1. INTRODUCTION

Conservation is the planning and management of resources, so as to maintain and enhance their quality, value and diversity for the present and future use by the mankind. Wildlife conservation involves the protection, preservation, perpetuation and judicious control of rare species in their natural habitats (Rastogi 1996).

The Conservation Status of a species is the indicator of the likelihood of that species continuing to survive either in the present day or the future. Many factors are taken into account when assessing the conservation status of a species not simply the number remaining but the overall increase or decrease in the population over time, breeding success rates, known threats and so on. Small isolated populations of wild animals are vulnerable to extinction through demographic, environmental and genetic stochasticity and catastrophes such as disease epidemics (Shaffer 1981 – cited in Khanal 2006).

1.1. Species Introduction

Blackbuck (*Antelope cervicapra* Linneaus, 1758), locally known as Krishnasaar, is an elegant, gazelle-like animal regarded as the most handsome member of the Bovidae family. It belongs to the subfamily 'Antilopinae' and order 'Artiodactyla'. The scientific name *Antelope* is restricted to Blackbuck only. Artiodactyls appeared in the age of Mammals in the Eocene epoch (57 to 37 MYA) and flourished during the middle of Tertiary (Grzimek 1972). The first fossil of the animal dated back to early and mid Pleistocene period, which witness the evolution of so many modern mammalian species of the world (Ranjitsinh 1989).

Mungall (1978) described four species of *Antelope cervicapra* according to the coat colour, length and the shape of the horn. They are:

i. *Antelope cervicapra cervicapra* in the South India
ii. *Antelope cervicapra centralis* in the Central India
iii. *Antelope cervicapra rupicapra* in Northern India and Nepal
iv. *Antelope cervicapra rajputane* in the North-West India and Pakistan

1.2. Status of Blackbuck

The Blackbuck is vulnerable as per the IUCN categories and is listed in the Appendix III of the CITES (Chapagain and Dhakal 2002). The National Park and Wildlife Conservation Act 1973, has listed 27 species of protected mammals and Blackbuck is one of them.

1.3. Distribution

The Blackbuck is typically South Indian in distribution, having once occurred from what is now West Pakistan along the foothills of the Himalayas from Punjab through Uttar Pradesh and Nepal to West Bengal and East Pakistan (Lydekker 1924 cited in Chand 1999). Once there were four million Blackbucks in India; by the end of 1964, only 8,000 remained (Rao and Prasad 1982); Ranjitsinh (1989) estimated a total of 45,000 animals in India. The Blackbuck was extinct in Bangladesh and also became extinct in Pakistan in 1970s but 10 animals were re-introduced from Texas, USA in Lal Sunhara National Park of Sindh Provience of Pakistan (Burton and Burton 1987).

In Nepal, before the malaria eradication programme, Blackbucks were commonly found in Eastern and Western Terai; but later the population of Blackbuck declined gradually. Scattered population of Blackbucks occurred in Kanchanpur, Bardia and Banke districts in Western Nepal as late as 1960s (Paudel 2009). Blackbucks are now restricted to Khairapur, Bardia, few are in captive in Central Zoo and Mahendra Park and few are in semi-captive enclosures at Mrigasthali, Kathmandu (Khanal 2006).

1.4. Morphology

This animal is built like a gazelle. There is great difference in coloration of the sexes (Grzimek 1972). The male Blackbuck has striking black and white pelage and bears long spiral horns (Shrestha 2003). The brown areas in the males gradually darken with age finally becoming black (Prater 1965). The doe is yellowish on the head and back. The male Blackbuck stands 70 to 80 cm at shoulder height. Its weight varies between 34 to 45 kg, that of adult females between 31 to 39 kg (Ranjitsinh 1989). In both sexes, the under parts, insides of the legs and an area encircling the eyes are white. In males, the nape is rusty (Shrestha 2003). A light coloured streak runs laterally along the upper flank of the

body. They have pronounced pre-orbital glands which secrete a pungent sticky secretion, which the animal uses to mark territories (Mungall 1978-cited in Chand 1999).

The horns are marked with rings and make there to force spirals in adults (Schaller 1967). These horns are non-deciduous horns that grow from an ossicone on the forehead and are hollow giving rise to the designation bovids as hollow horned ruminants (Grzimek 1972).

1.5. Ecology and Behaviour

The Blackbucks have the preference for open habitat with low grazing grasses and tend to avoid environment dominated by tall grasses (Schaller 1967). They are gregarious and gather in herds. Blackbucks are true grazers, but sometimes they browse over leaves of trees and take some herbs and shrubs. While grazing and browsing, they keep themselves alert for danger and raise their heads to look around. Daily requirement of food by the Blackbuck accounts for nearly 6 percent of its body weight (Kafle 1998). According to Nair (1975), cud chewing in Blackbuck takes place at the rate of three chews per two seconds.

Blackbuck changes its social structure and behavior according to the season. Schaller (1967) recognized the following types of social structure in the Kanha National Park.

i. Mixed herds consisting of a loose aggregation of bucks and does
ii. Breeding herds consisting of a buck and several does confined to the territory at the time of rut, and
iii. Buck herds consisting solely of bucks

Mating is throughout the year with two peak rutting seasons (July- August and February-March). The female antelope gives birth to one fawn at a time at the age of two years, and gestation period lasts for a period of six months. Blackbucks maintain nearly constant breeding size consisting of 10-20 individuals, occasionally they range up to 40. A number of excess bucks which neither established a territory nor acquire does, occur throughout the year either in bachelor herd or periphery to breeding herd (Schaller 1967). Territories were marked with urination-defecation and with pre-orbital glands. However, in the Blackbuck, the steeply erect posture of the neck and head also occurs when the animal is displaying against its opponent. Then he raises his head again (Grzimek 1972).

Blackbucks are extremely swift, one of the fastest of land animals, credited with speeds of 50 mph. They can take strides of 19-22 ft and can leap over six feet into the air (Burton and Burton 1974). Schaller (1967) recorded the speed of running buck to be 33 miles per hour.

1.6. Population status of Blackbuck in Nepal

There is a chaotic fluctuation in population of Blackbuck in Nepal at Khairapur (Figure 1 and Appendix II). There were only 11 individuals of Blackbuck in the year 1975. The population rose to 190 in 1988. It declined to 92 in the year 1993. Anthropogenic activities like encroachment of the area, clearing bushes, over grazing by livestock and use of stray dogs to chase Blackbuck were the main reasons for the decline in Blackbuck population. It reached 40 in 2000. The sudden decline in Blackbuck population in 1999 was largely due to the dispersal of 39 individuals on the Indian side (FONAREM, 2007). The gradual increase in population of Blackbuck was observed since 2000 and it has currently reached to 264. The continuous conservation efforts, local people's participation and the establishment of BCA have improved the status of Blackbuck population at Khairapur.

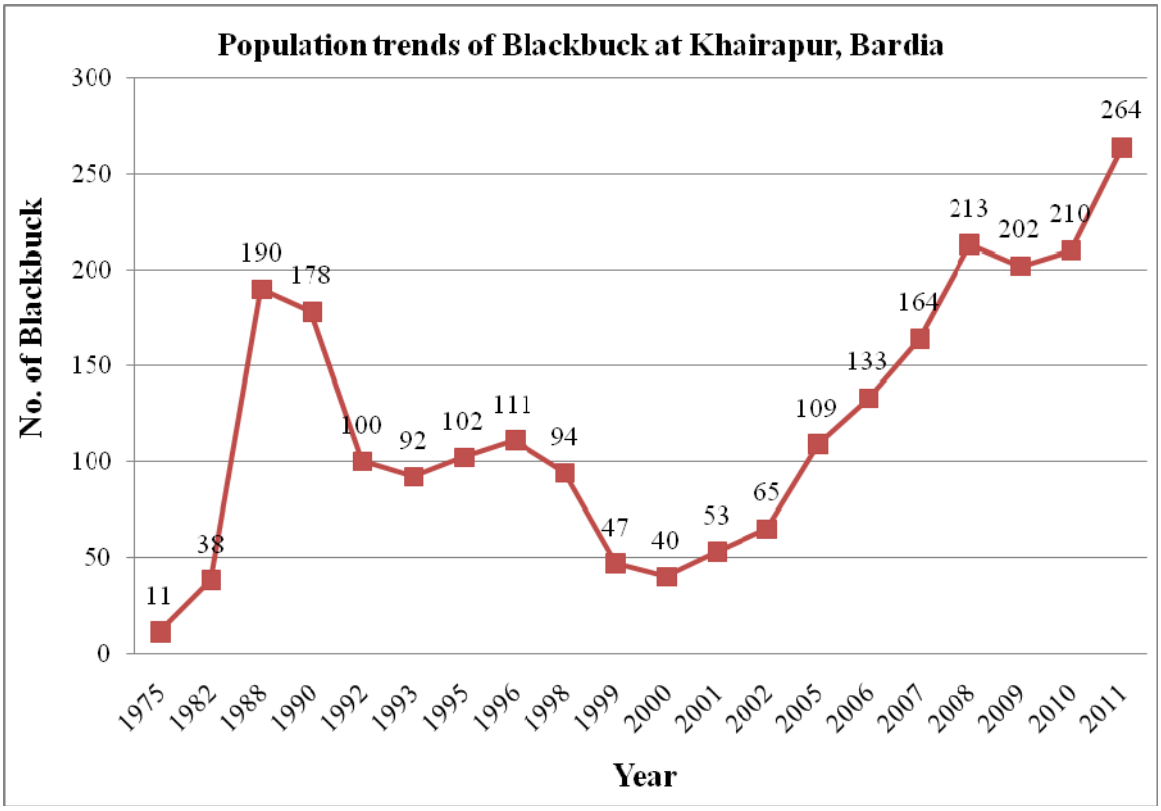


Figure 1: Population of Blackbuck at Khairapur (Source: DNPWC, 2010 and field study, 2011)

1.7. Conservation threats

The major threats to Blackbuck in the BCA are habitat encroachment (by illegal human settlement), excessive livestock grazing, diseases, no other habitat option for Blackbuck, chances of inbreeding, human disturbances in the core habitat including grass cutters and visitors, village dogs and predators like Common Leopard, Jungle cat, *Hyaena* and Jackal.

1.8. Conservation Practices

The Blackbuck Conservation Practices and efforts at Khairapur are Land acquisition and BCA boundary, Infrastructure development, growing seasonal crops, control of weeds and non-palatable species Besurma (*Ipomea fistulosa*), involvement of NGO's and INGO's like ICDC and CCEW and TAL Programme under WWF, Local Conservation Committees and Eco-clubs. The construction of fences and trenches, water holes as well as planting provisional crops and controlled fire in BCA help in the management of Blackbuck.

1.9. Economic Importance

Blackbuck has important ecological roles in grassland ecosystem. It has genetic, medicinal (horns and skin to cure liver and heart diseases), scientific, aesthetic and recreational value. In Hinduism and Buddhism, the horns and skin of Blackbuck are used in rituals like '*Bratabandha'* and in meditation by Saints; respectively. In Australia, Blackbuck has good meat value.

1.10. Rationale of the study

The recent population scenario of Blackbuck shows an increasing trend of Blackbuck which are found only in a small area of the core habitat. In that condition, it encourages to study the distribution of Blackbuck in the area as well as several conservation problems in BCA. The major research questions of this study were:

What is the population status of Blackbuck at Khairapur? Are all the areas of the core habitat occupied? What are the major conservation threats to the Blackbuck? Is Blackbuck troublesome due to crop depredation? These are the priority areas of this study.

1.11. Objectives of the study

The main goal of this study was to gather information on the population, animal distribution and conservation problems of Blackbuck at Khairapur, Bardia.

The specific objectives of the present study were:

1. To estimate the population status and density of Blackbuck at Khairapur.
2. To study the seasonal habitat use pattern of the Blackbuck at Khairapur
3. To investigate the threats to Blackbuck
4. To determine the crop loss by Blackbuck

1.12. Justification of the study

The main aim of carrying this study on Blackbuck is because Blackbuck is a vulnerable as well as single population species in the wild in Nepal, so its habitat should be managed properly for its survival and population growth. More area of BCA is encroached by the human settlement and agricultural lands, which cannot be vacated easily in short time period. But it is possible to manage the small area of the core habitat for the conservation of Blackbuck until the other areas are in the objective use. So it is necessary to know about the seasonal habitat use pattern of Blackbuck which helps to draw effective approaches for the Blackbuck habitat management. Also the information on conservation threats and crop depredation can be worthy for the species management in the area. Therefore, this study has its significance in itself.

1.13. Limitations of the study

- Night observations could not be made.
- Sex of fawns could not be identified.
- Pellets of Blackbuck could not be observed due to tall grasses in BCA.
- Sophisticated scientific instruments could not be used for the study.
- Budget constraint

2. LITERATURE REVIEW

Dinerstein (1975) and **(Wegge and Wilson 1976)** revealed the existence of two small remnant populations of Blackbuck in the Bardia and Banke districts; respectively, of the Western Terai in Nepal.

Rao and Prasad (1982) estimated only 8,000 Blackbucks in India.

Ranjitsinh (1989) estimated a total of 45,000 animals in India. He estimated the weight of Blackbuck which varied between 34 to 45 kg in males; adult females were between 31 to 39 kg. The male Blackbuck measured 70 to 80 cm at shoulder height.

Schaller (1967) reported that short grasses, such as *Chrysopogon, Paspalum* and *Sporobolus*, composed the bulk of the diet in Kanha National Park. He reported that in Blackbuck, grazing is more frequent in females than in males. He also observed that lying was more frequent in males than in females. He also reported the breeding seasons in Blackbuck which is a minor peak in April and a more intense peak from August to October.

Bhandari (1994) made an assessment of the food habits of Blackbuck in the study area. The result of faecal analysis showed that the average intake of crops in winter season were much higher (54%) than during summer season (33%). Utilization of grasses in the summer season was 68% and during the winter, it constituted 46%. He also recorded that number of livestock in Blackbuck habitat increased to 1100-1200 in 1994.

Prasad (1987) investigated the territoriality in Blackbuck, for two years in six individually identified territorial bucks at Mudmal, Andhra Pradesh. The territory size varied from 3.33 ha to 16.65 ha with a mean size of 9.19ha. The minimum territorial period was five weeks, while the maximum was 9.5 months. All territories had characteristic ‘scrapes’ ie: shallow depressions about 20 cm deep, 80 cm long and 30 cm

wide dug by males with the hooves of the forelegs, digging 2-3 times each with the first one and then the other.

Khanal (2006) investigated that the most common activity in day time was feeding (57.33%) followed by resting (20.61%), walking (12.44%), others (6.29%) (sparring, chasing, courtship, mating, etc) and alert (3.34%). The average number of the livestock grazed inside the Pataha Phanta in a characteristic day excluding the night grazers were found to be 976 per day; almost 7.34 times more than the Blackbuck population. He also reported *Paramphistomum*, *Strongyles* and *Ascaris* as the common gastro-intestinal parasites in the livestock and Blackbuck.

Baur and Ellenberger (1988) recorded the total livestock grazed in the Blackbuck habitat at Khairapur were 811 (671 Cows, 108 Buffaloes and 32 Goats).

Tapol (2001) studied the behavior of Blackbuck in captivity and found that its behavior had not changed from that of its behavior in the wild except that the territory of the male Blackbuck was not observed in the captivity, but could be sensed through its agonistic behavior or fights among the males. He also estimated the average diet of a Blackbuck in captivity to be 1.185 kg. He also includes that the domestic animals grazing in Blackbuck habitat in Bardia National Park's record in 1988 was 811 while it was 1100 to 1200 in 1994. He also mentions the migration of Blackbuck across the border as a major problem in conservation of Blackbuck.

According to a report, between May 1995 and March 1996, stray dogs killed four Blackbucks, which prompted park authorities to kill the dogs **(DNPWC 2005)**.

Nair (1975) reported that in Blackbuck, grazing is more frequent in females than in males. He mentioned that the cud chewing in Blackbuck takes place at the rate of three chews per two seconds.

Bharucha and Asher (1993) reported that the herd size and structure of Blackbuck is in a constant state of flux. The activity pattern of ungulates may also be influenced by the age, sex, pasture and climatic conditions. He also includes that in protected areas where

Blackbuck population show an upward trend, they become increasingly dependent on adjacent croplands, leading to increasing man-animal conflict due to localized intense crop damage. According to him, the general principle for the Blackbuck habitat management should aim at encouraging the animals into smaller interlinked populations rather than into single, fragmented, high density aggregations.

Rahmani (1989) mentions that crop damage by Blackbuck are a major issue. He also recommended the translocation of wildlife from the locally abundant populations to provide genetic vigour to depleted populations as an important management tool in future.

Kafle (1998) studied the conflict between Blackbuck and local people in Khairapur village and found that the people living within 1 km distance received the maximum loss. 91% of the respondents claimed that pulses were totally destroyed by Blackbuck.

Paudel (2009) estimated the area covered with different land-use types in Blackbuck habitat in which grassland covered 32.71% and 30.71% of the habitat was covered with settlement area and cultivated land. He estimated 586 households which also show the ultimate threats to the Blackbuck survival.

Chand (1999) estimated the total population of Blackbuck at Khairapur to be 94 with a density of 19.38 animals per sq. km. According to him, Hyaena (*Hyaena striata*) and Wolves as predator as well as poaching were the main causes of decline of Blackbuck population in Nepal.

Nepal (1994) reported that the major problems for the declination of Blackbuck in Nepal were habitat destruction, overgrazing by the cattle and predation particularly by the domestic dogs.

Tamang and Shrestha (1998) reported that nine Blackbucks killed by dogs in 1995/ 1996; the most vulnerable were the young and the pregnant females. Stray dogs killed nine Blackbucks during 1997-2000. The report also includes that the present habitat of

Blackbuck was isolated and densely encroached by human and inbreeding, diseases and visitors as the factors affecting the survival of Blackbuck.

Khanal (2000) recorded 415 people, five motorbikes and12 bull carts that travelled from the area in a particular day.

Puri (1960) mentioned that the short grass types are maintained by heavy grazing and periodic fires in Northern India.

Lehmkuhl (1979) mentions that succession can be reversed to favor short grasses by burning and mechanically breaking *Imperata* stands, making the area more suitable for grazing animals such as Blackbuck.

Khanal (2002) had conducted the researches on habitat options for the conservation of the last remaining Blackbuck population in Nepal. Among the three new translocation sites (Rauteli Bichuwa, Arjuni and Chaliaya Phanta of Suklaphanta Wildlife Reserve), the Rauteli Bichuwa was recommended as the most suitable habitat for the animal. He also mentioned that a total of 342 dogs were killed at Khairapur in 1993-1999. He also gave light on the importance of mild grazing for the Blackbuck as the animal prefers sprouting shoots of grass.

3. MATERIALS AND METHODS

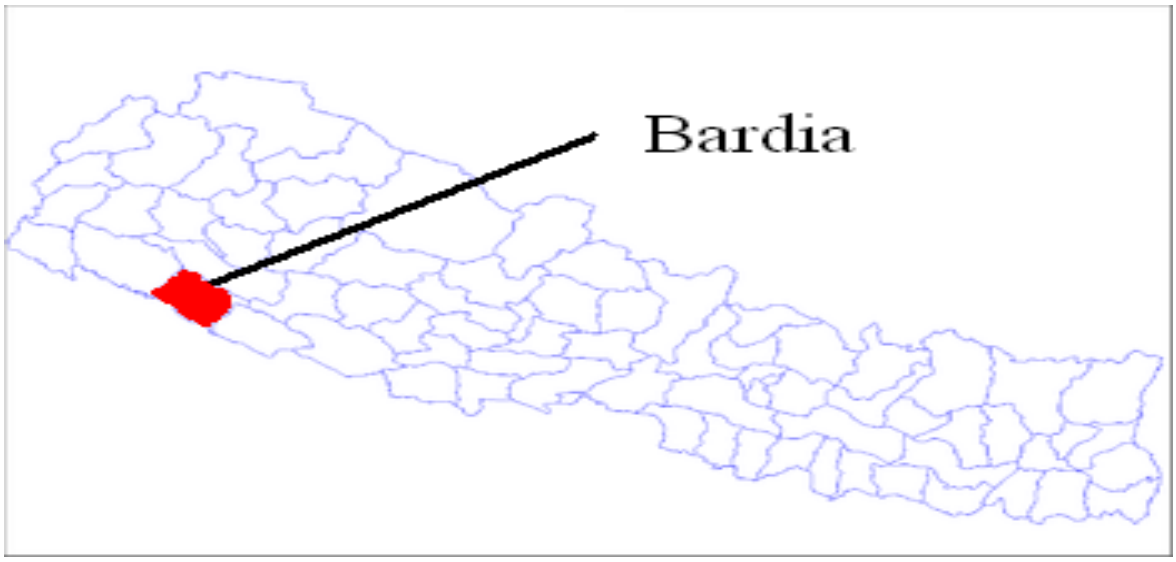
3.1. Study Area

The study was done in BCA, the only Conservation Area of Terai, which is located at Khairapur and Ward Number 2, 3, 4 and 5 of Gulariya Municipality (20˚7'54'' to 28˚17'22"N and 81˚16'48" to 81˚22'54''E) in Bardia District in western Nepal. The BCA is located at a distance of 30 km east of Bardia National Park. It covers an area of 16.95 sq. km which includes the core habitat of 5.27 sq. km. and peripheral area of villages and settlements spreading over 11.68 sq.km.

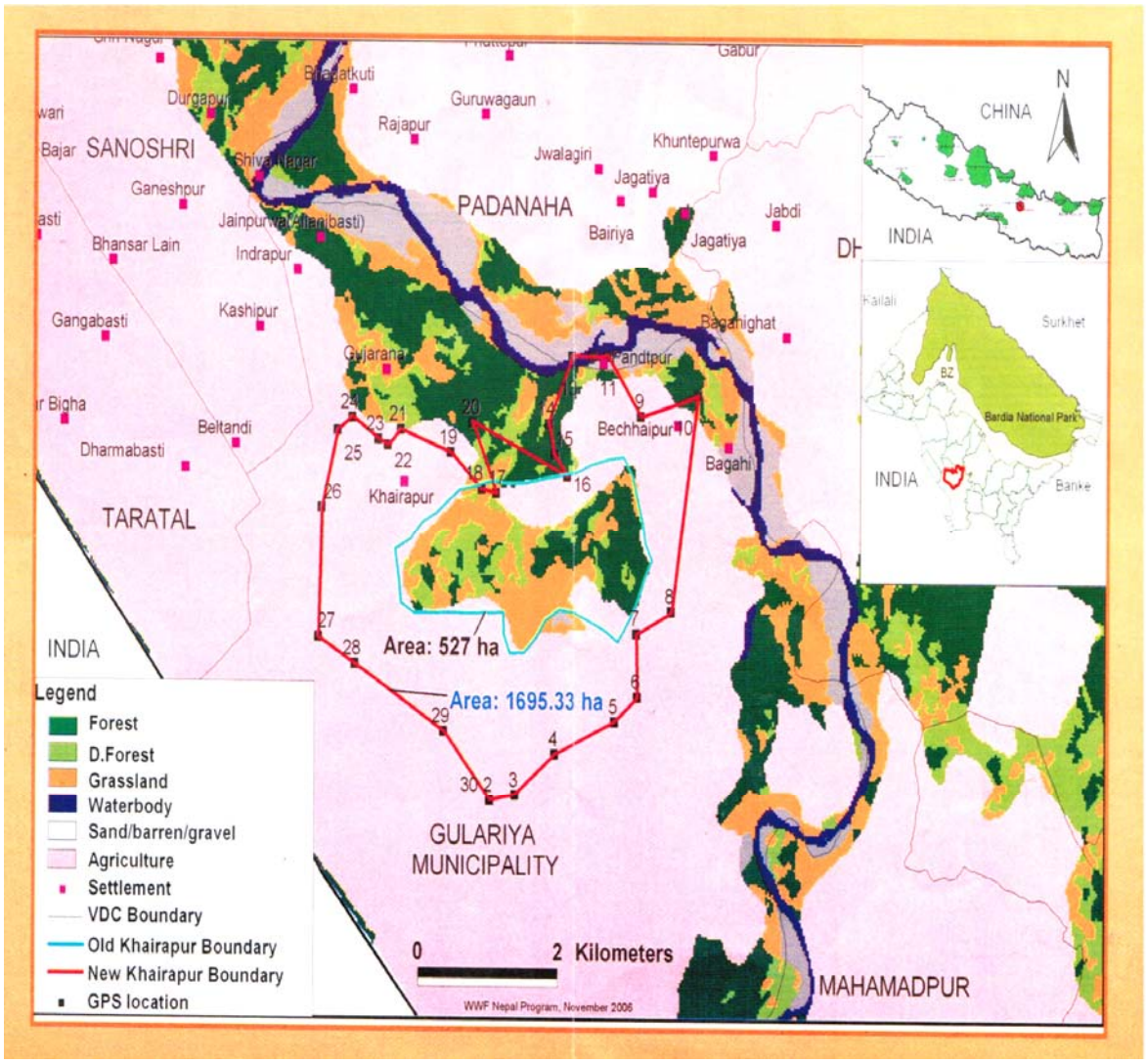
The Blackbuck habitat is situated in Pataha Phanta. The old Babai riverbed, locally known as '*Sarju Nadi*', runs along north, west and south boundary of the study area. The area is mostly marginal agricultural land and grazing land bordered on the three sides by the old riverbed and on the other side by scrub jungle (Lehmkuhl 1979). Topography of the study area is more or less flat land, sloping towards the south with an elevation of average 146m above mean sea level.

The Siwalik Range of Bardia is late tertiary in origin having fine grained sandstone with deposits of clay, shale conglomerate and fresh water limestone (Bolton 1976). The sandy slopes are heavily leached, whereas the lowland plains are more fertile consisting of fine sand and clay loams (Wegge 1991).

Standing water is found in the old riverbed during most of the year, but dry areas appear in many places during the hot season of March to June (Lehmkuhl 1979).



Map 1: Map of Nepal showing Bardia



Map 2: Map of BCA, Khairapur, Bardia (Source: DNPWC, 2009)

3.1.1. Climate

The study area has tropical monsoon climate and receives less rain than the east. The rainfall occurs from the monsoon coming from the Bay of Bengal. Average annual rainfall was recorded during 2005 to 2010 was 1155 mm. Minimum rainfall was in the year 2006 and maximum rainfall was in the year 2007. The mean annual climate of Rani Jaruwa Nursery, Bardia for the year 2002 to 2010 is given below (Appendix III; Table 10-14).

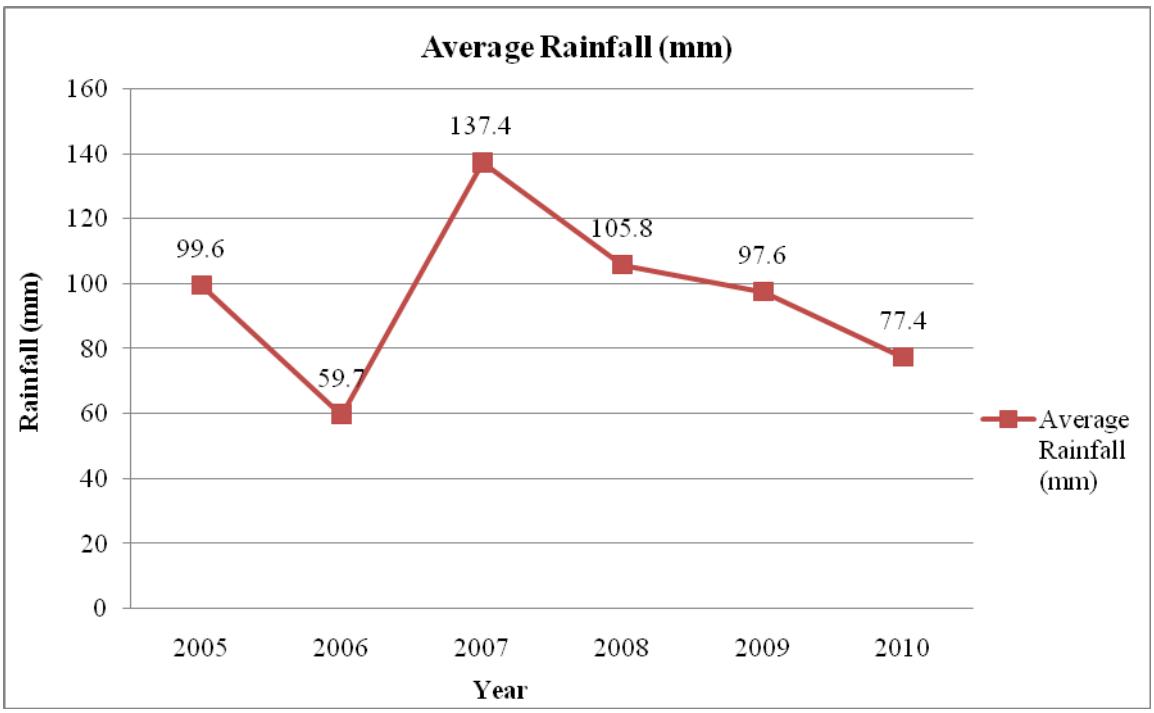


Figure 2: Annual rainfall in Rani Jaruwa Nursery, Bardia, 2005 to 2010. (Source: Department of Hydrology and Meterology, NG, 2006).

Three distinct seasons were identified in this area as hot season (mid February to mid June), monsoon (mid June to late September) and cool, dry season (early October to mid February) (Khanal 2002).

The maximum and minimum temperatures recorded at Rani Jaruwa Nursery from 2006 to 2010 were 40.5˚C and 7.0˚C; respectively.

The annual mean maximum and minimum temperatures recorded at the nursery from 2006 to 2010 were 32.8˚C and 17.5˚C; respectively.

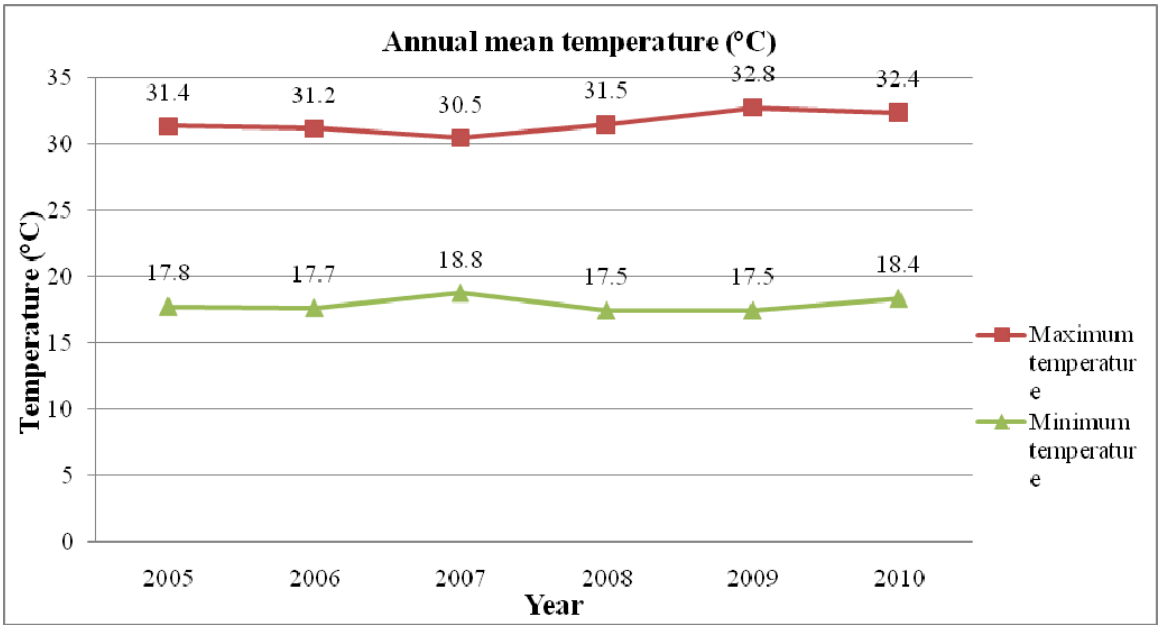


Figure 3: Annual mean maximum and minimum temperature in Rani Jaruwa Nursery, Bardia, 2005 to 2010. (Source: Department of Hydrology and Meterology, NG, 2006).

The western terai is relatively drier area. The maximum annual average relative humidity in the morning and evening recorded at Rani Jaruwa Nursery from 2005 to 2010 were 87.14 and 89.53; respectively. The annual mean minimum relative humidity in the morning and evening recorded at Rani Jaruwa Nursery from 2005 to 2010 were 79.63 and 81.8; respectively.

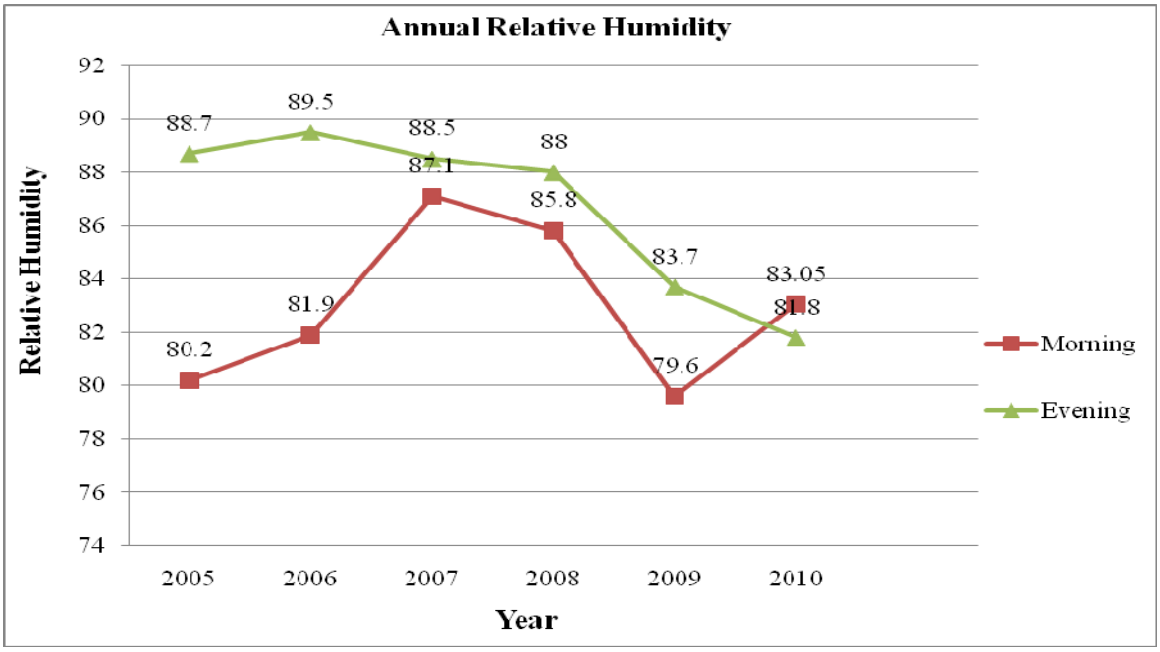


Figure 4: Annual average relative humidity in Rani Jaruwa Nursery, Bardia, 2005 to 2010. (Source: Department of Hydrology and Meterology, NG, 2006).

3.1.2. Flora and Fauna

The Pataha Phanta at Khairapur, also known as the core habitat of Blackbuck consists of few patches of forest land and open grazing land. The forest patch consists of Khair (*Acacia catechu*), Sissoo (*Dalbergia sissoo*), Simal (*Bombax malabaricum*), and Babool (*Acacia nilotica*) with *Glycosmis pentaphylla*, *Ichnocarpus frutescens*, *Zizyphus* sps, *Phyllanthus* sps, and *Murraya koenigii.* The open grazing land is *Imperata-Desmodium* dominated land. The land has a large plot of Jarakush (*Cymbopogon jwarancus*) and was observed spreading to other parts too. The other important plant species of the land consists of *Cynodon dactylon*, *Cyperus* sps, *Seteria glauca, Clerodendrum* sps, *Cassia tora, Rotala* sps, *Brachiaria* sps, *Ipomea fistulosa* etc.

The fauna of the Blackbuck habitat consists of Blackbuck (*Antelope cervicapra*), Common Leopard (*Panthera pardus*), Palm squirrel (*Funambulus pennati*), Brown Hare (*Lepus nigricollis*), Stripped Hyaena (*Hyaena hyaena*), Jackal (*Canis aureus*), Rodents, Black Ibis (*Pseudoidis papillosa*), Pond Heron (*Ardeola grayii*), White necked Stork (*Ciconia episcopus*), Little Egret (*Egretta garaetta*), White breasted kingfisher (*Halcyon smyrnensis*), Cattle Egret (*Bubulcus ibis*), Common Peafowl (*Pavo cristatus*), House sparrow (*Passer domesticus*), House crow (*Corvus splendens*), Jungle Crow (*Corvus macrorhynchus*), Red vented Bulbul (*Pycnonotus cafer*), White wag tail (*Motacilla alba*), Black Drongo (*Dicrurus adsimilis*), Blue jay (*Coracias bengalensis*), Bengal green pigeon (*Treron phoenicoptera*), Blue rock pigeon (*Columba livia*), Spotted dove (*Streptopelia chinensis*), Ring dove (*Streptopelia decaocto*), Garden Lizard (*Calotes)*, Rattle snake, etc.

3.2. Research Methods

The preliminary survey was done on 25-28 January, 2011 in the BCA and around its vicinity. The study was conducted in and around BCA from 29 January to 22 October, 2011.

3.2.1. Population status

3.2.1.1. Population census

Direct count of the animals was done with the help of binoculars (10×25mm) to estimate the total population, age and sex composition of Blackbuck. The counting was done from

07:00 am to 09:00 am. Repeated regular census was carried out in all the seasons and the maximum concurrent count was taken as the total population of Blackbuck in the study area. During the census, well trained five people were involved. For this the whole study area was divided into three blocks and the people were asked to be in the different blocks for the population census avoiding the double count of an individual.

3.2.1.2. Age and sex composition

The age and sex composition of Blackbuck was determined by using binoculars by repeated observations. Age and sex classes were determined based on (Jhala 1991).

a. Fawns (less than six months)

The neonate Blackbuck is brown over the pigmented areas and finally assumes the typical orange tan. In males, the buds which will latter develop to become horns can be discerned at about four months age. Urination posture is basically used for the identification of sex classes among the fawns.

b. Adolescent (six to 12 months)

Adolescent has lost the body proportion of the fawn, has a longer, deeper body which makes the legs appear relatively shorter and the neck longer than the fawn stage. The withers come up to an adult female's side with typically orange tan coat. Male continue to grow more robust horns which curve forward, grow rings and develop spirals.

c. Sub-adult (one to two years)

Sub- adults are as tall and long as adults and are lighter in built than the adult. The white along the ventro-lateral side of female is comparatively less wide than the pigmented area and bear shorter face than adults. The sub-adult male has horns with two spirals with the tips pointing in. Males still have orange tan pelage and start turning black during this stage.

d. Adult (more than two years)

The width of the white on the side approximates that of the pigmented area. Females often have some darkening on the lower shoulder where the pigmented area borders on the white, on the upper forelegs and on the stifle. Males may be orange-tan, black or any

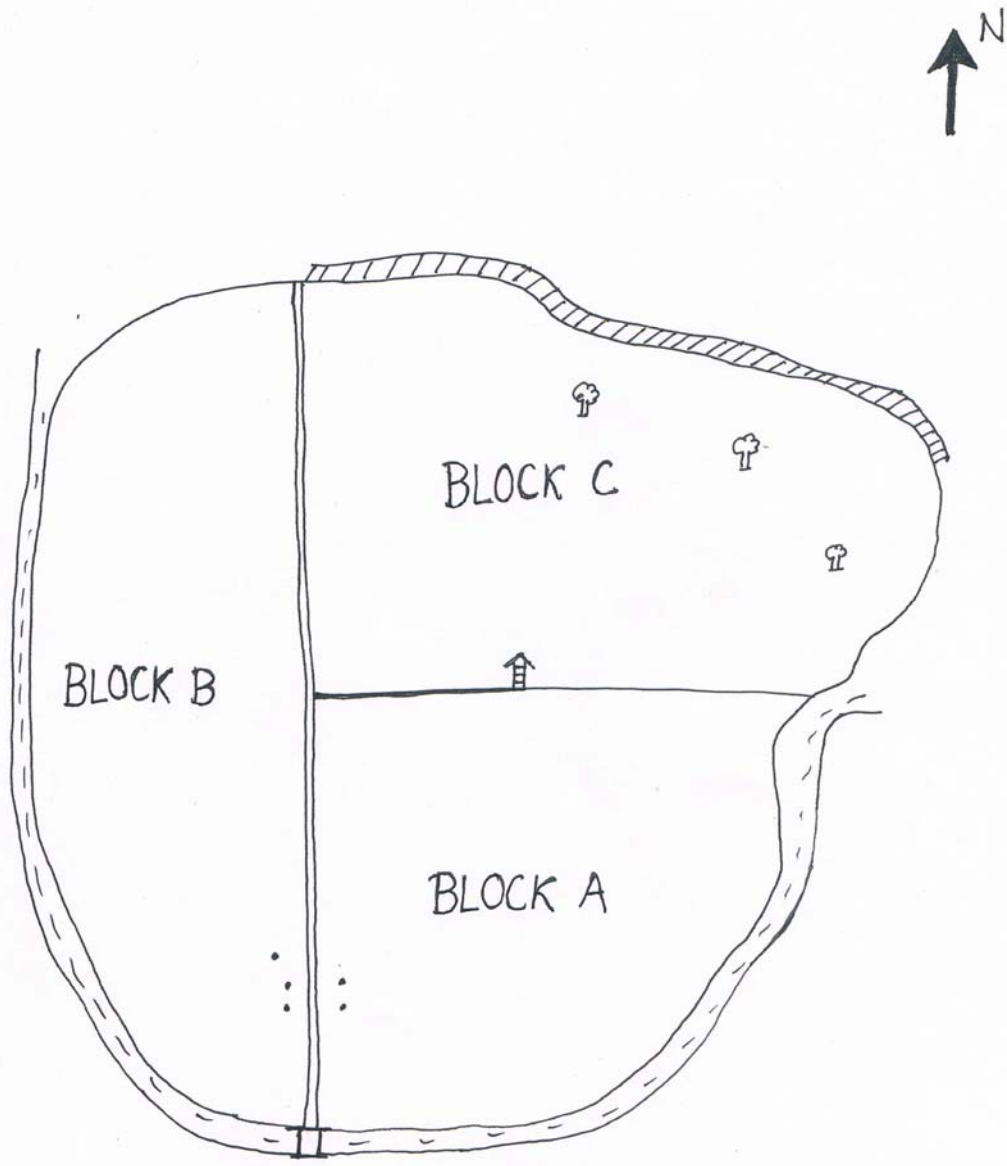
colour in between. The black colour starts to develop after the age of three years, the darkness of which varies in different seasons. The horns have three to five spirals.

3.2.2. Seasonal habitat use pattern

To study the seasonal habitat use pattern the realized habitat of Blackbuck (area approximately 1.74 km^2) was divided into three blocks A, B and C of varying sizes (Table 1). The cart road to Panditpur passes across the Blackbuck habitat. The cart road divides the block B on one side and the remaining two blocks on the other side. The seasonal habitat use pattern was determined by direct count method and indirect count method. In direct count method, the number of individuals found in three blocks was recorded. The daily observation schedule was divided into three shifts: morning shift (07:00 am-10:00 am), noon shift (11:00 am-02:00 pm) and afternoon shift (03:00 pm-06:00 pm). The observations were done regularly in all seasons for a week.

Table 1. Description of the Blocks in the Pataha Phanta:

Blocks	Area (in Bigaha)	Area (km^2)	Area (%)	Remarks
A	64.29	0.527	30.30%	Lies just in front of the guard post; direct monitoring of Blackbuck; open grassland with very few scattered trees; was demarcated by the way to *Machan* and covered the area on the right of *Machan*
B	52.82	0.433	24.89%	Lies in the east; is separated by the cart road; has a patch of secondary forest and few scattered trees
C	95.03	0.779	44.79%	Lies on left of the way to *Machan* and covered a large area including grassland and forest; is also demarcated by the trench in east and northeast
Total	212.148	1.739	100%	



LEGEND

- Sarju River
- Cart road
- Way to Machan
- Trench
- Bridge
- forest area
- Infrastructures

Map of Realized Habitat of Blackbuck, BCA (map not in scale)

In indirect count method, the number of fresh pellet of Blackbuck was counted by transect walk (later separated into block wise) within 4 m belt transect in all the seasons in a particular day.

3.2.3. Vegetation study

The study of vegetation was done by the quadrat sampling method. The perpendicular line transects were made at an interval of 200 m on both sides of the reference line (cart road). The total number of line transects laid were 14 and the total length of transects was 9362 m.

For the study of grasses, shrubs and trees, 1×1 m^2, 5×5 m^2, 20×20 m^2 quadrats were used; respectively at an interval of 100 m in each line transect at the belt transect of 4 m. In 20×20 m^2 quadrats, random nested plot quadrats were used in two corners. A total of 28 quadrats of size 20×20 m^2, 26 quadrats of size 5×5 m^2 and 202 quadrats of size 1×1 m^2 were used to study the vegetation in the study area. The 'dbh' of trees were measured at 1.3 m. The vegetations were studied and recorded based on the local name. The unknown species were collected and preserved as herbarium for their identification. The herbariums were identified at Central Department of Botany, Tribhuvan University, Kirtipur.

3.2.4. Study of conservation threats

a. Habitat encroachment

Direct counts of livestock and transect walk (within the belt transect of 4 m) was done to record the number of pellets or dung of the herbivores. In all the seasons, the human disturbances viz. people on foot, bicycle, motorcycle, carts etc were recorded in a particular day from early morning (07:00 am) to evening (06:00 pm).

b. Diseases

In the summer season the fresh pellets of Blackbuck were collected in plastic bags and were preserved in 10% formalin. The parasites were identified under microscopic observations (10X × 40X). The centrifuging, floatation and sedimentation techniques were used for the study of parasites in Central Veterinary Hospital, Teku, Kathmandu. For each samples, three observations were done under microscope.

c. Predators

The incidents of death of Blackbuck by the attack of its predators were recorded during the field visits.

3.2.5. Questionnaire survey

The questionnaire survey was conducted in 172 households in total. It was done in different wards of Gulariya Municipality that were in vicinity of core habitat of Blackbuck. The respondents were chosen at random based on their settlement from the Blackbuck habitat and were categorized according to the name of the user committee. The main aspect of the questionnaire survey was to know the agricultural practices, animal husbandry and crop damage by Blackbuck.

3.3. Data analysis

3.3.1. Population Density

Population density is defined as the total number of animals per unit area they occupy.

Crude density is the total number of individuals present in the total area and is given as:

$$\text{Crude Density} = \frac{\text{Total no. of animals in an area}}{\text{Total area}}$$

Ecological or Realized density is the total number of individuals present in the actual area habitat available to the species and is given as:

$$\text{Ecological Density} = \frac{\text{Total no. of animals in an area}}{\text{Area of actual habitat}}$$

3.3.2. Herd size

A group or herd of Blackbuck consists of one or more animals and varies at different times of day and seasons. The average herd size was measured as:

$$\text{Average herd size} = \frac{\text{Total no. of animals counted}}{\text{Total no. of groups observed}}$$

3.3.3. Natality and Mortality Rate

Natality is the number of organisms born per female of child bearing age per unit time. The natality rate is expressed as:

Natality Rate (b) = Number of births per unit time

Average population of females

Mortality is the number of deaths per unit time out of the average population and is given as:

Mortality Rate (d) = Number of deaths per unit time

Average population

3.3.4. Vegetation analysis

Different parameters like density, relative density per hectare for a species and IVI etc were determined for quantitative analysis of vegetation following Zobel et.al., 1987. Similarity index was also calculated based on Odum, 1996. Formulae to calculate the parameter are given below.

1. Density (ind/ ha) = Total no of individuals of a sps in all sample units (s.u.) ×100

   Total no of s.u.studied × Area (ha) of sampling units

2. Relative density = Density of a species ×100

   Total density of all species

3. Coverage = Total coverage of individuals of a species in all sampling units

   Total no. of sampling units studied

4. Relative coverage = Coverage of species ×100

   Total coverage of all the species

5. Frequency = No. of sampling unit in which species occurred × 100

   Total no. of sampling units studied

6. Relative frequency = Frequencies of a species ×100

   Total frequency of all species

7. Basal area (BA) = $\pi(dbh)^2$

   4

   where, dbh = diameter at breast height(1.37 m) of a tree

8. Relative Basal area (RBA) = Basal area of a species ×100

   Sum of basal area of all species

9. Basal area per ha for a species = Total BA per ha × $\frac{\text{RBA of the species}}{100}$

   a. Total BA per ha = Density of all species× Average BA per tree

   b. Average BA per tree = $\frac{\text{Total BA of all trees measured}}{\text{No. of trees measured}}$

10. IVI = RD + RF + RBA (RC for herbs and shrubs)

    where, RD = relative density

    RF = relative frequency

    RBA = relative basal area

    RC = relative coverage

    IVI = Important Value Index

11. Shannon Wienner's Diversity Index (H′)

It is the measure of species diversity in a community. It is also called as Heterogeneity. Odum (1996) has given the diversity index as:

$(H') = -\sum (ni/ N) \log (ni / N)$ or $-\sum Pi \log Pi$

where, ni = IVI for each species

N = Total of Importance values

Pi = Importance probability for each species = ni / N

3.3.5. One-way ANOVA test:

The One -way ANOVA test was used to study the seasonal habitat use pattern of Blackbuck at Khairapur, Bardia. The version 2.15.1.0 R Foundation (2012) was used for the statistical analysis.

3.3.5.1. For direct count method:

Null hypothesis:

Ho: There is no significant difference in mean population distribution of Blackbuck in three different blocks due to four seasons.

Alternative hypothesis:

H1: There is significant difference in mean population distribution of Blackbuck in three different blocks due to four seasons.

Null hypothesis:

Ho′: There is no significant difference in mean population distribution of Blackbuck in four different seasons due to different blocks.

Alternative hypothesis:

H1′: There is significant difference in mean population distribution of Blackbuck in four different seasons due to different blocks.

3.3.5.2. For indirect count method:

Null hypothesis:

Ho: There is no significant difference in mean pellet distribution of Blackbuck in three different blocks due to four seasons.

Alternative hypothesis:

H1: There is significant difference in mean pellet distribution of Blackbuck in three different blocks due to four seasons.

Null hypothesis:

Ho′: There is no significant difference in mean pellet distribution of Blackbuck in four different seasons due to different blocks.

Alternative hypothesis:

H1′: There is significant difference in mean pellet distribution of Blackbuck in four different seasons due to different blocks.

3.3.6. Secondary Data Collection

Different reports and journal papers, literatures were incorporated for the secondary data collection.

4. RESULTS

4.1. Population status of Blackbuck

4.1.1. Total population

The population of Blackbuck increased from 210 in 29 January, 2011 to 264 in 22 October, 2011.

4.1.2. Population Density

The total population of Blackbuck counted on 19 Oct, 2011 was 264 and the total area of core habitat of BCA is 5.27 km^2. The crude density of Blackbuck was estimated to 50.09 individuals / km^2.The ecological density of Blackbuck in the study area was calculated to be 151.72 individuals / km^2.

4.1.3. Age and Sex composition

Out of 264 individuals, total male Blackbucks were 87 (32.95%), females were 143 (54.16%). So the male to female ratio was computed to be 1:1.64 showing a sex ratio of 60.97 bucks to 100 does. Among adolescents, out of 81 individuals, male to female ratio was computed to be 1:1.7 showing a sex ratio of 58.82 bucks to 100 does. Among 92 sub-adults, male to female ratio was computed to be 1:1.78 indicating a sex ratio of 56.17 bucks to 100 does. Among 57 adults, male to female ratio was computed to be 1:1.37 showing a sex ratio of 72.99 bucks to 100 does (Figure 5).

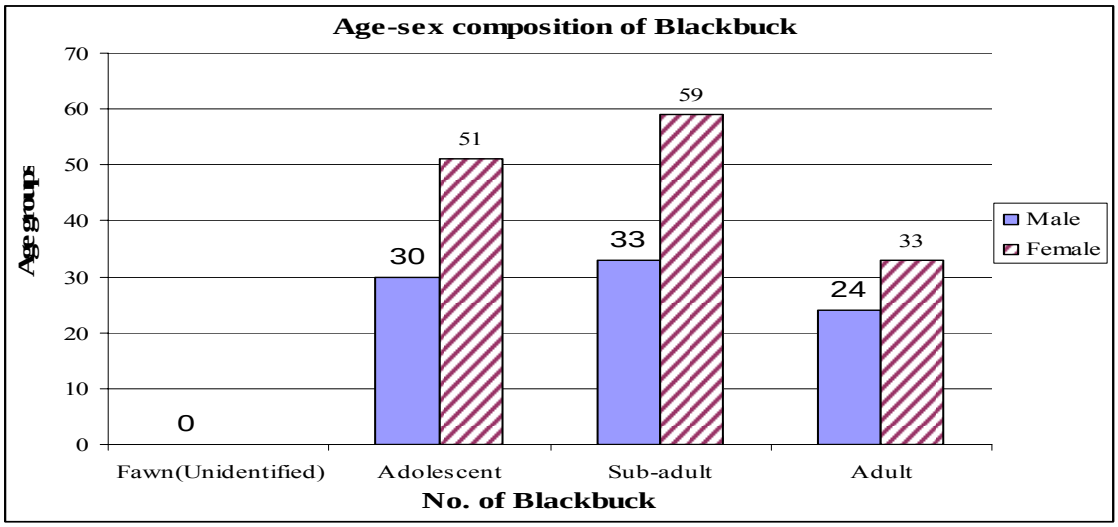


Figure 5: Age- sex composition of Blackbuck in BCA

4.1.4. Herd size

A total of 14,982 individuals of Blackbuck in 992 herds were counted during the overall study period. The average herd size was computed to be 15.10 individuals. The total number of single isolated male was counted to be 1,092 individuals (7.28%).

4.1.5. Natality and Mortality Rate

The total number of live births from 29 January, 2011 to 22 October, 2011 was recorded to be 60 and the average number of females of age of reproduction for that time period was 86. Hence, the natality rate of Blackbuck population at Khairapur was computed to be 0.84 per mature female per year.

The average population of Blackbuck in BCA from 29 January, 2011 to 22 October, 2011 was 237. The total number of death within that period was recorded to be 3 and the mortality rate was computed to be 0.015 per individual per year.

4.2. Seasonal Habitat use pattern of Blackbuck

4.2.1. Vegetation analysis

A total of 32 species of herbs, 10 species of shrubs and four species of trees were recorded based on the quadrat method (Appendix V; Table 19-21). In trees, *Bombax ceiba* (IVI = 201.48) was the dominant tree species in the study area. It was followed by *Dalbergia* sissoo (IVI = 52.83), *Acacia catechu* (IVI = 36.24) and *Quercus floridunda* (IVI = 19.14).

In shrubs, Cassia tora (IVI = 107.8) was dominant followed by *Glycosmis pentaphylla* (IVI = 67.83), *Murraya koenigii* (IVI = 25.40), *Achyranthes aspera* (IVI = 20.24), *Zizyphus mauritiana* (IVI = 19.59), *Phyllanthus* sps (IVI = 17.05) and *Clerodendrum* sps (IVI = 12.96). The other shrubs recorded were *Sida acuta* (IVI = 9.771), *Ichnocarpus frutescens* (IVI = 9.69) and *Zizyphus* sps (IVI = 9.581).

In herbs, *Desmodium microphyllum* (IVI = 62.07) was dominant followed by *Imperata cylindrica* (IVI = 48.60), *Chrysopogan aciculatus* (IVI = 22.35), *Cymbopogon jwarancus* (IVI = 22.35), *Bothriochloa bladhii* (IVI = 21.28) and *Cynodon dactylon* (IVI = 17.39) (Appendix V; Table 20, 21 and 22).

The Shannon Wienner's Diversity Index was calculated to be 1.46.

4.2.2. Direct Count Method

Among 14,982 individuals of Blackbuck counted in the realized habitat of Blackbuck, block A, block B and block C had a total animals counted to be 8,676 (57.90%), 2,795 (18.65%) and 3,511 (23.43%); respectively.

Table 2. No. of Blackbuck counted in three blocks in different seasons

Season	No. of Blackbuck			Total no. of Blackbuck
	Block A	Block B	Block C	
Winter	3,348	438	13	3,799
Spring	2,395	598	657	3,650
Summer	1,403	1,237	1,003	3,643
Autumn	1,530	522	1,838	3,890
Total	8676	2,795	3,511	14,982

Among the 992 herds observed during the study period, block A, B and C had a total number of 481 (48.48%), 275 (27.72%) and 236 (23.79%) herds in total; respectively.

Table 3. No. of herds observed and average herd size of Blackbuck

Season	Total no. of Blackbuck	No. of herds observed			Average herd size
		Block A	Block B	Block C	
Winter	3,799	168	84	42	12.92
Spring	3,650	147	86	52	12.80
Summer	3,643	84	63	70	16.78
Autumn	3,890	82	42	72	19.84
Total	14,982	992			15.10

The one-way ANOVA test concluded that the p value (0.033) with df 2 at 95% level of confidence (LC) signifies the acceptance of alternative hypothesis. And p value was 1 at 3 df at 95% level of confidence (LC), i.e the null hypothesis was accepted (Annexes IV; Table 14, 15 and 16).

4.2.3. Indirect count method

Out of 1,023 signs of fresh pellets of Blackbuck counted, block A had a total of 373 signs (36.46%), block B had 292 signs (28.54%) and block C had 358 signs (34.99%).

Table 4. Indirect method used to study the no. of signs (pellets) of Blackbuck in three blocks in all seasons

Season	Block			Total
	A	B	C	
Winter	159	69	74	302
Spring	127	154	174	455
Summer	20	47	60	127
Autumn	67	22	50	139
Total	373	292	358	1,023

The one-way ANOVA test concluded that the p value was 0.876 at 2 df at 95% of confidence level, so the null hypothesis was accepted. And the p value was 0.00888 having 3 df at 99% of confidence level, so the alternative hypothesis was accepted (Annexes IV; Table 17 and 18).

4.3. Conservation threats

4.3.1. Habitat encroachment

In particular days, the number of livestock that grazed in BCA in winter was 450, in spring 20, in summer 200 and in autumn 50.

From the questionnaire survey, it was found that there were a total of 929 livestock (280 buffaloes, 215 cows, 420 goats and 14 sheep) in 172 households interviewed. Out of 172 respondents, 55.34% of the respondents had their livestock vaccinated and rest (44.65%) respondents had not vaccinated their livestock.

The correlation between Blackbuck and livestock pellets and dung in winter was ($r = 0.180$); in spring, ($r = -0.01$); in summer, ($r = -0.35$) and in autumn, ($r = 0.33$).

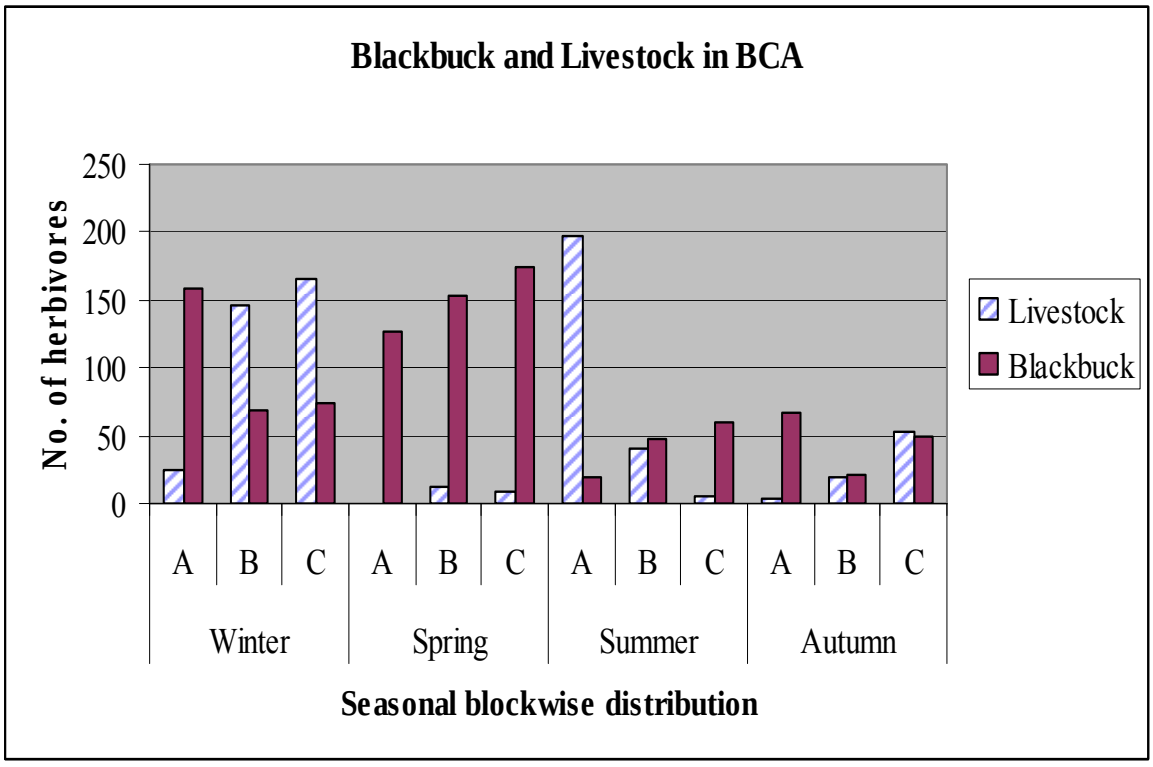


Figure 6. No. of signs of Blackbuck and livestock in three blocks in different seasons

4.3.2. Human Disturbances

A total of 358 people on foot, 1,195 bicycle, 431 motorcycle, nine carts, one bus and nine tractors were recorded to move in and out of the core area based on the one day observation in all the seasons.

Table 5: Human disturbances in the realized habitat of Blackbuck at Khairapur

Season	People on foot	Bicycle	Motorcycle	Carts	Others (Bus, Tractor)
Winter	105	353	38	7	9
Spring	63	247	29	1	1
Summer	90	320	25	1	0
Autumn	100	275	39	0	0
Total	358	1,195	431	9	10

4.3.3. Endo-parasites in Blackbuck

Out of 42 samples of fresh pellets of Blackbuck studied, only 35 samples (83.33%) were infected by endo-parasites and rest (16.66%) was uninfected.

Out of 126 observations, 92 observations had the prevalence of endo-parasites; out of 92 observations, the infections in males, females and fawns were 60 (65.21%), 27 (29.34%) and 5 (5.43%) respectively (Appendix VI and VII).

The status of parasitic prevalence in Blackbuck was *Strongylus* (43.47%), *Paramphistomum* (26.08%) and *Moniezia* (11.95%).

Among the 40 observations infected by *Strongylus*, the infected males, females and fawns were 72.5%, 22.5% and 5%; respectively. The *Paramphistomum* infection was found in 24 observations out of which the infected males, females and fawns were 75%, 20.83% and 4.16%; respectively. The *Moniezia* infected Blackbucks were in 12 observations, out of which, the infected males, females and fawns were 72.72%, 18.18% and 9.09%; respectively (Annexes VI and VII).

Table 6. Endo-parasitic prevalence in Blackbuck

S.N.	Parasites	Male	Female	Fawn	Total
1.	*Strongyles*	29	9	2	40
2.	*Trichuris*	2	1	1	4
3.	*Trichostrongylus*	1	2	0	3
4.	*Paramphistomum*	18	5	1	24
5.	*Fasciola*	1	2	0	3
6.	*Coccidia*	0	2	0	2
7.	*Strongyloides*	1	1	0	2
8.	*Moniezia*	8	2	1	11
9.	*Schistosoma*	0	3	0	3
	Total	60	27	5	92

4.3.4. Predators

An adult female was found dead by the attack of a group of village dogs just in front of *Machan* on 28 July, 2011. Two adult male Blackbucks and a village dog were killed by Common Leopard on 17 Oct, 2011 in Block C nearby the community forest in the east.

4.4. Crop loss by Blackbuck

Out of 172 households interviewed, 67 households (38.95%) suffered crop loss by Blackbuck, 93 households (54.06%) did not suffer crop loss by Blackbuck and agriculture was not done in 12 households (6.97%).

The methods used to get rid of Blackbuck was chasing (58.6%), shouting (18.2%), guarding fields at night (20.8%), making scarecrows (5.6%) and making noise by beating drums (2.5%).

Wheat and maize were highly affected by Blackbuck in the area (Figure 7).

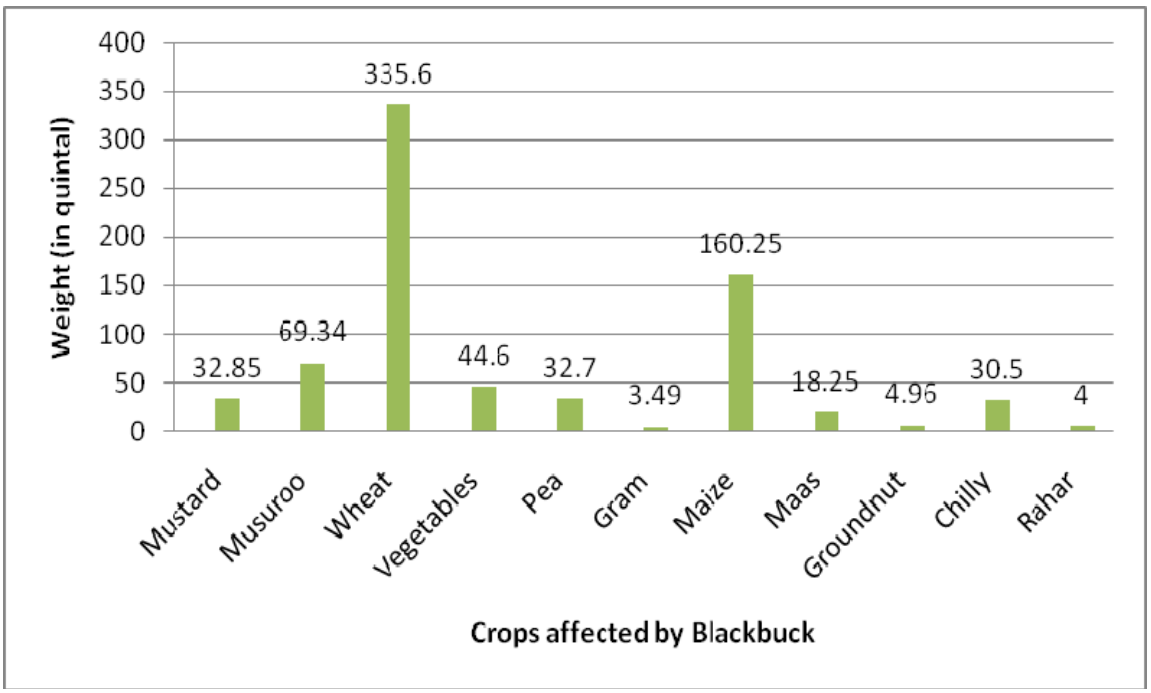


Figure 7. Crop loss by Blackbuck in BCA

It was observed that the crop loss was more in SUC > DUC > RUC > BUC (Appendix VIII; Table 22-25). In Sarju User Committee the crop loss was 328.06 quintals while in Babai User Committee, it was 66.35 quintals (Figure 8).

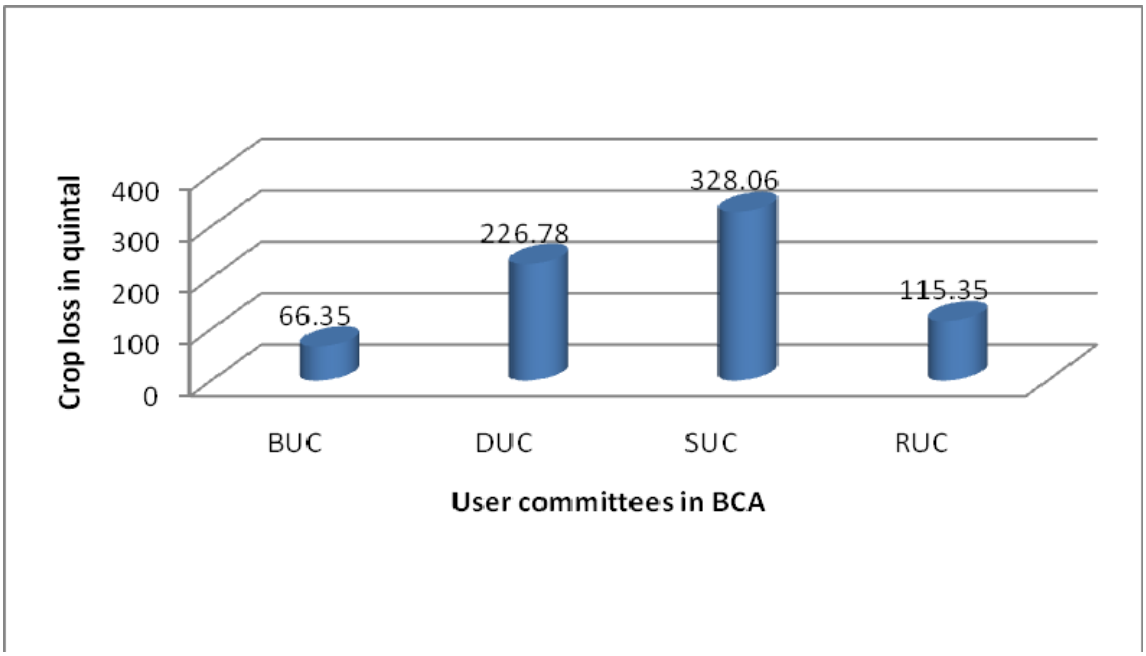


Figure 8. Crop loss in the user committees of BCA

Altogether, the crop loss by Blackbuck was estimated to be 736.54 quintals which amounts to NRs. 2,126,260 in BCA. The crop loss per household in BCA was estimated to be NRs. 31,735.22.

Table 7: Crop loss in the user committees of BCA

User Committees	Total expected yield in quintal	Total observed yield in quintal	Crop loss in quintal	Crop loss (in NRs)
Babai	205.3	138.95	66.35	2,13,060
Dasaratha	805.2	578.42	226.78	6,74,711
Sarju	662.24	334.18	328.06	8,72,720
Radhakrishna	286.7	171.35	115.35	3,65,769
Total	1959.44	1222.9	736.54	21,26,260

There were 97.35% respondents who were positive towards the conservation of Blackbuck; 82.51% of the respondents recommended on the need of construction of alternative road and blockage of the present cart road; 93.65% respondents recommended on fencing around the core habitat of Blackbuck; 52.91% respondents recommended that resettlement of people from the core habitat of Blackbuck should be done immediately and 47.83% respondents were against livestock grazing in the core habitat of Blackbuck.

5. DISCUSSION

5.1. Population status and Density of Blackbuck

The total estimated population of Blackbuck was 264 in 19 Oct 2011. In earlier studies, Chand (1999) estimated a total of 94 Blackbucks in the same habitat; indicating an increase of 180.85% since 1999. The increase in population of Blackbuck from 210 to 264 in 2011 within a short period of time may focus on the effectiveness of controlled and rotational livestock grazing implemented in the area during the study period. Good forage and relatively short grasses were maintained which even resulted a total of 34 births in October as well as no infant mortality due to predators in the habitat. The peak breeding period of Blackbuck at Khairapur was April and October. This agrees with Schaller (1967) who reported that a minor peak in April and a more intense peak from August to October.

The J-shaped population growth form (Odum 1996) was clearly illustrated by the population trend of Blackbuck in Nepal at Khairapur which shows the effect of physical and biological factors to cause chaotic fluctuations in population of the animal in the habitat. The Blackbuck population increased from 11 individuals recorded in 1975 to 264 individuals in 2011 at Khairapur. Similarly, between 1960 and 1980, the population of Blackbuck grew from about 20 animals to around 200 in Rehekuri Blackbuck Sanctuary (Bharucha and Asher, 1993). This increase in population of Blackbuck may have the chances of inbreeding too. Two horned females were observed in BCA which might also be an effect of inbreeding.

The present study showed the crude density of Blackbuck to be 50.09 individuals per sq. km. The ecological density was estimated to be 151.72 individuals per sq. km which is more than the findings of Khanal (2006) who estimated it to be 75.14 individuals per sq.km. The ecological density of the present study shows that the realized habitat of Blackbuck is overcrowded and focuses on the immediate need of either vacating the core habitat or translocation of the animals to similar habitat. The density of Blackbuck population at Khairapur was estimated to be 17.90 individuals per sq. km. (Chand 1998), 12.38 individuals per sq. km. (Khanal 2002) and 25.33 individuals per sq. km (Khanal

2006). It clearly reveals that the same habitat is still supporting the increasing number of Blackbuck and may be the cause of trans-boundary migration as well. It focuses for the early habitat management before the population of Blackbuck again collapses to a serious level.

The natality rate was estimated to be 0.84 per mature female per year which is same as that estimated by Khanal (2006). It shows that the birth rate of Blackbuck has not changed at Khairapur. The mortality rate was estimated to be 0.015 per individuals per year which is less than the estimation by Khanal (2006) viz. 0.094 per individuals per year.

The sex ratio is defined as the population of males in population. The sex ratio of Blackbuck in the present study was found to be 1: 1.64 showing 60.97 bucks to 100 does. It was less than the estimates by Rashid (1977) at Velavadar National Park, by Chand (1999) at Khairapur and by Nair (1976) at the Point Calimere Sanctuary, Tamilnadu, which was 1:3, 1:4 and 1:4.7; respectively. But it is similar to the estimates by Khanal (2002) in the same habitat as well as to Daniel (1967) at Point Calimere Sanctuary who recorded the sex ratio to be 1:1.95 and 1:2; respectively. The ideal sex ratio of dioecious animal is 1:1 which is rarely found in the wild population. More unequal sex ratio indicates the higher rates of genetic drift in the population. The sub-adults formed only about 10.63% of the total population in 1999 but increased to 15.78% in 2006 and at present it is 34.84% at Khairapur which indicates that there may be an increase the Blackbuck population in near future if immediate actions like alternative habitat management and translocation of the species is implemented.

The average herd size of Blackbuck in the present study was found to be 15.10 individuals which is less than the estimates by Bharucha and Asher (1993) and Nair (1975) which was 21 and 23; respectively. The average herd size of Blackbuck at Khairapur was recorded to be 7.64 individuals by Khanal (2006), 9.8 to 10.55 individuals by Chand (1999), 4.4 to 6.9 animals by Tamang and Shrestha (1998).

A number of excess bucks which neither established a territory nor acquire does, occur throughout the year either in bachelor herd or periphery to breeding herd (Schaller 1967).

In the present study, 7.28% were observed as single isolated male. Tamang and Shrestha (1998) observed 34% of the herds as single individuals. Chand (1999) observed 29.58% of the herds as single individuals. Almost one third (32.34%) were observed as single individuals of whom 82% of the individuals were single isolated male (Khanal 2006).

The largest herd size of 102 to 128 individuals including both sexes of all age groups was observed in 13-19 Oct, 2011, in the present study. Khanal (2006) observed the largest herd size of 59 individuals including both sexes of all age groups on April 20, 2006.

5.2. Seasonal habitat use pattern of Blackbuck

The total number of floral species that occurred in the present study were 46 species out of which, 32 species were herbs, 10 species were shrubs and 4 species were trees but Khanal (2002) recorded only 32 species of flora in the same habitat. *Cymbopogon jwarancus* has occupied large plots in Block A and B and was found spreading to other areas as well. Also *Ipomoea fistulosa* which was confined in *Sarju Nadi* has dispersed to the realized habitat of Blackbuck as well. The *Cynodon dactylon* was out competed by *Desmodium microphyllum* in the area. Out of 33 *Acacia catechu* that occurred in the quadrats laid in the present study, 5 (15.15%) were logged completely or partly; and many were observed logged and burnt in BCA other than those that occurred in quadrats.

The vegetation of the Phanta varied seasonally but the grasses like *Imperata cylindrica*, *Desmodium microphyllum*, *Chrysopogan aciculatus* and *Cynodon dactylon*; and the shrubs like *Cassia tora*, *Glycosmis pentaphylla*, *Phyllanthus* sps and *Murraya koenigii* were also seen all the time.

The direct method showed that although block A covered only about 30.30% of the areas, 57.90% of Blackbucks were observed here. In contrast, in block C which constitutes about 44.79% of the area, there were 23.43% of sightings. The block B which covers 24.89% of the area had 18.65% of Blackbuck recorded. But more number of herds was observed in block A followed by block B and block C. The number of herds observed in block A, B and C were 481 (48.48%), 275 (27.72%) and 236 (23.79%) respectively indicating the safety to remain in small herds in those blocks accordingly. The indirect method showed that block A had a total of 373 pellets (36.46%), block B had 292 pellets

(28.54%) and block C had 358 pellets (34.99%) and the results were similar to that of direct method which illustrate that Block A was mostly used by Blackbuck followed by Block C and Block B.

The hypothesis on direct count method used to study the seasonal habitat use pattern of Blackbuck was tested by the statistical analysis (One-way ANOVA). It showed that the alternative hypothesis was accepted at 95% confidence level. It may be due to controlled rotational grazing of livestock in winter and summer seasons; and no livestock grazing in spring and autumn seasons in the realized habitat of Blackbuck.

Also the statistical analysis (One-way ANOVA) used for the test of hypothesis on indirect count method to study the seasonal habitat use pattern of Blackbuck showed that showed the acceptance of alternative hypothesis at 99% level of confidence. It may be due to poor visibility of pellets due to tall grasses except in winter season.

Thus, the approaches of daily monitoring combined with controlled grazing; the permit of grass cutting in the absence of livestock grazing and monitoring the stray dogs and chasing them from the Blackbuck habitat improved the survival of Blackbuck in the area. Blackbuck had good forage and the habitat of predators like Hyaena and Jackal were reduced. Also, the fawns were safe due the presence of grass cutters in the grassland.

It was noted that each block had its own importance. Block A is an open grassland that is safe for Blackbuck due to prompt monitoring. It has the provision of good water source for Blackbuck. Block B has *Cassia tora* which is good hiding place for the fawns. It was comparatively safe for Blackbuck when most of the areas of Block A and C were subducted in summer. Block C has forest that provide shade to Blackbuck in sunny days and bushy vegetation like *Glycosmis pentaphylla* and *Phyllanthus* sps were good hiding places for the fawns. Also the provisional crops like Rahar, wheat and maize planted in a small area of Block A and B attract Blackbuck in the absence of good forage in the area.

5.3. Conservation threats

The threat of extinction of Blackbuck increases as it is only the surviving population in Nepal and can easily collapse due to habitat encroachment, disease epidemics, predators,

inbreeding and changing habitat condition. The Blackbuck habitat is heavily encroached by human settlement and livestock; it holds community forests also. There were only 10 households at Khairapur during the 1975s; immigration in the area increased to a total of 1663 households. Above 300 households consist of *Mukta Kamaiyas* (liberated bounded laborers), and the landless people (FONAREM, 2007). The community is dominated by indigenous Tharu people. Agriculture and livestock rearing are the main occupation of the local people of the area. Some of the households have initiated other livelihood options such as fish farming, vegetable farming and poultry in the area. They depend on the adjoining community forest and Blackbuck habitat for firewood, fodder and grazing their livestock.

The BCA is overgrazed by livestock. In particular days, the number of livestock that grazed in winter was 450, in spring it was 20, in summer it was 200 and in autumn, 50 livestock were observed grazing in the Blackbuck habitat while the total livestock grazed in the area were 811 (671 Cows, 108 Buffaloes and 32 Goats) in the year 1988 as recorded by (Baur and Ellenberger 1988). The number increased to 1100-1200 in 1994 (Bhandari 1994). The domestic animals grazing in Blackbuck habitat in Bardia National Park's record in 1988 was 811 while in 1994, it was 1100 to 1200 (Tapol 2001). The average number of the livestock grazed inside the Pataha Phanta in a characteristic day excluding the night grazers were found to be 976 per day; almost 7.34 times more than the Blackbuck population (Khanal 2006).

A total of 358 people on foot, 1,195 bicycle, 431 motorcycle, nine carts, one bus and nine tractors were recorded to move in and out of the core area based on the one day observation in all the seasons during the study period. Khanal (2000) recorded 415 people, five motorbikes and 12 bull carts that travelled from the area. The carts, tractors and bus were occasional cases but there was a regular daily movement of 300 people in the Blackbuck habitat.

The major parasites prevalent in Blackbuck were *Strongyles* (43.47%), *Paramphistomum* (26.08%) and *Moniezia* (11.95%). Khanal (2006) reported *Paramphistomum*, *Strongyles* and *Ascaris* as the common gastro-intestinal parasites in the livestock and Blackbuck. But the cases of foot and mouth diseases were not observed in 2011 which was a severe

epidemic in 2009 and caused the mortality of five Blackbucks (Samabesi Sandesh, National Weekly, 30 Aug, 2009).

The other threats to Blackbuck were grass cutters, village dogs, visitors and attack by Common Leopard. Two adult male Blackbucks and a village dog were killed by Common Leopard on 17 Oct, 2011 in Block C nearby the community forest in the east. The village dogs were troublesome; they disturbed the Blackbuck herd and even attacked them. An adult female was found dead by the attack of a group of village dogs just in front of Machan on 28 July, 2011. The staffs of the BCA chase village dogs out of the core habitat. Six dogs often visited the core habitat of Blackbuck and harassed Blackbuck. Around 200 grass cutters come to the Blackbuck habitat on a daily basis. The Park people seize the *Khurpi* of the grass cutters but let them use sickle. A minimum of about 150 bhari (= 4500 kg) of grass is removed on a daily basis from the Blackbuck habitat by the grass cutters. Also the visitors and local people caused harassment that disturbed the herd as well as separated the fawn from the mother.

5.4. Crop loss

Blackbuck damaged the crops planted in the marginal agricultural lands. It might be the result of overgrazing by livestock, overcrowding of Blackbuck in the Blackbuck habitat, lack of food or the preference of crops to grasses. The crop loss by Blackbuck was due to trampling or feeding the whole or parts of plants. The effect of crop loss by Blackbuck in the marginal agricultural lands is directly proportional to its distance from the Blackbuck habitat, cropping pattern and the extent of crop protection. The agricultural lands that are located at a distance of about 1.5 km are seriously affected by Blackbuck.

Crop loss by Blackbuck was observed mostly in the winter season. The crops preferred by Blackbuck were mostly wheat, maize, groundnuts, pulses, peas and gram. But people have reduced growing the crops preferred by Blackbuck in the marginal fields. Wheat, Maize and Musuroo were mostly affected by Blackbuck in the marginal agricultural lands. It was observed that the crop loss was more in SUC > DUC > RUC > BUC. Altogether, the crop loss by Blackbuck was estimated to be NRs. 2,126,260. The crop loss by Blackbuck per household was estimated to be NRs. 31,735.22. Local people adopted chasing as the best method to raid the Blackbuck from their agricultural fields.

6. CONCLUSION AND RECOMMENDATION

The total population of Blackbuck in BCA during the terminal period of this study was 264, showing an increase of 180.85% since 1999 A.D. The crude density of Blackbuck in BCA was 50.09 individuals per sq. km. while the ecological density in the realized habitat was 151.75 individuals per sq. km. The natality rate was 0.84 per mature female per year and the mortality rate was 0.015 per individuals per year. The sex ratio was 60.97 bucks to 100 does. Female population in all the age group was more than the male population. The highest population percentage was of sub-adult female (22.35%) and 12.88% of total population were fawns.

The core habitat of Blackbuck is 5.27 sq. km in area with the realized habitat of Blackbuck in Pataha Phanta which is only about 1.74 sq. km; the rest area is heavily encroached by human settlements, agricultural lands and community forests. The small realized habitat of Blackbuck was also fragmented by the busy cart road and other small foot trails that crossed the area. But as the cart road was blocked and the entry of heavy vehicles was prevented, the distribution of Blackbuck to all the areas relatively improved. The external forces that confine the distribution of Blackbuck to only few areas were noted to be the anthropogenic disturbances and livestock grazing.

From the study it was found that block A (57.90%) was mostly preferred by Blackbuck followed by block C (23.43%) and block B (18.65%). The distribution pattern of Blackbuck was also determined by rotational and controlled grazing of livestock in two blocks A and C with few rest periods which resulted in dispersal of Blackbuck to newer areas and created good forage condition. And this method was found to be effective for the management of habitat of Blackbuck as well as to settle the problem of livestock grazing of local people. Also at the periods of no livestock grazing, people were allowed to cut grass.

During the study period, the number of livestock grazing in Pataha Phanta varied. In particular days, the number of livestock that grazed in winter was 450, in spring it was 20,

in summer it was 200 and in autumn, 50 livestock were observed grazing in the Blackbuck habitat. The minimum number of livestock seen grazing per day in the realized habitat of Blackbuck was 20 to a maximum number of 450. Around 200 grass cutters come to the Blackbuck habitat on a daily basis. A minimum of about 150 bhari (4500 kg) of grass is removed on a daily basis from the Blackbuck habitat by the grass cutters. The heavy pressure on grassland by the herbivore grazing and grass removal forces Blackbuck to visit the agricultural lands and cause damage to crops. So, Blackbuck damages the crops within 2 km far from the main Blackbuck habitat.

The human disturbances was noted to be a total of 358 people on foot, 1,195 bicycle, 431 motorcycle, nine carts, one bus and nine tractors in four days observations in 2011. About 300 to 400 people move in the Blackbuck habitat on a daily basis.

The major gastro-intestinal parasites recorded in Blackbuck from the feacal test were *Strongyles* (43.47%), *Paramphistomum* (26.08%) and *Moniezia* (11.95%).

The community forests located in proximity to the Blackbuck habitat harbours the predators of Blackbuck like Jungle cat, Hyaena, and Common Leopard. Two adult male Blackbucks and a dog were killed by the attack of Common leopard in the area during the study period. Also a female Blackbuck was killed by the attack of group of village dogs in the study period. The number of Blackbucks killed by dogs were two while those killed by Common Leopard were 12 as recorded from 13/04/2066 BS to 15/04/2067 BS (Source: Khairapur post record).

It was observed that the crop loss was more in SUC > DUC > RUC > BUC. Altogether, the crop loss by Blackbuck was estimated to be NRs. 2,126,260. The crop loss by Blackbuck per household was estimated to be NRs. 31,735.22.

Based on the present research and its conclusion, following recommendations are made for the consideration by concerned authorities for the long term survival of Blackbuck in Nepal.

1. Resettlement or removal of the encroachers should be done immediately.

2. Translocation, captive breeding and farming of Blackbuck should be done in Nepal.
3. Alternative road should be constructed in place of the cart road that passes across the Blackbuck habitat. Other foot trails should also be blocked.
4. The area should be divided in blocks for the Blackbuck habitat management and rotational and controlled livestock grazing in different blocks should be implemented as an important wildlife management tool in the area.
5. Seven to eight feet tall fencing should be done along the core habitat to protect crops from damage by Blackbuck as well as to prevent illegal livestock grazing in the area.
6. The invasive and unpalatable species like *Ipomea fistulata* should be eradicated and the shrubs like *Zizyphus mauritiana*, *Glycosmis pentaphylla* and *Phyllanthus* sps should be planted and protected.
7. Provisional food and water holes should be managed for Blackbuck.
8. Predation by village dogs should be controlled by conducting awareness programmes in the area.
9. Grass cutting in the Pataha Phanta should be permitted and the use of '*Khurpi*' should be totally banned.
10. Awareness programme should be conducted to promote quality animal husbandry, to encourage vaccination for livestock and stall feeding, to encourage use of alternative energy sources, to improve the health and sanitation of the people in the area, to increase literacy rates, to promote ecotourism, etc.
11. Research and studies on Blackbuck including the ecology and genetics aspects as well as parasitic study should be encouraged.

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8.APPENDICES

Appendix I. Blackbuck Factsheet

Table 8: Blackbuck factsheet (Source: FONAREM, 2007)

S. N.	Date	Remarks
1.	Before 1950	Blackbucks were widely distributed in Banke, Bardia and Kanchanpur districts
2.	Before 1970	Blackbuck was thought to be extinct from Nepal
3.	5 September, 1975	KrishnaMan Shrestha (then Warden), Dr. Eric Dinesterin (then a researcher) and Gagan Singh Chunara (then Game scout) observed Blackbucks in Khairapur districts
4.	1 October, 1975	Guard post was established to protect Blackbuck in Khairapur area
5.	1977-1979	Sixteen Blackbucks were translocated from Central Zoo of Kathmandu to Baghauraphanta of Bardia National Park
6.	1981-1984	Blackbucks were translocated from Khairapur to Baghaura Phanta
7.	1986	The then Government resettled 36 families from the Blackbuck habitat
8.	1987	First study on Blackbuck Population at Khairapur by a Nepali student
9.	1989	Encroachment in the Blackbuck habitat
10.	1992	Twenty seven Blackbucks were translocated from the Central Zoo to Baghauraphanta

(*In 1995, 488 hectares of land consisting of 173 hectares of registered land and 105 hectares of ailani, land not registered; 210 hectares of forest was proposed as the BCA. The BCA was established on 6 March 2009.)

Appendix II. Population of Blackbuck at Khairapur

Table 9: Population of Blackbuck at Khairapur

Year	Blackbuck population	Source
1975	11	Lehmkul 1979
1982	38	BNP
1985	130	BNP
1987	178	Bhatta 1987
1988	190	Bauer 1989
1990	178	BNP
1992	100	BNP
1993	92	Nepal 1994
1995	102	Tamang and Shrestha 1998
1996	111	Tamang and Shrestha 1998
1998	94	Chand 1999
1999	47	Pradhan, Bhatta and Jnawali 1999
2000	40	Khanal 2000
2001	53	Khanal 2001
2002	65	Khanal 2002
2005	109	BNP
2006	133	Khanal 2006
2007	164	BCA
2008	213	BCA
2009	202	BCA
2010	210	BCA
2011	264	Present study

Appendix III. Climate of Rani Jaruwa Nursery, 2005-2010 AD.

Table 10: Monthly maximum temperature (˚C)

Year / Months	Maximum Temperature (˚C)					
	2005	2006	2007	2008	2009	2010
Jan	18.9	23.0	22.4	24.8	24.9	20.8
Feb	25.8	28.2	25.1	23.9	28.9	25.7
Mar	31.6	31.5	28.0	31.7	32.5	32.2
Apr	35.8	35.3	33.7	37.0	37.2	37.7
May	37.6	36.5	35.7	38.1	37.2	40.5
Jun	39.7	35.9	37.1	35.9	39.6	38.2
Jul	33.6	33.1	33.0	32.6	35.7	35.5
Aug	33.2	34.1	33.4	33.3	34.1	34.6
Sept	34.8	33.9	31.8	34.2	36.7	34.3
Oct	31.9	32.2	32.2	32.3	32.5	34.0
Nov	28.9	28.8	29.9	29.6	28.6	30.4
Dec	25.5	22.0	24.5	24.7	26.0	25.9

Table 11. Monthly minimum temperature (˚C)

Year / Months	Minimum Temperature (˚C)					
	2005	2006	2007	2008	2009	2010
Jan	7.7	7.0	7.5	7.7	8.9	8.0
Feb	11.7	12.0	12.3	7.8	9.1	10.8
Mar	15.6	12.8	14.8	13.7	11.5	15.2
Apr	19.0	17.6	18.8	17.3	16.9	20.4
May	19.5	22.8	25.9	20.3	23.6	20.7
Jun	26.1	23.9	25.3	24.9	23.1	20.2
Jul	25.3	25.3	25.4	25.2	25.3	25.7
Aug	25.5	24.4	26.2	24.9	26.2	26.0
Sept	25.2	24.4	25.2	22.3	24.6	25.0
Oct	18.5	21.4	20.8	19.0	18.6	23.1
Nov	12.5	14.4	14.7	15.3	13.0	16.0
Dec	7.4	7.4	9.0	12.6	9.2	10.1

Table 12: Average relative humidity

Year	Relative humidity	
	Morning	Evening
2005	80.2	88.7
2006	81.9	89.5
2007	87.1	88.5
2008	85.8	88
2009	79.6	83.7
2010	83.05	81.8

Table 13. Rainfall in mm

Months	Rainfall (mm) in year					
	2005	2006	2007	2008	2009	2010
Jan	83.4	0	0	0	0	0
Feb	21.2	0	76	0	0	32
Mar	17	32.8	46	0	0	0
Apr	6	8	8	0	7	0
May	18	51	21	48	0	58
Jun	77.8	0	28	339.5	0	0
Jul	369.4	0	725.8	453.2	329.8	344
Aug	361.6	429.6	276	309.5	449.8	478.5
Sep	165.3	177	469	120	124	0
Oct	75.5	10	0	0	261.5	0
Nov	0	0	0	0	0	0
Dec	0	8	0	0	0	17

Appendix IV. Seasonal habitat use pattern of Blackbuck

Table 14: Seasonal mean population of Blackbuck in different blocks by direct count method

Season	Blocks			Total
	A	B	C	
Winter	159	21	1	181
Spring	114	28	31	173
Summer	67	59	48	174
Autumn	73	25	88	186
Total	413	133	168	714

For direct count method:

Table-15: Summary of mean population distribution of Blackbuck in three different blocks (One-way ANOVA)

	DF	Sum sq	Mean sq	F value	Pr (>F)	Remarks
LC	2	11638	5819	5.077	0.0334	Significant
Residuals	9	10315	1146			

Table 16: Summary of mean population distribution of Blackbuck in four different seasons (One-way ANOVA)

	DF	Sum sq	Mean sq	F value	Pr (>F)	Remarks
LC	3	38	12.6	0.005	1	Not Significant
Residuals	8	21915	2739.4			

For indirect count method:

Table 17: Summary of mean pellet distribution of Blackbuck in three different blocks (One-way ANOVA)

	DF	Sum sq	Mean sq	F value	Pr (>F)	Remarks
LC	2	929	464	0.134	0.876	Not Significant
Residuals	9	31182	3465			

Table 18: Summary of mean pellet distribution of Blackbuck in four different seasons (One-way ANOVA)

	DF	Sum sq	Mean sq	F value	Pr (>F)	Remarks
LC	3	24016	8005	7.912	0.00888	Highly Significant
Residuals	8	8095	1012			

Appendix V. IVI of Flora of BCA, Khairapur.

Table 19. IVI of herbs in Pataha Phanta

S.N.	Local Name	Scientific Name	RD	RF	RC	IVI
1.	Baksa	Unidentified	0.0514	0.224	3.482	3.75
2.	Bandari	*Setaria glauca*	0.1603	2.587	2.090	4.83
3.	Bansi ghans	*Arundinella* sps.	0.00514	0.124	2.090	2.21
4.	Chamarvadi	*Cyperus* sps.	2.642	5.061	5.226	12.92
5.	Chari amilo	*Medicago denticulre*	0.0216	0.112	3.482	3.61
6.	Chauri	*Echinochloa* sps.	1.057	3.824	2.090	6.97
7.	Dhoodhi	*Equisetum* sps.	0.0617	0.124	5.226	5.41
8.	Dubo	*Cynodon dactylon*	3.283	8.886	5.226	17.39
9.	Dudhiya	*Youngia japonica*	0.00226	0.124	2.090	2.21
10.	Gandhaila	*Grangea maderaspatana*	0.0032	3.374	3.482	6.85
11.	Ghoda tapre	*Hydrocotyle asiatica*	0.00247	0.124	2.090	2.21
12.	Gomme	*Leucas cephalotus*	0.00843	8.998	2.090	11.09
13.	Hada	*Kyllinga brevifolia*	0.0339	0.562	2.090	2.68
14.	Harauwa	*Corchorus aestuans*	0.002	1.124	3.482	4.60
15.	Janewa	*Bothriochloa bladhii*	1.433	14.623	5.226	21.28
16.	Jarakush	*Cymbopogon jwarancus*	1.770	4.499	8.711	22.35
17.	Jhusi	*Hedyotis corymbosa*	0.273	3.936	2.090	6.29
18.	Jungali siuri	*Oplismenus burnanii*	0.0376	0.124	2.090	2.25
19.	Kaas	*Saccharum spontaneum*	0.343	1.462	2.090	3.89
20.	Katkahari	Unidentified	0.538	2.924	2.090	5.55
21.	Khadedar	*Evolvulus nummularius*	0.146	2.699	2.090	4.93
22.	Pankhara	*Hygrophilia polysperma*	0.00041	0.124	3.482	3.60
23.	Kodo ghans	*Paspalum scrobiculatum*	0.164	0.674	2.090	2.92
24.	Kuro	*Chrysopogan aciculatus*	9.139	7.986	5.226	22.35
25.	Makara	*Dactyloctenium aegypticum*	0.0543	1.012	2.090	3.15
26.	Mothei	*Cyperus cephalotus*	0.0014	0.124	2.090	2.21
27.	Pani pankhara	*Rotala* sps	0.0617	0.224	5.226	5.51

26.	Siru	*Imperata cylindrica*	28.982	10.911	8.711	48.60
27.	Siuri	*Brachiaria* sps.	1.846	3.374	5.226	10.44
28.	Sulsule	*Eragrostis tenella*	1.338	5.849	2.090	9.27
29.	Tipatiya	*Desmodium microphyllum*	33.457	19.910	8.711	62.07
30.	Woiya	*Echinochloa colona*	0.0613	0.562	2.090	2.71

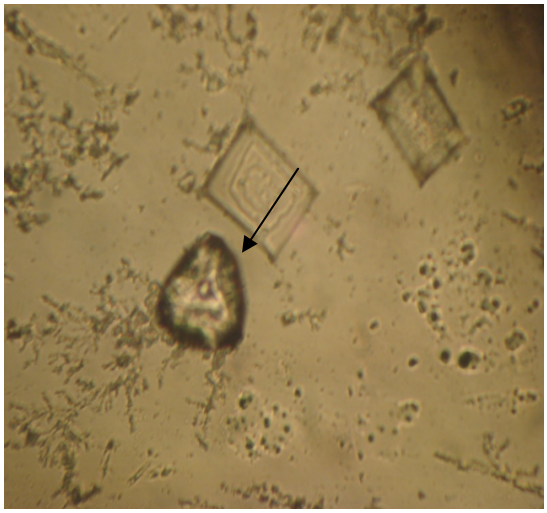
Table 20. IVI of shrubs in Pataha Phanta

S.N.	Local Name	Scientific Name	RD	RF	RC	IVI
1.	Baghi kada	*Zizyphus* sps.	0.37	2.32	6.891	9.58
2.	Barera	*Sida acuta*	0.56	2.32	6.891	9.77
3.	Bayer kada	*Zizyphus mauritiana*	3.406	9.30	6.891	19.59
4.	Bhet	*Clerodendrum* sps	1.42	4.65	6.891	12.96
5.	Chihor	*Phyllanthus* sps.	0.86	9.30	6.891	17.05
6.	Gutuhuru	*Glycosmis pentaphylla*	29.65	20.93	17.25	67.83
7.	Lahare dudhiya	*Ichnocarpus frutescens*	0.486	2.32	6.891	9.69
8.	Late jira	*Achyranthes aspera*	0.67	2.32	17.25	20.24
9.	Nim kathiya	*Murraya koenigii*	4.56	13.95	6.891	25.40
10.	Pwar	*Cassia tora*	57.99	32.56	17.25	107.8

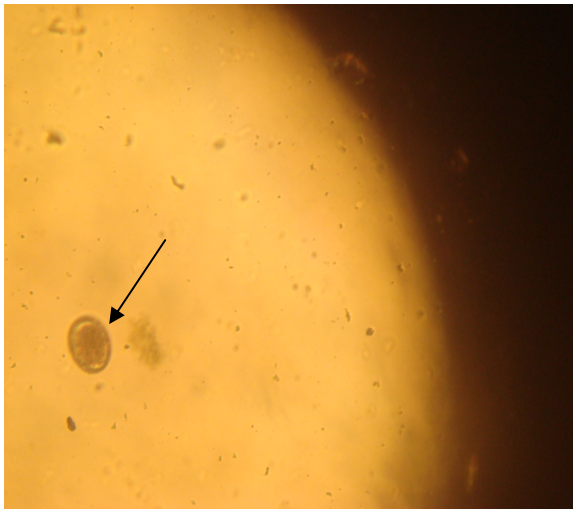
Table 21. IVI of trees in Pataha Phanta

S.N.	Local Name	Scientific Name	RD	RF	RBA	IVI
1.	Chiloun	*Quercus floribunda*	3.030	3.57	12.54	19.14
2.	Khair	*Acacia catechu*	9.090	10.71	16.44	36.24
3.	Seesam	*Dalbergia sissoo*	21.21	21.42	10.20	52.83
4.	Simal	*Bombax ceiba*	66.66	64.28	70.54	201.48

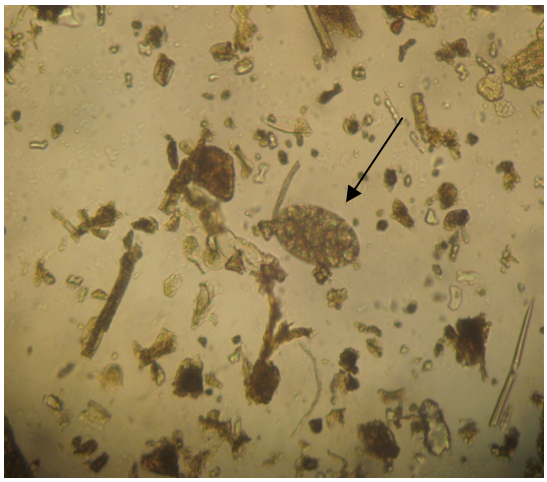
Appendix VI. Endo-parasites in Blackbuck



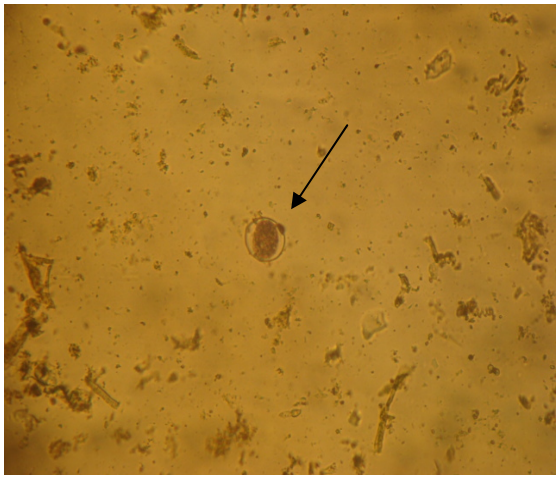
1. *Moniezia*



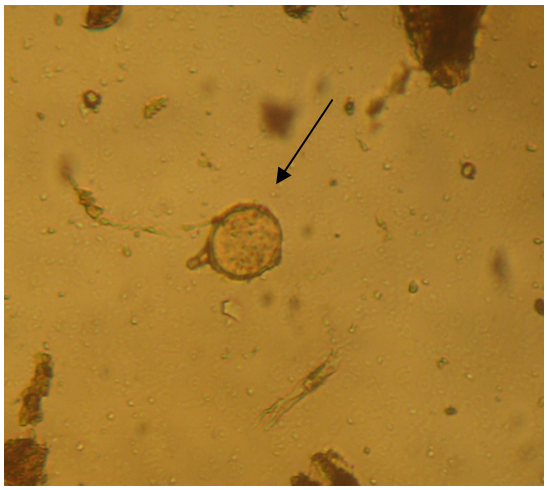
2. *Strongyles*



3. *Paramphistomum*

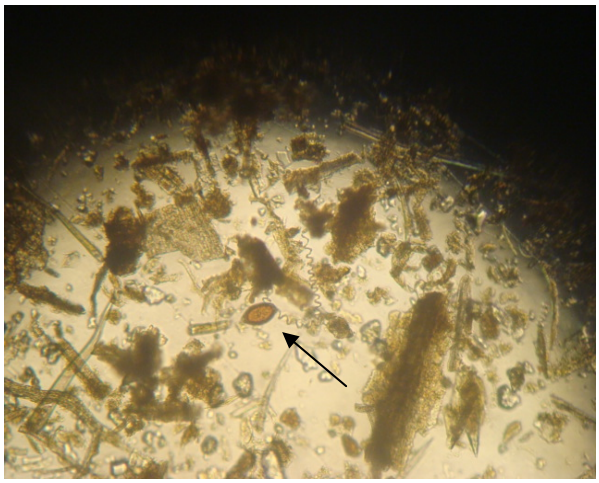


4. *Coccidia*

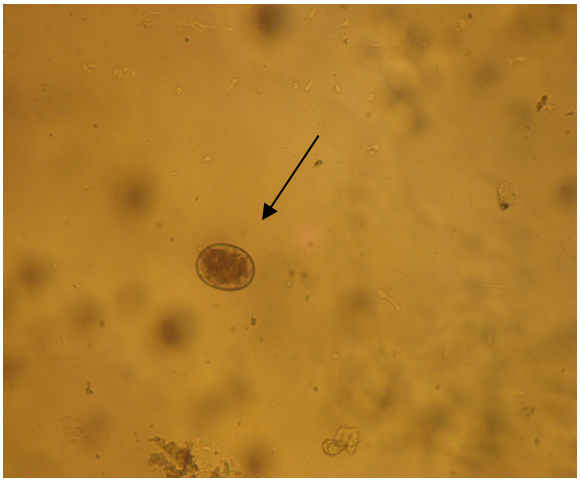


5. *Schistosoma*

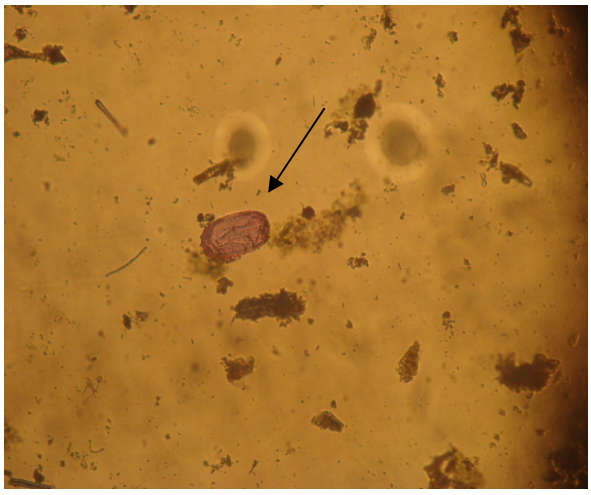
6. *Fasciola*



7. *Trichuris*



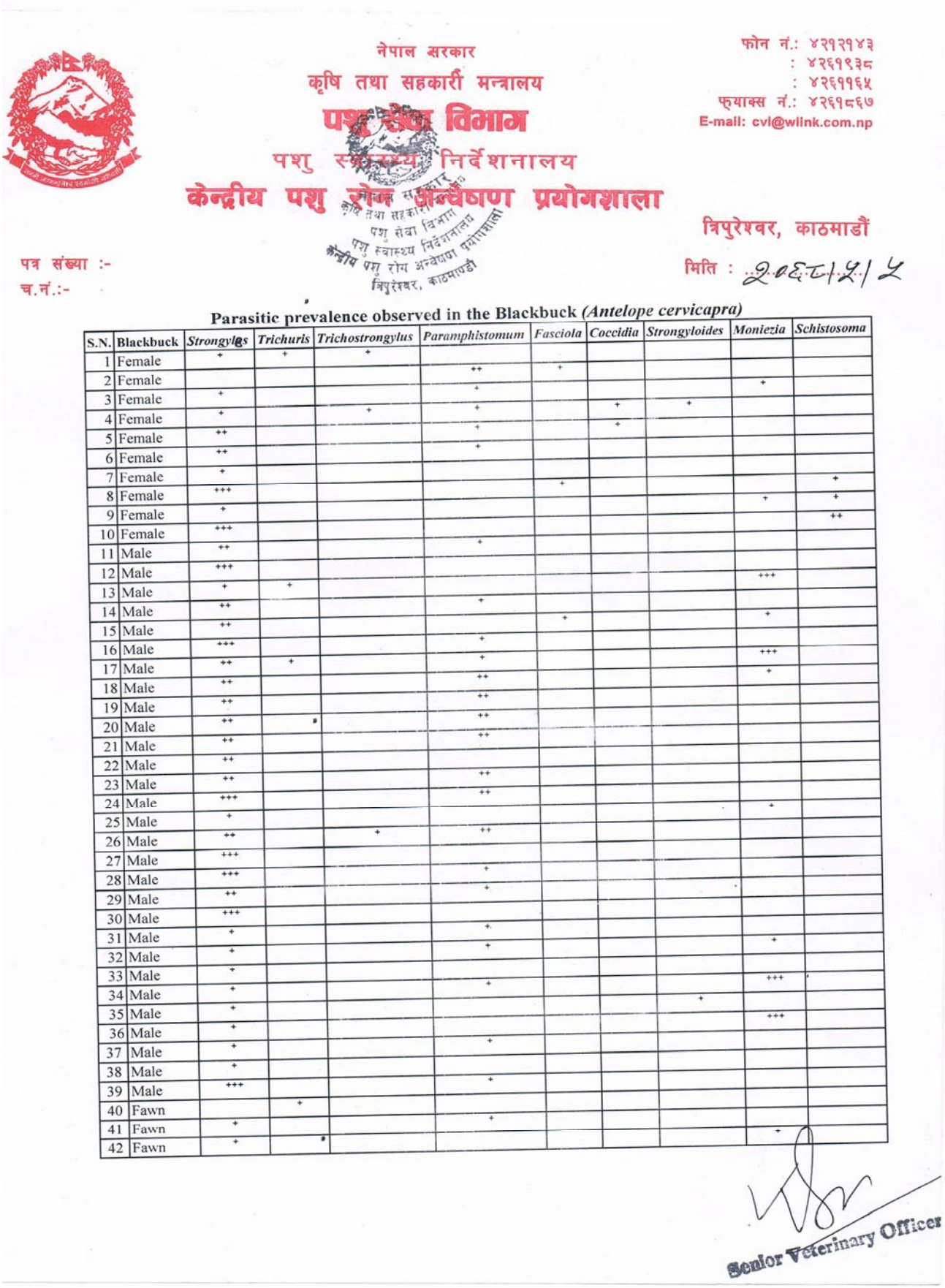
8. *Trichostrongylus*



9. *Strongyloides*

Photo plates 1-9: Endo-parasites in Blackbuck (under 10X × 40X)

Appendix VII. Report of Gastro-Intestinal parasites of Blackbuck



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फोन नं.: ४२१२१४३
: ४२६१९३८
: ४२६११६५
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त्रिपुरेश्वर, काठमाडौं

पत्र संख्या :-
च.नं.:-

मिति : २०८८।४।५

कृषि तथा सहकारी मन्त्रालय
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Parasitic prevalence observed in the Blackbuck *(Antelope cervicapra)*

S.N.	Blackbuck	*Strongyles*	*Trichuris*	*Trichostrongylus*	*Paramphistomum*	*Fasciola*	*Coccidia*	*Strongyloides*	*Moniezia*	*Schistosoma*
1	Female	+	+	+						
2	Female				++	+			+	
3	Female	+			+		+	+		
4	Female	+		+	+		+			
5	Female	++			+					
6	Female	++								
7	Female	+				+				+
8	Female	+++							+	+
9	Female	+								++
10	Female	+++								
11	Male	++			+					
12	Male	+++							+++	
13	Male	+	+							
14	Male	++			+					
15	Male	++				+			+	
16	Male	+++			+					
17	Male	++	+		+				+++	
18	Male	++			++				+	
19	Male	++			++					
20	Male	++			++					
21	Male	++			++					
22	Male	++								
23	Male	++			++					
24	Male	+++			++					
25	Male	+							+	
26	Male	++		+	++					
27	Male	+++								
28	Male	+++			+					
29	Male	++			+					
30	Male	+++								
31	Male	+			+					
32	Male	+			+				+	
33	Male	+								
34	Male	+			+				+++	
35	Male	+						+		
36	Male	+							+++	
37	Male	+			+					
38	Male	+								
39	Male	+++			+					
40	Fawn		+							
41	Fawn	+			+					
42	Fawn	+							+	

Senior Veterinary Officer

Appendix VIII. Crop loss by Blackbuck in BCA

Table 22. Crop loss by Blackbuck in BUC

Cultivated crops	Total land (ha)	Observed yield (q)	Loss (q)	Loss (NRs)
Mustard	1.518	16.3	6.4	33,280
Musuroo	2.376	27.8	7.7	35,420
Wheat	1.452	26.7	17.8	35,600
Vegetables	0.033	2.4	0.6	3,000
Pea	0.33	0	4	8,800
Gram	0.66	4	3	19,500
Maize	1.386	27	20	30,000
Maas	0	0	0	0
Groundnut	0.066	0.25	0.35	1,960
Chilly	0.231	34.5	6.5	45,500
Rahar	0	0	0	0
Total	8.052	138.95	66.35	2,13,060

Table 23. Crop loss by Blackbuck in DUC

Cultivated crops	Total land (ha)	Observed yield (q)	Loss (q)	Loss (NRs)
Mustard	3.498	37.23	14.27	74,204
Musuroo	6.864	65.93	22.07	1,01,522
Wheat	9.768	184.2	91.8	1,83,600
Vegetables	0.165	21	41	2,05,000
Pea	5.643	71.45	11.75	25,850
Gram	0.594	4.26	0.24	1,560
Maize	5.874	189.85	42.65	63,975
Maas	0	0	0	0
Groundnut	0	0	0	0
Chilly	0.033	3	2	14,000
Rahar	0.198	1.5	1	5,000
Total	32.637	578.42	226.78	6,74,711

Table 24. Crop loss by Blackbuck in SUC

Cultivated crops	Total land (ha)	Observed yield (q)	Loss (q)	Loss (NRs)
Mustard	1.782	24.27	5.23	27,196
Musuroo	3.993	31.28	29.22	1,34,412
Wheat	9.6195	155.1	159.9	3,19,800
Vegetables	0.0429	1	3	15,000
Pea	2.2143	12.03	16.21	35,662
Gram	0	0	0	0
Maize	7.359	97.5	85.5	1,28,250
Maas	0.099	0	15	1,20,000
Groundnut	0.5775	3	4	22,400
Chilly	0.132	10	10	70,000
Rahar	0	0	0	0
Total	25.8192	334.18	328.06	8,72,720

Table 25. Crop loss by Blackbuck in RUC

Cultivated crops	Total land (ha)	Observed yield (q)	Loss (q)	Loss (NRs)
Mustard	1.254	12.05	6.95	36,140
Musuroo	1.584	13.65	10.35	47,610
Wheat	6.039	101.9	66.1	1,32,200
Vegetables	0	0	0	0
Pea	0.4125	4.76	0.74	1,628
Gram	0.132	0.75	0.25	1,625
Maize	0.924	15.5	12.1	18,150
Maas	0.429	3.25	3.25	26,000
Groundnut	0.627	6.99	0.61	3,416
Chilly	0.099	5.5	12	84,000
Rahar	0.462	7	3	15,000
Total	11.9625	171.35	115.35	3,65,769

Appendix IX. Questionnaire survey

Name of User Committee……. Date:……

Address:……..Ward No:……...

1. Name of Respondent:……Age:……..Sex:……
2. How many members do you have in your family?

Male:……. Female:…… Total:……..

3. How much land do you have?

……..Bigaha…….Kattha……Dhur……

4. What are the winter crops that you grow?

……. ……

……. …….

…….. ……..

5. What are the monsoon crops that you grow?

……. ……

……. …….

…….. ……..

6. Does Blackbuck cause damage to your crops?

a. Yes b. No

7. What methods do you adopt to prevent the crop damage by Blackbuck?
   a. Chasing
   b. Shouting
   c. Guarding fields at night
   d. Fencing
   e. Making scarecrows in fields
   f. Beating drums
   g. Others…….

8. Please specify the total expected yield of winter crops and crop loss by Blackbuck.

Winter crops	Cultivated Land	Total expected yield	Loss by Blackbuck

9. Please specify the total expected yield of winter crops and crop loss by Blackbuck.

Winter crops	Cultivated Land	Total expected yield	Loss by Blackbuck

10. Do you have any livestock?

a. Yes b. No

If yes, how many?

Livestock	Number
Cow/Bull	
Buffalo	
Goat	
Sheep	
Other	

11. Are the livestock vaccinated?

a. Yes b. No

12. What are the benefits that you gain from BCA?

……

……

……

13. What are the problems in the conservation of Blackbuck?

……

……

……

14. What are the measures to solve the conservation problems? Any recommendations?

……

……

……

Appendix X. Conversion factor

One Bigaha = 0.68 ha

Ten Kattha = 0.3 ha

Twenty Dhur = 1 Kattha

One Dhur = 0.0015 ha

One quintal = 100 kg

Appendix XI. Local market price of crops at Khairapur

Table 26. Local market price of crops (in NRs.)

S.N.	Crops	Monetary value (in NRs) per quintal
1.	Mustard	5,200
2.	Musuroo	4,600
3.	Wheat	2,000
4.	Vegetables	5,000
5.	Pea	2.200
6.	Gram	6,500
7.	Maize	1,500
8.	Maas	8,000
9.	Groundnut	5,600
10.	Chilly	7,000
11.	Rahar	5,000

Appendix XII. Snapshots

Photo 10: Bachelor herd of bucks

Photo 11: Blackbucks feeding on provisional food, rahar in BCA

Photo 12: A group of females and fawns

Photo 13: A horned female Blackbuck

Photo 14: Bull carts in BCA, Khairapur

Photo 15: Local people in BCA, Khairapur

Photo 16. Construction of trench and fence to prevent entry of Blackbuck in field

Photo 17. Crop damage by Blackbuck

Photo 18. Scarecrows in fields

Photo 19. Crop damage by Blackbuck

Photo 20. A female Blackbuck killed by a group of village dogs

Photo 21. A male Blackbuck killed by the attack of Common Leopard