgai. Typically 170(43.8%) respondents didn't know about training related to conservation and surprisingly put questions about the success and effectiveness of the training. On the other hand, 218(56.2%) respondents were aware of the effectiveness of training through awareness program and suggested a training plays vital role for the conservation. The difference between gender of the local people, who didn't have an idea for Nilgai conservation was statistically significant (Pearson Chi-square= 6.511, df = 1 and p = 0.011). In addition, the difference between gender of the local people who had an idea about awareness program for Nilgai conservation was also statistically significant (Pearson Chi-square=8.561, df =1 and p= 0.003).

4.5 Threats to Nilgai

This study revealed that not only human-Nilgai conflict occurred in the study area but also there were several threats of Nilgai for their existence in the same area. Among 388 respondents, 247(63.7%) replied that the main threats of Nilgai was Illegal hunting, 231(59.5%) answered about habitat modification, 141(36.3%) answered about poisoning, 53(13.7%) answered increasing encounter with people and 20(5.2%) answered due to habitat destruction (Figure 17).

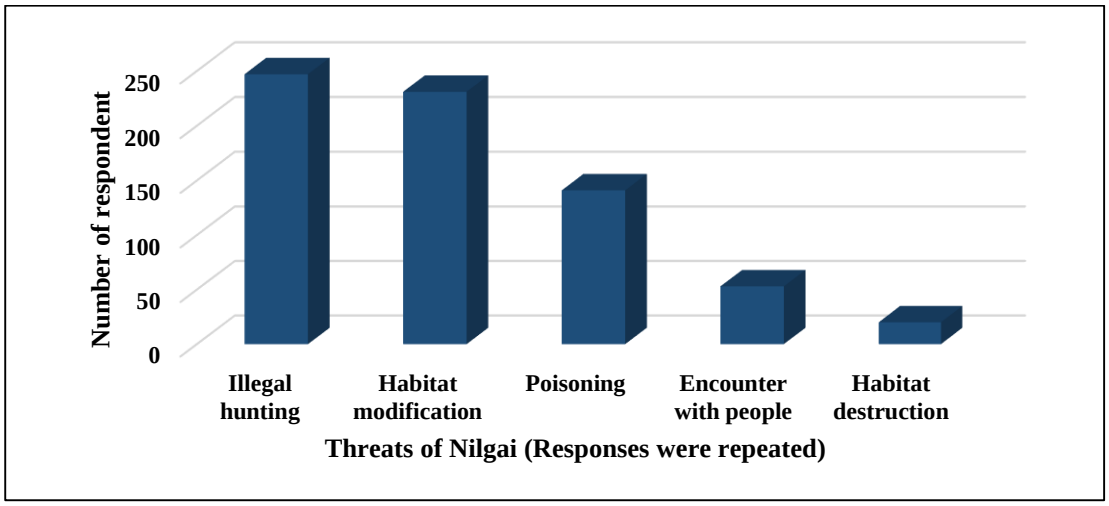

Figure 17:- Threats to Nilgai (N=388)

5. DISCUSSION

5.1 Population Status and Distribution of Nilgai

Rupandehi district provides an ideal habitat for a number of Nilgai. However carrying out an actual census of Nilgai is difficult by using direct census method for several reasons. So line transect method was used to find out the population of Nilgai. Nilgai is the creature of sexual dimorphism abundance in almost all Terai forests of Nepal. Nilgai usually grazes in a semi-open forest of Terai environment where uncontrolled local ethnic population growth and also the heavy settlement of migrated people from the hilly region have induced the emergence of several adversities to the flora and fauna of wild habitat. Thus Nilgai is one of the most abundant mammals in this area.

A total of 303 individuals of Nilgai population were recorded. The highest population of Nilgai was observed in community forest of Bishnupura VDC and lowest in Bairghat VDC at cultivated land. Sixty-two individuals of Nilgai were observed in Lumbini according to recent study but 41 Nilgai (Aryal, 2007), 17 Nilgai (Gosai, 2007), 37 Nilgai (Bagale, 2001), 10-15 Nilgai (Subedi, 2001), 160-200 Nilgai (Shrestha, 1999) were found around Lumbini Development Trust area (LDT). This result showed that the population of Nilgai had been increased. Lasiwa (1999) counted 52 Nilgai individuals in RBNP which is five times less than my findings. It might be due to predators, diseases and poaching. The present study found that the populations of Nilgai were increased because of the shifting of Nilgai herds from India to Nepal. There is an open border between India to Nepal (Sen 1999). This might be due to the scarcity of food, Habitat deterioration and illegal hunting.

The sex ratio (81: 100) was found in favour of female population of Nilgai. Similar results were reported by other researchers (Schaller, 1967; Khatri, 1995; Khan *et al*., 1995; Lasiwa, 1997; Bagale, 2003 and Aryal, 2007). But the present ratio was higher than the ratio 37:100 in Vanbihar Sanctuary, India (Schaller, 1967), 50: 100 in RBNP (Khatri, 1995) and 59:100 in Keolado Ghana Sanctuary Rajasthan, India (Schaller and Spiller, 1966), and 71: 100 in Gir lion Sanctuary, Gujrat, India (Khan *et al*., 1995) and lower (83:100) in RBNP (Lashiwa, 1997).The sex ratio of Nilgai was 66:100 in Lumbini (Aryal, 2007) which is lower than the present study. This showed that the population of Nilgai has been increased.

This study revealed that Nilgai represents widely in Rupandehi district and mostly found in part of the community forest. The result from the study of 38 different studied samples and four different habitats of Rupandehi district showed clumped or uneven type of distribution, which was the most common pattern of distribution among large mammals. Biological population exhibited clumped type of distribution that occurs in natural habitat (Odum, 1996). A similar type of distribution had been reported in the lowland of Nepal (Shrestha, 2004), SWR (Pokhrel, 2008), BNP (Adhikari and Khadka, 2009), Pillibit forest division (Bista, 2011), BNP (Gautam, 2013). Clumped type of distribution of the Nilgai

in the present study might be due to similar types of distribution of food type, habitat or social behaviour.

Chopra and Rai (2009) found a random distribution which in contrast with the current study.

Among 38 different studied samples, Nilgai was highly found in Bishnupura VDC. The presence of sufficient food, availability of water holes, escaping area from the predators could be some possible factors to support a high number of Nilgai in these studied samples. In Bairghat VDC, least number of Nilgai was observed. This VDC was affected by the human disturbance so this may be the reason for less distribution of Nilgai in this VDC. Similarly, direct presence of Nilgai was not observed in 22 studied samples but their indirect presence i.e. pugmark and pellets were recorded in these studied samples.

The present study analysed that the habitat utilisation by Nilgai in four different habitat types of Rupandehi district. Nilgai was a generalist in habitat use but it had relatively more preference to community forest and low preference to cultivated land. The community forest was preferred by Nilgai due to the availability of agricultural land near by those forests. Shakya (1999) found the wooded grassland as highly preferred habitat for the Nilgai in RBNP but according to (Bhat *et al*; 2012), Nilgai used grassland, savana, scrubland and woodland which does not match with a recent study. The reason for preference of Sal forest by Nilgai was due to the availability of preferred browse species such as *Murraya koenigii, Mallotusphilippinesis, Syzygium cumini* (Shakya, 1999). Similarly, its association to grassland could be attributed to the availability of short grasses such as *Imperata cylindrica, Cynodon dactylon* in grassland of RSWR (Pokhrel and Thapa, 2008). These short grass species are preferred food plants for Nilgai in comparison to tall grass species (Khatri, 1993).

Mean group size (herd size) of Nilgai in the study area during the study period was 5.61 animals per herd. Whereas the mean herd size of Nilgai was 3.7 animals per herd (Bagale, 2003) in Lumbini and 2.75 individuals per herd (Khatri, 1995) in south western sector (Khauraha and Gobrella) of RBNP. On the flip side, typical group size in Gir Lion Sanctuary, Gujrat, India was 3.5 ± 2.2 (Khan *et al*., 1995). Herd size and male to female sex ratio fluctuate as the member of one group splits and join another (Bagale, 2003).

5.2 Conflict of Nilgai with Human due to Crop Depredation

Considering the increasing population growth rate of humans, demands of natural resources would continue. The human settlement in Rupandehi district, which result in the destruction of Nilgai habitats also reduced wildlife range and possibly their traditional migratory routes. If the above factors were not controlled then the crop raiding by Nilgai would not easily control. These had forced Nilgai to enter the agricultural field and raid crops. This implied that human-Nilgai conflict would continue within Rupandehi district.

Data on crops mostly damage by Nilgai were collected to attempt to identify the type of crops affected mostly by it and extent of the damage. In Rupandehi district, a number of crops were grown by the communities. They included both food and cash crops. This research clearly showed in Table 9, that vegetables were most raided crop by Nilgai. The least damaged crops were paddy, wheat, mustard, maize and others. Aryal (2007), Bagale (2003), Sen (1999) reported the different types of crops that Nilgai damage was rice, wheat, maize, mustard, pulses, vegetables and others which were in agreement with the study. Nilgai damage different types of crops not only by eaten but also by trampling (Chauhan, 2014). Nilgai was reported as one of the most destructive animals to standing crop (Singh, 2002).

According to local people the loss of major crops paddy (11.66%), wheat (17.71%), maize (27.73), mustard (17.44%), vegetables (13.99%), pulses (22.24%) and others (3.24%). Crop damage by Nilgai in Lumbini was 6.6% for paddy, 17. 97% for wheat and 15.84% for mustard (Bagale, 2003) which was lower than the present study. The loss percent of paddy (Dhan) was 11.12%, wheat (Ghau) was 25.89%, mustard (tori) was 23.9%, 27.87% was red lentil (musuro), 22.59% pea (kerau) and 35% Pigeon pea (Rahar) at Tenuahawa VDC (Sen, 1999) which was in line with the findings of this study. The proportion of rice in the total diet of Nilgai was 12.3% to 12.9% and crop damage due to Nilgai in the field was 8.3% in RBNP (Khatri, 1995) and 5% in Lumbini in areas one km from LDT (Aryal, 2007). In Nahar areas of Harayana state of India damage was reported up to 58% of the total yield and rarely below 10% (Chawan and Singh, 1990). Gram, wheat seedlings and moong were recorded as preferred crops by Nilgai (Chawan and Singh, 1990).

Among 14 VDCs/Municipalities, two municipalities and three VDCs highly conflicted and one municipality and eight VDCs were low conflicted. The highly conflicted VDCs/Municipalities were near the habitat of Nilgai results in a huge economic loss because of crop damage. The high economic value of cash crops was planted in low conflicted VDCs/municipalities so that the economic loss of low conflicted VDCs/municipalities was nearly similar to highly conflicted VDCs/municipalities. The annual economic loss from crop depredation for these VDCs/municipalities was NRs 17,649,996.38 (US$ 166,501.075). The estimated average annual monetary loss for a household in the Rupandehi district was NRs 51,809.758 (US$ 488.747). Separately crop wise loss were NRs 41,94,347 (US$ 39,567.333) of paddy, NRs 18,35,884 (US$ 17,318.794) of wheat, NRs 4,89,966 (US$ 4,622.089) of maize, NRs 26,25,623 (US$ 24,768.789) of mustard, NRs 65,43,097 (US$ 61,724.244) of vegetables, NRs 13,92,314 (US$ 13,134.381) of pulses and NRs 5,68,778 (US$ 5,365.561). Sen (1999) reported the total economic loss for Tenuahawa VDC was NRs 8, 79,826.25 and the average household loss was approximately NRs 5,364.79 which didn't match with this study. The study conducted by (Aryal, 2007) revealed that the economic loss of rice and wheat was NRs 900,000 and NRs 1,103,595 respectively which was equivalent to (NRs 74= US$1) which seems there was a significant amount of crop damage done by Nilgai which causes impact on the local livelihood. Lumbini cultural municipality had highest crop loss and

Bairghat VDC has lowest crop loss. The possible reason was that the Lumbini cultural municipality was near the LDT where the habitat seems to be favourable for Nilgai which was the main pest of the study area. Bagale (2003) concluded that the actual loss of paddy was 132.27 quintal, wheat was 81.17 quintal and maize was 6.61 quintal per annum respectively which also agrees with the results of the recent study. Bagale (2003) concluded that crop loss varied in different stages that paddy was damaged from early stage to mature stage, milky grain stage, wheat was destroyed in growing and flowering stage and mustard were damage in all stage which follows the result of the recent study.

During the discussion, local people mentioned the increase of Nilgai population contributed to increasing the amount of crop depredation. Interaction with local people, they had not any special place to complain about the crop depredation by Nilgai. However, conservation of Nilgai must be done to minimise this type of depredation.

5.3 Perception of Local People towards Nilgai Conservation and level of Tolerance to Nilgai

The goal of this survey was to understand the importance of Nilgai as intrinsic value and perception of local people towards the Nilgai conservation. We found the mixed response of the respondents towards Nilgai conservation. This study did not establish a relationship between perception of local people towards Nilgai conservation and crop damage. Negative attitude to wildlife had been developed when wildlife damage exceeded the tolerance level (Hill, 1998). The majority of the respondents had a negative attitude towards Nilgai (Singh and Chauhan, 1990). The possible reason included the overlapping of local people and Nilgai needs (Singh and Chauhan, 1990). 75% of people were Muslim and they demand to hunt Nilgai (Sen, 19990. They did not show love and sympathy, negative attitudes were developed due to deterioration of farm economy, crop depredation and extraction of minor forest products (Sen, 1999). But the current study signifies that most of the local people were Hindus. Thus they didn't want to kill them due to religious belief. According to them, proper conservation must be done through the shifting of the animal. According to local people, there was not any suitable place to report to claim compensation. Similarly, in Barandabar Corridor Forest, crop damage is a serious issue that has developed some negative attitudes towards wildlife conservation (Bhattari and Basnet, 2004).

A Higher percentage of surveyed people strongly disagreed to the conservation of wildlife to various circumstances of events, indicated that the level of tolerance towards it was very less (Awasthi, 2014). The possible reason was the increasing human-wildlife conflict due to crop depredation. The extent to which farmers would tolerate crop loss to Nilgai was that their dependence on agriculture for income, the length of residence in an area and the presence or absence of effective compensation schemes (Hill, 2004). People usually often tolerate significant level of crop damage by domestic animals but were in tolerant of comparatively smaller losses from wild animals (Naughton-Treves, 1998)

5.4 Mitigation Measures

Local people were practising different indigenous means of controlling methods to stop the Nilgai intrusion in different crop field during growing state. Deterrents, Physical barriers, power fence, scarecrow were the main mitigation measures used by local people. Different notorious means of preventive methods such as electric wire fence, poisoned were also used in different villages of the Rupandehi district. Few of the local people believed the strong irritable smell of scales of fishes also acted as a barrier to Nilgai to enter in the crop field. Almost all the respondents provided suggestions for mitigating Human-Nilgai problems by changing the types of crops which were in less preference (as an example; in Lumbini cultural municipality people had replaced pulses to sugarcane and peanut and in Amuwa VDC people were planting wheat instead of maize and vegetables). The majority of respondents in Bagauli VDC had started to change in cropping pattern and planting the same crop at the same time but in Gonaha VDC, local people were not planting vegetable in view of business than before.The most common traditional methods were scarecrows, fencing, and Velvet mesquite, beating bells, animal excreta, crackers, insecticide and pesticide in Rajsamand district of Rajasthan (Meena *et al*., 2014; Aryal, 2007) and also shinning tapes like video/audio tapes around the crop fields which was similar to my study. (Bayani *et al*., 2016) concluded the common method to minimise the crop raiding by large herbivores was guarded overnight but unfenced the farms. Reactive and proactive measures needed to be taken to minimise the impact and the conflict (Madhusudan and Mishra, 2003).

5.5 Threats to Nilgai

The majority of respondents answered about the threats of Nilgai. Illegal hunting, Habitat modification, poisoning, an encounter with people and Habitat destruction were the main threats to Nilgai. According to local people of Kamahariya VDC, two Nilgai were found dead due to power fencing around their farmlands. Disease transmission, firewood collection and grass cutting also play a significant role for the threats to Nilgai (Aryal, 2007). Migration of people from hilly areas to terai areas, the habitat of Nilgai had been converted into the residential area because people use the land to build a house. The majority of people were Muslim, so they illegally hunted Nilgai because crop raiding by them caused a serious problem (Sen, 1999).

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

A total of 303 individuals of Nilgai were counted from 16 different locations. Among these locations, the highest numbers of Nilgai were found in community forest Bishnupura VDC and lowest numbers of Nilgai were found in the cultivated land of Bairghat VDC. Among them, 90 (29.70%) were male, 111(36.63%) were female and 102 (33.66%) were calves. The distribution pattern of Nilgai was clumped with no significance difference in the distribution of the population in different studied samples. The average male to female sex ratio was found to be 81: 100. The average mixed herd size was computed as 5.61 animals per herd, being 15 individuals as a highest herd in that area. Nilgai mostly used four different types of habitat. Among them 40 individuals of Nilgai were found in grassland, 107 individuals were in community forest, 85 were in the riverine forest and 71 were in the cultivated land. There were significance difference between the distribution of Nilgai with community forest habitat, riverine forest and cultivated land but however there was no significance difference between the distribution of Nilgai and grassland habitat.

Nilgai was found to be main crop raider in the crop fields of the Rupandehi district. Crop raiding is the main cause of poverty in Rupandehi district; farmers lost a lot of income per season to crop raiding by Nilgai. Nonetheless, food shortages and loss of income caused by Nilgai were not only the factors affecting people's livelihoods other factors like high population growth, over dependence on subsistence farming among others. Livelihood was directly associated with food security, income of household, leisure time of individuals and the poor social relationship among neighbours. A questionnaire survey revealed that Nilgai was responsible for 11.66%, 17.71%, 27.73%, 17.44%, 13.99%, 22.24%, 3.24 % loss of paddy, wheat, maize, mustard, vegetable, pulses and others respectively. The animal enters the farmlands at night to raid crops. Almost all of the respondents answered that the problem of crop damage increased day by day as the number of Nilgai also increased. The high incidence of crop raiding was mostly seen neighbouring the forest. Furthermore increased habitat destruction, high population, poor guarding methods and lack of grazing have also contributed to increased crop raiding.

Through the study showed that majority of local respondents were against the Nilgai conservation because they lost their crops. It should be kept in mind when formulating management plan, many people in this area are poor and depend on agriculture, so awareness program and material support should be increased for tolerance level of local peoples towards the Nilgai conservation. It is concluded that that the problem of human and Nilgai conflict in the study area are in increasing order and crop damage also increased. The attitude of the people towards Nilgai might be negative because crop depredation due to Nilgai is a serious problem of the study area.

Different mitigation measures were used to solve the problem regarding the human-Nilgai conflict. Deterrents, power fence, scarecrows, guarding were the main measures which

they applied. The awareness programme was also the best method to reduce human-Nilgai conflict. Besides from this there are several threats to Nilgai in this area. Illegal hunting, habitat modification, power fence and poisoning are the threats to Nilgai.

It is also important to note that crop raiding cannot easily be eradicated given the population pressure of Nilgai and the kind of human activities within Rupandehi district.

6.2 Recommendations

Programmatic recommendations

1) Census in regular intervals should be conducted in order to monitor the change in Nilgai population.
2) The population of Nilgai is in increasing order, so these high species population turns into pest. Thus population should be maintained within a certain level of species population management program such as translocation.
3) Rupandehi district is a potential habitat of Nilgai. So, crop depredation due to Nilgai makes local people intolerable against Nilgai. Thus local people should be encouraged to follow proper mitigation measures.
4) Local people should be motivated about the awareness for Nilgai conservation. So that management practices should be focused on increasing people's tolerance level for Nilgai, an integrated program combining conservation education and+-people's participation in resource management is recommended. Conservation education must be included in the curriculum of school level which makes children more aware about the importance of Nilgai and its conservation. Conservation education must also be provided to the villagers about the role of this species in balancing the ecosystem. The value of Nilgai is religious, scientific, economic, touristic and historical. The seminar, rally, public advocacy programmed should be organised regularly.
5) Publications must be prepared and distributed regularly by showing the importance of Nilgai and benefit about it. This could help people to be more aware of Nilgai conservation.
6) The conflict arises between human and Nilgai must be monitored regularly, if possible within a short time interval period.
7) Local people should be encouraged to support alternative cultivation by applying biological methods in controlling Nilgai which is effective to control crop depredation. The food habitat of Nilgai should be studied and local people be encouraged to the other varieties of crops and change the varieties of crops so that crop damage should be decreased, some extent caused by crop damage was high in this area.

Future Research

1. Very little research has been conducted about Nilgai, so the intensive study on biology and behavior and its habitat requirement is necessary to conserve this species in the long- term survival in Nepal.

2. Detailed study of Human-Nilgai conflict is necessary to reduce the crop depredation by Nilgai.
3. Regular follow-up research on population status and population projection for future is also necessary.
4. Study of birth rate, death rate and age-specific mortality to construct life tables of this species is important.
5. A regular survey of crop loss due to Nilgai with relation to their number to investigate the pestilence nature of the animal also useful.
6. Study on feeding behaviour, breeding behaviour and activity cycle of Nilgai are necessary.

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APPENDICES

I. Table 14: Crop Loss by Nilgai in Rupandehi District (In Kg)

S.N.	Name of the VDC/Municipalitiy	Paddy	Wheat	Maize	Mustard	Vegetables	Pulses	Others
1	Gonaha	27780	11222	0	2354	42619	2076	0
2	Kamahariya	23922	10246	0	2590	65144	3893	0
3	Bishnupura	14816	9268	0	3249	42329	2880	41649
4	Tilottama	18533	7475	5209	1614	11814	1764	0
5	Lumbini	40947	25169	0	10422	91034	4959	619
6	Butwal	1935	2192	1972	943	3916	438	0
7	Sau-pharsatikar	3797	4479	1939	997	2083	766	0
8	Amuwa	1732	1961	1548	0	2056	419	2155
9	Mainaya	1655	2466	0	1122	1604	307	2258
10	Bagauli	3664	918	0	283	12813	912	435
11	Bogadi	3585	1121	0	238	8474	315	326
12	Bairghat	806	201	0	51	1626	29	52
13	Suryapura	605	162	285	97	2167	55	10513
14	Rudrapur	3393	2939	1296	2296	5753	860	0
	Total	147171	79819	12249	26256	293434	19674	58007

II. Table 15: Monetary value of total crop loss in USD (1USD=106.0053).

Name of VDC/ Municipality	Paddy	Wheat	Maize	Mustard	Vegetables	Pulses	Others
Gonaha	7468.818	2434.821	0.000	2220.961	9527.616	1511.440	0.000
Kamahariya	6431.420	2223.057	0.000	2443.374	15662.364	2955.526	0.000
Bishnupura	3983.445	2010.950	0.000	3065.011	10022.686	1716.154	2138.934
Tilottama	4982.805	1621.824	1965.570	1522.304	2336.637	905.449	0.000
Lumbini	11008.882	5460.846	0.000	9831.960	15465.759	3693.478	350.292
Butwal	520.282	475.691	744.263	889.371	892.403	313.480	0.000
Sau-pharsatikar	1020.742	971.805	731.714	940.776	363.197	358.305	0.000
Amuwa	465.686	425.547	583.952	0.000	322.477	314.433	813.025
Mainaiya	444.978	534.942	0.000	1058.211	271.956	268.549	851.860
Bagauli	984.997	199.226	0.000	266.523	2708.658	501.795	410.445
Bogadi	963.737	243.308	0.000	224.479	1936.414	63.438	307.287
Bairaghat	216.780	43.545	0.000	48.428	406.493	15.430	49.410
Surya pura	162.766	35.184	107.635	91.388	412.944	29.117	444.307
Rudrapur	912.249	637.672	488.956	2166.005	1394.642	487.792	0.000
Total	39567.586	17318.417	4622.089	24768.790	61724.246	13134.385	5365.561

III. Table 16: Per household loss in kg.

Name of VDC/Municipality	Paddy	Wheat	Maize	Mustard	Vegetables	Pulses	Others
Gonaha	1068	432	0	91	1639	80	0
Kamahariya	583	250	0	63	1589	95	0
Bishnupura	390	244	0	86	1114	76	1096
Tilottama	350	141	98	30	223	33	0
Lumbini	602	370	0	153	1339	73	9
Butwal	97	110	99	47	196	22	0
Sau-pharsatikar	190	224	97	50	104	38	0
Amuwa	102	115	91	0	121	25	127
Mainaiya	127	190	0	86	123	24	174
Bagauli	229	57	0	18	801	57	27
Bogadi	163	51	0	11	385	14	15
Bairaghat	101	25	0	6	203	4	7
Surya pura	47	12	22	7	167	4	809
Rudrapur	103	89	39	70	174	26	0
Average	379	206	32	68	756	51	150

IV. Table 17: Local market price of crops (in NRs)

S.N.	Crops	Monetary value in NRs per Kg	
1	Paddy	28.5	
2	Wheat	25	
3	Maize	40	
4	Mustard	100	
5	pulses	Lentil	NRs 20
		Pea	NRs 60
		Red lentil	NRs 100
		Others Includes Bakkula,	NRs 30
6	vegetables	Potato	NRs 12.5
		Cauliflower	NRs 24.25
		Tomato	NRs 22.30
		Cabbage	NRs 17.50
		Corriander	NRs 230
		Others	NRs 27.0 (Includes Bittergourd, Onion, Cucumber, Black eyed bean, Brinjal and Pumpkin)
7	Others	Sugarcane	NRs 4.48
		Peanut	NRs 100
		Banana	NRs 40

Conversion Rate of US Dollars in Nepali Rupees
1 US $ =106.0053NRs. (20thApril 2016)

V. Questionnaire for Household survey for Nilgai Ref:-

	Questions	Responses		Code	Go to
101	District name				
102	VDC/Municipality name		Ward ----------		
103	Name of respondent				
105	What is your caste/ethnicity?				
106	What is your sex?	Male	Age ----------	1	
		Female	Age ----------	2	
107	What is the highest grade you have completed? *If less than grade 1, write "0"*	Grade			
		SLC passed……		11	
		Higher education……..		12	
		Others……		13	
109	What is your main occupation?	Yes	No		
	110_a Agriculture	1	0	1	
	110_b Teaching	1	0	2	
	110_c Other Services	1	0	3	
	110_d Business	1	0	4	
	110_e Daily wage labor	1	0	5	
	110_f Not involved in any occupation	1	0	6	
	110_g If others please specify				
110	How much land do you have?	……/……/…….. (Bigha/Katha/Dhur)			
111	What type of crop do you grow commonly?	Yes	No		
	111_a Paddy	1	0	1	
	111_b Wheat	1	0	2	

	111_c Maize	1	0	3		
	111_d Mustard	1	0	4		
	111_eIf other please specify. _____					

112	What type of crops do you plant in different seasons?	Seasons									
		Spring		Summer		Autumn		Winter			
		Yes	No	Yes	No	Yes	No	Yes	No		
	112_a Paddy	1	0	1	0	1	0	1	0	1	
	112_b Wheat	1	0	1	0	1	0	1	0	2	
	112_c Maize	1	0	1	0	1	0	1	0	3	
	112_d Mustard	1	0	1	0	1	0	1	0	4	
	112_e If other please specify. _____										

113	What is yearly income from these crops?	Yield	Income		
		Kilogram	Rupees		
	113_a Paddy			1	
	113_b Wheat			2	
	113_c Maize			3	
	113_d Mustard			4	
	113_eIf other please specify. _____				
114	Do you have any practice about mix cropping system?	Yes	No	6	If yes, go to 116
		1	0		
115	Which crop do you plant together?	_____ _____		7	
116	Do you get full production from your land?	Yes	No	8	If no, please go to 118
		1	0		
117	What are the causes?	Yes	No		
	117-a Live-stock depredation	1	0	1	
	117-b Flood	1	0	2	
	117-c Low rainfall	1	0	3	
	117-d If other please specify. _____				
118	Is there any animal damage due to which you are not getting full production?	Yes	No		
		1	0		
119	If yes which animal is that?	Yes	No		If Nilgai please go to 121 and 122.
	119-a Nilgai	1	0	1	
	119-b Wild boar	1	0	2	
	119-c Monkey	1	0	3	

	119-d Sarus Crane	1	0	4	
	119-e if other please specify. _____.				
120	Have you seen Nilgai?	Yes	No		
		1	0		
121	Which season does Nilgai Visit your farm?	Yes	No		
	121-a Spring (March, April & May)	1	0		
	121-b Summer (June, July & August)	1	0		
	121-c Autumn (Sept, Oct & Nov)	1	0		
	121-d Winter (Dec., Jan. & Feb.)	1	0		
122	How often does Nilgai Visit your farm?	Yes	No		
	122-a Everyday	1	0		
	122-b Once a week	1	0		
	122-c Twice a week	1	0		
	122-d Occasionally	1	0		
	122-e Never	1	0		
123	When does this animal enter in the field?	Yes	No		
	123-a Evening	1	0		
	123-b Morning	1	0		
	123-c Day time	1	0		
	123-d Night	1	0		
124	How do you find that damage was made by Nilgai?	Yes	No		
	124-a By observing	1	0		
	124-b By watching directly	1	0		
	124-c By their dung	1	0		
	124-dIf others please specify. _____.				
125	Does the Nilgai come in group?	Yes	No		
	Herds(Groups)	1	0		
	Single	1	0		
Economic loss due to crop depredation					
126	Which crop do they prefer?	Yes	No		
	126_a Paddy	1	0		
	126_b Wheat	1	0		
	126_c Maize	1	0		
	126_d Mustard	1	0		
	125_e If other please specify. _____				

127	What was the actual yield of crop?	Mass in kilogram.	Yield(Rs)		
	127_a Paddy				
	127_b Wheat				
	127_c Maize				
	127_d Mustard				
	126_e If other please specify. _____				
128	What was the total loss of crops?	Mass in kilogram.	Loss(in Nrs)		
	128_a Paddy				
	128_b Wheat				
	128_c Maize				
	128_d Mustard				
	128_e If other please specify. _____				
Perception of local community towards Nilgai Conservation					
129	Do you like Nilgai?	Yes	No		
		1	0		
130	What is the reason of liking Nilgai?	Yes	No		
	130-a Beautiful species				
	130-b Revenue from tourism				
	130-c Religious belief				
	130-d Maintaining ecosystem				
	130-e If other please specify. _____.				
131	What is the reason of disliking Nilgai?	Yes	No		
	131-a Killing Livestock	1	0		
	131-b Attacking human	1	0		
	131-c Damaging crop	1	0		
	131-d Damaging forest	1	0		
	131-e If other please specify. _____.				
132	Do you think that Human-Nilgai co-existence in this area?	Yes	No		
		1	0		
133	If yes, What should be done?	Yes	No		
	133-a Managing Habitat	1	0		
	133-b Conservation action plan	1	0		
	133-c Enormous food	1	0		
	133-d If others please specify._____				
134	If No,What should be done?	Yes	No		

	134-a KillingNilgai	1	0		
	134-b Relocating people	1	0		
	134-c RelocatingNilgai	1	0		
	134-d If other please specify. _____.				
135	If relocate,Nilgai, Where	Yes	No		
	135-aIn Zoo				
	135-b In Forest				
	135-d If others please specify _____				
136	If Relocate People, Where?	Yes	No		
	136-a Within Rural area	1	0		
	136-b Outside Urban area	1	0		
	136-c If others please specify				
137	Have you applied any protective measures to stop damage?	Yes	No		If yes move to 138
		1	0		
138	What are the measures?	Yes	NO		
	138-aChasing them by throwing stones	1	0		
	138-b shouting and making noise	1	0		
	138-c Guarding over night	1	0		
	138-d If others please specify _____				
139	Are these techniques effective?	Yes	No		
		1	0		
140	Do you think the damage problem is growing every year?	Yes	No		
		1	0		
141	Do you receive any training regarding Nilgai conservation?	Yes	No		
		1	0		
142	From which sector did you receive training?	Yes	No		
	142-a NGO	1	0		
	142-b INGO	1	0		
	142-c Nepal government	1	0		
	142-d If others please specify _____				
143	If No, What must be done?	Yes	No		
	143-a provide training				
	143-b provide skillful job				
	143-cAwareness programme				
	143-d If others, please specify _____				
Level of tolerance of Nilgai					
144	Are there any human casualties in your family due to Nilgai?	Yes	No		
		1	0		
145	Who are they?	Yes	No		

	145-a Male	1	0		
	145-bFemale	1	0		
	145-c Child	1	0		
	145-d If others please specify _____				
146	What is the age of casualty?	Yes	No		
	146-a Below 15	1	0		
	146-b Above 15	1	0		
	146-c If others please specify _____				
147	Do you support that humans are killed by Nilgai?	Yes	No		
	147-a Agree	1	0		
	147-b Disagree	1	0		
	147-c Neutral	1	0		
148	Do you support that humans are injured by Nilgai?	Yes	No		
	148-a Agree	1	0		
	148-b Disagree	1	0		
	148-c Neutral	1	0		
149	Do you support that crops are damaged by Nilgai?	Yes	No		
	149-a Agree	1	0		
	149-b Disagree	1	0		
	149-c Neutral	1	0		
Mitigation measures					
150	What are the mitigation measures taken for minimizing conflict?	Yes	No		If it is compensation,then move to 152
	150-a Deterrents(noise, firecrackers)	1	0		
	150-b Nilgai squad	1	0		
	150-c Physical barriers(Trench, Fence)	1	0		
	150-d Power fence(Electric, Solar)	1	0		
	150-e Awareness and Training	1	0		
	150-f Compensation	1	0		
	150-g If others please specify _____				
151	What kind of compensation do you Need?	Yes	No		
	151-a Money	1	0		
	151-b Crops	1	0		
	151-c Vegetables	1	0		

	151-d Others please specify	1	0		
152	Are you getting compensation on time?	Yes	No		If no, move to 154
		1	0		
153	What should be the time frame?	Yes	No		
	153-a One month	1	0		
	153-b Two month	1	0		
	153-c Six month	1	0		
	153-d If others please specify _____				
154	In your opinion, compensation is the best method to reduce impact?	Yes	No		If no, move to 156
		1	0		
155	Where do you complain this problem?	Yes	No		
	155-a Management of Lumbini Garden	1	0		
	155-b DFO	1	0		
	155-c LDT	1	0		
	155-dIf other please specify. _____.				
156	What do they suggest?	Yes	No		
	156-a Shifting the animal	1	0		
	156-b Guarding	1	0		
	156-c Punishment	1	0		
	156-d If others please specify _____				
Threats of Nilgai					
157	Has the population of Nilgai increased or decreased?	Yes	No		If no, move to 159
	157-a Increased	1	0		
	157-b Decreased	1	0		
158	What are the causes of decreasing?	Yes	No		
	158-a Habitat loss	1	0		
	158-b Poaching	1	0		
	158-c Poisoning	1	0		
	158-d If others please specify				
159	Do you think Nilgai must be preserved?	Yes	No		If yes, go to 160
		1	0		
160	Why it should be done?	Yes	No		
	160-a Ecosystem balance	1	0		
	160-b Religious belief	1	0		
	160-c Eco-tourism	1	0		
	160-d If others please specify _____				
161	In your opinion, what are the threats to Nilgai?	Yes	No		

	161- a Illegal hunting	1	0		
	161-b Forest destruction	1	0		
	161-c Habitat modification	1	0		
	161-d Increasing encounter with people	1	0		
	161-e If others please specify _____				
162	Are you getting any benefit by LDT?	Yes	No		
		1	0		
163	If Yes,What are they?	Yes	No		
	163-a Education	1	0		
	163-b Training	1	0		
	163-c Money	1	0		
	163-d If others please specify _____				
164	If No,what will you suggest?	Yes	No		
	164-a Managing rules	1	0		
	164-b Providing proper guidance	1	0		
	164-c Manage trainings and skills	1	0		
	164-d If others please specify _____				
165	In your opinion,local community is benefit from tourism?	Yes	No		If yes move to 166
		1	0		
166	What are the benefits?	Yes	No		
	166-a Increasing income	1	0		
	166-b Increasing manpower	1	0		
	166-c Increasing expenditure	1	0		
	166-d If others please specify _____.				

VI. Quantity conversion

The data of crop damage was obtained from local in the quintal and convert it in to kg**.**
1 Kattha = 20 Dhur
1 Bigha= 20 Kattha
1 Bigha= 13.31 ropani
1 Bigha= 0.66683367 hectare

VII. Flora and Fauna of Rupandehi District

List of Plants of Rupandehi District

S.N.	Scientific name	Local name	S.N.	Scientific name	Local name
1	*Acacia arabica*	Babul	22	*Dalbergia sossoo*	Sissoo
2	*Acacia catechu*	Khair	23	*Delonix regia*	Gold mohar
3	*Acacia sp*	Tarkar	24	*Dendrocalamus sp*	Bans
4	*Adina cordifolia*	Karma	25	*Engelhardtia spicata*	Mahuwa
5	*Aegle marmelos*	Bel	26	*Albizia sp*	Siris
6	*Annona squamota*	Sarifa	27	*Eucalyptus citroidora*	Masala
7	*Athocepharus cadamba*	Kadam	28	*Ficus bengalensis*	Bar
8	*Artocarpus integrifolia*	Katahar	29	*Ficus elastica*	Rabar
9	*Artocarpus lakoocha*	Badahar	30	*Ficus rumphii*	Paakar
10	*Azadiracta inidca*	Neem	31	*Grevillea robsta*	Kaiyo
11	*Bauhinia purpurea*	Koiralo	32	*Jacaranda mimosifolia*	Jakarinda
12	*Bombax malabaricum*	Simal	33	*Leucaena leucocephala*	Ipil ipil
13	*Butea monsperma*	Pallas	34	*Mangifera indica*	Aanp
14	*Callistemon citrinus*	Kalki	35	*Morus alba*	Kimbu

14	*Carica papaya*	Mewa	36	*Pinus roxburghii*	Kote salla
16	*Cassia fistula*	Amalatas	37	*Psidum guajava*	Amba
17	*Cinnamomum camphora*	Kapur	38	*Saraca indica*	Ashoka
18	*Citrus limon*	Nebu	39	*Syzgium cumini*	Jamun
19	*Cocos nucifera*	Nariwal	40	*Tamarindus indica*	Imlii
20	*Cupressus torulosa*	Mayur Pankhi	41	*Tectonia grandis*	Til
21	*Dalbergia latilfolia*	Satti sal	42	*Zizyphus mauritiana*	Bayar

Wildlife found in Rupandehi District:

Amphibians:

S.N.	Scientific Name	Family Name
1	*Bufo melanostictus*	BUFONIDAE
2	*Bufo stomaticus*	BUFONIDAE
3	*Rana crassa*	RANIDAE
4	*Rana tigerina*	RANIDAE
5	*Tomopterna breviceps*	RANIDAE
6	*Rana cyanophlyctis*	RANIDAE

Source: Biodiversity Profiles Project/Bioidiversity Database System of Nepal, 1995

Reptiles:

S.N.	Scientific name	Family name	S.N.	Scientific name	Family name
1	*Caloies versocolor*	AGAMIDAE	13	ELAPIDAE	*Bungurus fascinates*
2	*Python molurus*	BOIDAE	14	ELAPIDAE	*Bungarus caeruleus*
3	*Ahaetulla nasuta*	COLUBRIDAE	15	ELAPIDAE	*Naja kauothia*
4	*Amphiesma stolata*	COLUBRIDAE	16	EMYDIDAE	*Kachuga tecta*
5	*Atretium schistosum*	COLUBRIDAE	17	EMYDIDAE	*Melanochelys Tricarinata*
6	*Boiga trigonata*	COLUBRIDAE	18	EMYDIDAE	*Morenia perersi*
7	*Dendrelaphis tristis*	COLUBRIDAE	19	GEKKONIDAE	*Hemidactylis Flavbiviridis*
8	*Elaphe hodgsoni*	COLUBRIDAE	20	GEKKONIDAE	*Mabuya dissimilis*
9	*Lycodon aulicus*	COLUBRIDAE	21	SCINCIDAE	*Manuya macularia*
10	*Ptyas mucosus*	COLUBRIDAE	22	TRIONYCHIDAE	*Aspideretes gangeticus*
11	*Sibynophis Sagittarius*	COLUBRIDAE	23	TRIONYCHIDAE	*Lissemys punctata*
12	*Xenochrophis piscator*	COLUBRIDAE	24	VARANIDAE	*Varanus flavesvens*

Mammals

S.N	**FAMILY**	**SCIENTIFIC NAME**	**S.N**	**FAMILY**	**SCIENTIFIC NAME**
1	BOVIDAE	*Boselaphus tragocamelus*	9	FELIDAE	*Felis chaus*
2	BOVIDAE	*Tetracerus quadricornis*	10	HYNAEDAE	*Hyenae hyaenae*
3	CANIDAE	*Canis aureus*	11	LUTRANAE	*Aonyx cinerea*
4	CANIDAE	*Vulpes vulpes*	12	LUTRANAE	*Lutrogale perspicillata*
5	CERCOPITH E CIDAE	*Macaca mulatta*	13	MURIDAE	*Neviventer fulvescens*
6	CERVIDAE	*Axix axix*	14	MURIDAE	*Niviventer fulvescens*
7	FELIDAE	*Pardofelis nebulosa*	15	MUSTELIDAE	*Martes flavigula*
8	FELIDAE	*Panthera pardus*			

Birds

S.N	COMMON NAME	SCIENTIFIC NAME
1	Little Grebe	*Tachybaptus ruficolis*
2	Little Cormorant	*Phalacrocorax niger*
3	Lesser Whistling Duck	*Dendrocygna javanica*
4	Cotton Pigmy-Goose	*Nettapus cormandelianus*
5	Common Teal	*Anas crecca*
6	Black-crowned Night Heron	*Nycticorax nycticorax*
7	Pond Heron	*Ardeola grayii*
8	Cattle Egret	*Bubulcus ibis*
9	Little Egret	*Egretta garzetta*
10	Grey Heron	*Purple Heron*
11	Purple Heron	*Painted Stork*
12	Asian Openbill Stork	*Anastomus oscitans*
13	Black Stork	*Ciconia nigra*
14	Wooly-necked Stork	*Ciconia episcopus*
15	Lesser Adjutant	*Leptoptilos javanicus*
16	Black Ibis	*Pseudibis papilisa*
17	Oriental White Ibis	*Threskiornis melanocephalus*
18	Eurasian Spoonbill	*Platalea leucorodia*
19	White-breasted Waterhen	*Amaurornis phoenicurus*
20	Common Moorhen	*Gallinulachloropus*
21	Water cock	*Gallinula cinerea*
22	Purple Gallinule	*Porphyrio porphyrio*
23	Bronze Winged Jacana	*Metopidus indicus*
24	Pheasant-tailed jacana	*Hydrophasianus chirugus*
25	Gray-headed Plover	*Hoplopterus cinereus*
26	Red-wattled Plover	*Hoplopteris indicus*
27	Common Snipe	*Gallinago gallinago*
28	Comon Green Shank	*Tringa nebularia*

S.N	COMMON NAME	SCIENTIFIC NAME
51	Wire-tailed Swallow	*Hiruno smithii*
52	Indian Peafowl	*Pavo cristatus*
53	Eurasian Collared Dove	*Streptopelia decaocto*
54	Alexandrine Prakeet	*Psitta eupatria*
55	Red collared Dove	*Streptopelia tranqubarica*
56	Rose-ringed Parakeet	*Psittacula krameri*
57	Plum-headed Parakeet	*Psittacula cyaneocephala*
58	Red-breasted Parakeet	*Psittacula alexandrii*
59	Common koel	*Eudynamys scolopacea*
60	Greater Coucal	*Centropus sinensis*
61	White-throated Kingfisher	*Halcyon smyrnensis*
62	Eurasian Golden Oriole	*Oriolus oriolus*
63	Long-tailed Shrike	*Lanius schach*
64	Black Drongo	*Dicrurus macrocercus*
65	Rufous treepie	*Dendrocitta vagabunda*
66	Baya Weaver	*Ploceus phillipinus*
67	Red Avadavat	*Amandava amandava*
68	Scaly-breasted Munia	*Longchura punctulata*
69	Yellow-brested Bunting	*Emberiza aureola*
70	Crested Bunting	*Melophus lathami*
71	Stork-billed Kingfisher	*Pelargopis capensis*
72	Common Kingfisher	*Alcedo atthis*
73	Pied Kingfisher	*Ceryle rudis*
74	Blue-bearded Beeeater	*Nyctyornis athertoni*
75	Blue-tailed Beeeater	*Merops phillipinus*
76	Chestnut-headed Beeeater	*Merops leschenaultia*
77	Hoopie	*Upupa epops*
78	Gray Hornbill	*Tockus birostris*

29	Green Sandpiper	*Tringa ochropus*
30	Black Shouldered Kite	*Elanus caeruleus*
31	Pallas's Eagle	*Ichthyophaga nana*
32	Egyptian Vulture	*Neophron percnopterus*
33	White-rumped Vulture	*Gyps benglensis*
34	Slender-billed Vulture	*Gyps tenuirorstris*
35	Cinerous Vulture	*Aegypius monachus*
36	Crested Serpent Eagle	*Spolornis cheela*
37	Eurasian Marsh Harrier	*Circus aeruginosus*
38	Northern Sparrow Hawk	*White-Eyed Buzzard*
39	Butastur teesa	*Steppe Eagle*
40	Osprey	*Pandion haliaetus*
41	Common Kestrel	*Falcon tinnunculus*
42	Peregrine	*Falco preregrinus*
43	Collard Falconet	*Michrohierax caerulescens*
44	Eurasian Eagle Owl	*Bubo bubo*
45	Spotted Owlet	*Athene brama*
46	Jungle Owlet	*Glaucidium radiatum*
47	Brownn Hawk Owl	*Owl Ninix scutulata*
48	Barn Ow	*Tyto alba*
49	Black Francolin	*Francolinus francolinus*
50	Barn Swallow	*Hirundo rustica*

79	Lineated Barbet	*Megalaima lineate*
80	Blue-throated Barbet	*Megalaima haemacephala*
81	Black-rumped Flameback	*Dinopium shorii*
82	Fulcous-frested Pied Woodpecker	*Dendrocopos macei*
83	Bengal Bushlark	*Mirafra assmica*
84	Rufous-tailed Lark	*Ammomanes phoenucrus*
85	White-browed wagtail	*Moralcilla maderasatensis*
86	Red Whiskered Bulbul	*Pycnonotus jocosus*
87	Red Vented Bulbul	*Pyconotus cafer*
88	Asian Magpie Robin	*Copsychus saularis*
89	Commomn stone chat	*Saxicola torquata*
90	Pied Bush Chat	*Saxicola caprata*
91	Gray-headed canary fly catcher	*Culiciapa ceylonensis*
92	Verditer Flycatcher	*Muscicapa thalassina*
93	Asian Paradise Flycatcher	*Terpisphone paradise*
94	Scaly Thrush	*Zoothera dauma*
95	Velvet Fronted Nuthatch	*Sitta frontalis*
96	Chestnut bellied Nuthatch Oriole	*SItta castanea*
97	Purple Sunbird	*Nectarinia asiatica*
98	Oriental White Eye	*Zosterops palpebrosa*
99	Black Hooded	*Oriolus xanthornus*

VIII. Some Snaps of Studied Area

Picture 1: Resus Monkey at Lumbini

Picture 2: Ostrich at farm at Tilottama Municipality

Picture 3: Mayadevi Temple at Lumbini

Picture 4: Peepal tree of Lumbini

Picture 5:- Community forest of Lumbini

Picture 6:- Sarus Crane at farmland at Bagauli VDC

Picture 7:- Lesser Adjuctant Stroke at wetland of Butwal Sub-Metropolitan

Picture 8:- Folk of Sarus Crane at Gaidahawa Tal

Picture 9:- Tinau River at Suryapura VDC

Picture 10:- Nilgai Grazing at Grassland of LDT area

Picture 11:- Nilgai at Farmland of Gonaha VDC

Picture 12:- Nilgai at Community Forest of Butwal Sub-Metropolitan

Picture 13:- Fecal Pellets (Bairghat VDC and Rudrapur VDC)

Picture 14:- Nilgai at Community Forest Bishnupura VDC

Picture 15:- Interview with Local Peopleof

Picture 16:- Walking through Line Transect (Farmland and Riverine habitat)

Picture 17:- Crop depredated by Nilgai (Kamahariya VDC, Bagauli VDC, Lumbini Ciltural Municipality and Tilottama Municipality)

Picture 18:- Mitigation Measures (Wire Net (Tilottama Municipality), Scare Crow (Rudrapua VDC), Deterrents (Devdaha Municipality), Net (Bairghat VDC), Shining Tape (Suryapura VDC) and Deterrents (Paschim Amuwa VDC))