STUDY OF ECOLOGY OF MONKEY SPECIES AND CROP DEPREDATION IN ARKHALE AND NAYAGAUN, GULMI, WEST NEPAL

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.

Submitted to

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Nepal

Submitted by

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T.U. Registration No: 5-2-37-508-2004

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March, 2012

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 authors or institutions.

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RECOMMENDATION

This is to recommend that the thesis entitled "**STUDY OF ECOLOGY OF MONKEY SPECIES AND CROP DEPREDATION IN ARKHALE AND NAYAGAUN, GULMI, WEST NEPAL**" has been carried out by **Kulchandra Aryal** for the partial fulfilment of Master's Degree of Science in Zoology with special paper Ecology. This is his original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree.

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LETTER OF APPROVAL

On the recommendation of supervisor **Dr. Mukesh Kumar Chalise** this thesis submitted by **Kulchandra Aryal** entitled "**STUDY OF ECOLOGY OF MONKEY SPECIES AND CROP DEPREDATION IN ARKHALE AND NAYAGAUN, GULMI, WEST NEPAL**" is approved for the examination and submitted to the Tribhuvan University in partial fulfilment of the requirements for Master's Degree of Science in Zoology with special paper Ecology.

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This thesis work submitted by **Kulchandra Aryal** entitled "**STUDY OF ECOLOGY OF MONKEY SPECIES AND CROP DEPREDATION IN ARKHALE AND NAYAGAUN, GULMI, WEST NEPAL**" has been approved as a partial fulfilment for the requirements of Master's Degree of Science in Zoology with special paper Ecology.

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List of Abbreviation

Abbreviated form	Details of abbreviation
CAMP	Conservation Assessment and Management Plan
DNPWC	Department of National Parks and Wildlife Conservation
Ed.	Editor
et al.	Other people
Ha	Hectare
M.Sc.	Master of Science :
Max.	Maximum
MBCA	Makalu Braun Conservation Area
Min.	Minimum
N/G	Nepal Government
Pp.	Pages
RH	Relative Humidity
ShNP	Shivapuri National Park
TU	Tribhuvan University
UK	United Kingdom
USA	United States of America

VDC Village Development Committee

ABSTRACT

The study entitled as "**STUDY OF ECOLOGY OF MONKEY SPECIES AND CROP DEPREDATION IN ARKHALE AND NAYAGAUN, GULMI, WEST NEPAL**" was carried with the major objective of analyzing monkey ecology along with human and monkey interference in Arkhale and Nayagaun of Gulmi district. The study site coversArkhale and Nayagaun Village Development Committee where two wards from each VDC were taken as a sample for detail study. Both primary and secondary data related to the study were used. Primary data were collected by field study as well as household questionnaire survey. Monkey population was determined by direct counting of the individuals in each group Quadrat method was used to analyze vegetation pattern of natural forest or monkey habitat.

Two species of monkeys, Rhesus monkey (*Macaca mulatta*) and Hanuman Langur (*Semnopithecus entellus*) were found in study area. Four troops of rhesus monkey with total population of 128 and 1 troop of Hanuman Langur with a population of 14 were recorded. Rhesus monkey (as reported by 65% respondents) was found as more damaging ones. Monkeys were found affecting human welfare by varying degrees. Crop depredation (reported by 64% respondents) and as well asphysical hurt and harassment (reported by 27%) were the major monkey related problem in the study area. Maize (as reported by 53% respondents) and wheat (as reported by 23% respondents) were reported to be worst affectedwhereas pulses were the least affected crop in the study area.

Shouting and following (30%) as well as using stone and catapult (24%) were the common deterrent method against monkey.

Monkey problem was increasing (as reported by 82%) in the area. Such soaring of monkey problem was due to lack of food for monkey in natural habitat, increase of monkey population itself, no provision of killing the monkey and so on. Worth compensation (as reported by 39% of respondents) would be the effective measure to reduce human-monkey conflict in the study area.

I

INTRODUCTION

1.1 Background

Primate is an order of mammals, which includes the monkeys, apes, humans and other similar forms typically having dextrous hands and feet, binocular vision and a well-developed brain. They are commonly called monkeys, excluding only the tree shrews; the lemur-like forms, the apes and humans and therefore embody tremendous evolutionary and adaptive arrangements of animals (Tattersall, 1993). Of all the primates, monkeys, next to human have adapted best to widely diverse environmental conditions. They are found in tropical forests, dry savannas, mountains, villages, temples and eve in large cities (van Hooff, 1990).

Primates today are found throughout the tropical zones of South America, Africa and Asia. Within those continental areas where they do occur, primates occupy all types of habitat, from climax rain forest and moorland, on high mountain ranges to open savannah and desert habitat (Dunbar, 1998). In broader sense, Primates now a day are confined 40^0N to 40^0S of equator in the moderate habitat (Chalise, 1999).

Monkeys are included under the sub-order Simiae of order primates. Further monkeys according to the geographical distribution are categorized into two types: New World monkeys and Old World monkeys.

The New World monkeys lack cheeks pouches and with nostril open to side rather than down. Area between the nostrils is wide and flat. Most have long prehensile tail and non-have callous pads on the buttocks, E.g. Spider monkeys, Capuchins etc. The Old World monkeys have protruded muzzle and well developed cheek pouches, nostrils set close together facing forward and downward. The tail is never prehensile and some species are tailless. Both the hands and feet are adapted for grasping. Callous pads on the buttocks are often bright and incase of females swollen during estrus period (Walker, 1968).

In Nepal, only three species of monkeys (Hanuman Langur, Rhesus and Assamese Monkeys) are recorded until to date (Chalise *et al*., 2005). The Rhesus monkeys (*Macaca mulatta*) are found freely ranging in wild as well as in urban religious places.

The Langur monkeys (*Semnopithecus entellus*) are found freely ranging in wild forest and marginal areas of Nepal. The other species Assamese monkey (*Macaca assamensis*) reported from mid-hills and high Montana forest of Nepal.

1.1.1 Rhesus Monkey (*Macaca mulatta)*

Rhesus Monkey is one of the best-known Simian species of family Cercopithecidae . They are distributed in Southeast Asia from northern Afganistan in the east and south to the Godavari River in India, Thailand, Laos, Cambodia, Vietnam, Nepal, Bangladesh, Tibet and China in the west (Roonwal and Mohnot, 1977). It is most frequently kept in zoos even in smallest Zoological gardens. Rhesus monkeys are considered pest species by their nuisance behavior. *M. mulatta* is likely the most adaptable to a wide variety of habitats and elevations, from high heat to snow fields to cities. It is partly migratory, sometimes ascending the Himalayas to an altitude of about 2500 m (about 8200 ft) in summer. Rhesus monkey is heavily built with compact robust limbs. The silky hair is yellowish brown, the naked skin is brown to yellowish-brown, and the large posterior callosities are bright red. No marked menstrual swelling occurs but skin of buttock becomes red during estrus period. An adult male of rhesus has a stoutly built body that may be up to 63 cm (25 inch) long and body weight 6.5-12 kg where as females are relatively small with body length ranging from 45-55 cm and body weight around 5.5 kg. Length of is up to the half of the length of body. The skin hangs in loose folds about the neck, breast, and abdomen.

Rhesus monkeys are characterized by a high degree of social flexibility. Four types of social groups can be described depending on the number of males in the group. They are one-male troop, multi-male troop, age-graded male troops and all-male band (Chalise, 2004). Most social groups range from 8-180 individuals of both sexes, but there are generally 2-4 times as many females as males. Dominance hierarchy is more evident among small groups of males than those with more females who tend to live together more peacefully than the males. The gestation period for *M. mulatta* is 135-194 days and usually one baby is born. Infrequently a set of twins is produced. Babies are nursed for about one year, first clinging to their mother's bellies and later riding on her back. Sexual maturity in females is reached between the ages of 2.5 and 4 years whiles males 2-3 years after that. Females reach menopause at age 25 (Southwick *et al*., 1982).

Rhesus is ground feeder and is partly terrestrial and partly arboreal. Preferred foods include wild and cultivated fruits, berries, grains, leaves, buds, seeds, flowers, and bark. They roost peacefully in trees mid canopy to avoid their predators (Chalise, 1998).

1.1.2 Hanuman Langur (*Semnopithecus entellus)*

Langurs also called *Dhendu Bandar* are popularly named after the Hindu monkey-god Hanuman, and considered the sacred animal. It is the most widely distributed of the 19 non-human primate species found in the Indian subcontinent and is a highly adaptive species (Roonwal and Mohnot, 1977; Wolfhemin, 1983; Chhangani and Monhot 2004). Hanuman langurs have the largest geographical distribution of the 250 or so non-human primates, and dwell from the Himalayan Mountains to the cultivated plains of Tarai. They are found across India, Pakistan, Bangladesh, Sri Lanka and Burma. Hanuman langurs inhabit tropical, dry thorn scrub, pine and alpine forest, and urban areas.

Head and body length of female is 40-68 cm and that of male is 51-78 cm. Approximate tail length is 69-101cm. Weight of adult female and male 11.2 kg and 18.3 kg respectively. The color of their fur ranges from gray, dark brown to golden with varying amounts of black, depending on the subspecies. They also vary in size - subspecies from the southern part of their range are smaller than those from the north. They feed on leaves, fruits, buds and flowers. They live in groups of 11-64, typically 1 male: multi-female, but occasionally multi-male: multi-female. They have a home range of 200-1200 ha. Hanuman langurs spend up to 80 per cent of their time on the ground, although they will also spend time in the trees. They are diurnal. When a new male takes over a troop, he systematically kills all the infants sired by the previous alpha male. Infanticide among Hanuman langurs has primarily been reported in one-male groups, possibly because having a situation where only one male breeds facilitates the evolution of this trait (Newton 1986, 1988). After a gestation period of 168-200 days, females give birth to one infant. The infant is weaned after 13-20 months.

1.1.3 Assamese Monkey (*Macaca assamensis* and *M. pelpos*)

Assamese monkey is less well researched non human primate of Nepal (Chalise 2000) and it is categorized as Vulnerable *2007 IUCN Red List of Threatened Animal*s. The Assamese macaque (*Macaca assamensis*) of Nepal is fully protected under NPWC Act 1973. The local vernacular names of this monkey are Pahare Bandar, Pupa, Timnyau and Kala Ganda (Chalise, 2000). Assamese macaques are distributed in Nepal, Sikkim, Bhutan, Assam, northern Myanmar, northern Thailand (Fooden, 1982; Chalise & Ghimire, 1998; Chalise, 1999) and Yunnan, southern China (Zhang *et al.*, 1981). Assamese monkeys inhabits in the mountains and hills along the Himalayas.

This monkey has darker fur in exposed area while whitish blonde-haired to ashy white in abdominal and inner parts. It has purple snout particularly around the nose while crimsoned red to pinkish red around the eyes and chick. General Assamese monkey consists of nearly 2 ft in head and body length while tail is one-third of it. It is heavier and larger than rhesus weighing more than 12 kg weight (Chalise, 2005).

Assamese monkeys of Nepal are diurnal animal found along the hills, valleys and upland river basin along the east-west mountainous range with diversified ecological zones. They are found in riverside hill-Sal forest area to mixed deciduous and evergreen forest of *Schima-Castonopsis*, *Elaeocarpus-Macaranga* forests in mid-hills and Quercus-Pine-Rhododendron forest of high mountains. These monkeys are shy, timid and less aggressive to human beings in comparison to rhesus monkey. They are arboreal, terrestrial and omnivorous animals with multi-male and multi-female social troops. They predominantly leaf eater but will feed on petiole, gum, shoot, flower, fruits, seeds, bark and caterpillar while they do long foraging activities to find young sprouts of grass, aquatic herbs and their pith, aquatic insects and larva, climb hanging greenish rocks to lick and eat a special type of ground soil. (Chalise, 2005).

1.2 Statement of the Problem

Human and monkey share the same root of evolution. Man-monkey association is as old as man's own existence. Monkey and human being are related in the sense that a particular species of monkey is popularly considered the remote ancestor of present day human. However, with the rapid increment in human population in and around the monkey's habitat, the relationship between these primates has turned into enmity. It is frequently argued that human beings are sole blame of destructing habitat of monkey. The macaques inhabiting forests were markedly disturbed by the over-utilization of forests by humans who cultivate crops in fields, cut tree branches as food for domestic animals and collect firewood. It is because monkeys are very often causes of nuisance to local people leading to the seeds of accord between these two creatures. Human population growth and activities like deforestation, agriculture and urbanization lead to an ever-increasing encroachment on wildlife habitats. The interface of wildlife habitat and human use dominated landscape has become grounds for a wide range of human-wildlife conflict (Sinha, Pathak and Rawal, 2004). Arkhale and Nayagaun area of Gulmi is no far an exception to this fate resulting into man-monkey conflict which is likely to be intensified in future.

1.3 Objectives of the Study

The major objective of research is to analyze the people and monkey conflict in Arkhale and Nayagaun of Western Nepal

The specific objectives of the study were as follows:

•To explore the status and general distribution of monkeys.

•To find out the causes of human-monkey conflicts.

•To list out the local preventive measures to mitigate human-monkey conflict

1.4 Rationale of the Study

In many areas of the country, farmers are encountering the problems of wild animals to their arable crops and household properties. Wild monkeys are not far an exception. So there is the need to resolve this conflict vis-à-vis nurturing the natural species. This calls the use of sustainable measure of conflict resolution and resource use. Arkhale and Nayagaun ; the two VDCs of Gulmi district are the areas having more potential of agricultural production . Diversity of the landscape from plane areas to steep hills bears high potential of biodiversity as well. If the natural habitat of monkey as well as other wild animals is conserved properly it will definitely reduce the damage they cause to local people and could contribute lot in the natural diversity. This study would be of particular significance to the people involving in this area and findings could be replicated to similar setting in different parts of the country. This study is, therefore, necessary to note their population, adaptability, conflicts, and socio-economic problems so that they can be managed in proper way without affecting human welfare and monkeys' habitat. Resolving conflict between wild monkeys and local people could lead to the increment in farm productivity thus enhancing their income. Knowledge of distribution, their habitat and interaction with people is essential for their proper management.

1.5Scope and Limitation of the Study

This study covers about the ecology of monkey and their conflict with local people, particularly crop raiding. It assesses the causes of human-monkey enmity in Arkhale and Nayagaun Area of Gulmi. But based on the outcome of this particular region, generalization cannot be made in overall context. Due to the limitation of time, the study was not sufficient to cover in detail the behavioral ecology of monkey and different aspect of monkey human conflict. The relevance of the study basically lies on the response of the respondents assuming they have truth.

Regarding the extent of losses caused by the crops, it was difficult to estimate the losses in quantitative value, because respondents were found never to keep such data and hence questionnaire regarding the crop loss in terms of percent, monetary value were omitted. Similarly, sophisticated equipment, finance etc were some of the lacks felt during the research work.

However, the outcomes from the study will definitely be valuable information to the person, researcher, organization and other line agencies working in the field of wildlife–human conflict especially focusing in monkey species. The research work will help the VDCs of study area as well as the Gulmi District Development Committee at all for the proper management of monkey-people conflict.

II
LITERATURE REVIEW

2.1 Population Status and Distribution of Monkey in Nepal

According to the latest classification of Conservation Assessment and Management Plan (CAMP) workshop 2002, status of available primate species has been classified for Nepal (Sanjaya et al., 2003). Three species of Hanuman Langur has been classified as: *Semnopithecus entellus hector* (Lesser Hill Langur) as Critically Endangered, *Semnopithecus entellus ajax* (Western Himalayan Grey Langur) as Endangered and *Semnopithecus entellus schistaceous* (Central Himalayan Langur) as Near Threatened. CAMP designated Assamese monkeys of Nepal as "Nepal population" from the existing two subspecies (*M. a. assamensis* and *M. a. pelops*) based on the information on their fur coloration, head body tail length and its ratio, size, variation and weight etc. It is categorized as Endangered species. The conservation status of Rhesus monkey (*Macaca mulatta*) was assessed as least concern as it is widely distributed and abundant in its population. Rhesus and Langurs are common and the Assamese is strictly protected under the National Park and Wild Life ActNepal 1973 and has considered in the Endangered status (Chalise, 1997 and 1998). Population density of this animal has been found more in temple, religious places, cities and town (Nepal, 2005).

In Nepal, Rhesus monkeys are found in tropical rain forest of Tarai to the valleys across of higher elevation of Makalu-Barun, Langtang and coniferous, alpine forest of Rara area too (Southwick et al., 1982;Chalise, 1998). They are in larger number in religious jungles and temples like Pashupati,

Swayambhu, Sankhu, Bajrajoginietc.of Kathmandu Valley (Chalise, 1998). Hanuman Langurs, *S. e. ajax* is reported from East Langtang, Melamchi area, *S. e. hector* from Central to West Nepal in outer Tarai, and *S. e. schistaceus* is reported from south to north in Cenrtal Nepal (Chalise, 2004).

2.2 Human-Primate Conflict

According to World Conservation Union, World Park Congress 2003, human-wildlife conflict occurs when wildlife's requirements overlap with those of human population, creating cost to residents and wild animals.

Direct contact with wildlife occurs in both urban and rural areas, but it is generally more common inside and around protected areas, where wildlife population density is higher and animals often stray into adjacent cultivated fields or grazing areas. One of the main challenges facing wildlife conservation in the twenty-first century concerns the increasing interaction between people and wildlife and the resulting conflicts that emerge (Sillero&Switzer 2001). Conflict between wildlife and people is an important factor affecting the relationship between protected areas and the people who live near them (Studsrod and Wegge, 1995).

Across the globe primates are the most frequently identified crop-raiding animals. From Africa to the Arabian Peninsula to Southeast Asia to Japan, primates come into conflict with humans due to the renowned crop raiding behaviour of many species (Sillero& Switzer 2001). Conflicts often occur when non-human primates raid crops (Forthman, 1986; Siex and Struhsaker, 1999; Hill, 2000) or when humans provision groups of primates (for example, *S. entellus,*Hrdy, 1977; *Macacasylvanus*, O'Leary and Fa, 1993; *M.radiata*, Schlotterhausen, 1998; *M. mulatta*, Gupta, 2002). A large number of primate species raid crops, but it appears that terrestrial species are more likely to damage crops than arboreal species, and non-folivores are greater crop raiders than folivores. Amongst the Old World monkeys, the most common, and betterable to coexist with man, species are from the genera *Macaca, Papio,* and *Cercopithecus,*in particular the several species of baboon (Papio spp.), the rhesus monkey (*Macacamullatta*), and the vervet monkey(Sillero& Switzer 2001). Rhesus monkeys are also a major crop pest in the hills and mountains of Nepal (Giri and Shah, 1992; Chalise, 1997, 2001, 2003; Ghimire, 2000).

In the Indian context the man-monkey relationship is remarkable. On one side people consume blood and flesh of monkeys as medicines, trap, kill and eat them as food, on the other side people keep them

as pets, trained them to play, feed and protect them (Rajpurohit et al.,2006). Urbanized populations are provisioned frequently due to religious sentiment of people. So human attitude towards monkey seems differ from area to area and species to species. Likewise, monkeys are not liked in the areas of massive agriculture, horticulture and other plantations since they damage the crops and orchards. In such areas they are considered pests (Roonwal and Mohnot, 1977). In yet another situation monkeys have become commensals and competitors of human being in and around villages, towns and cities. These are "Urbanized monkeys" (Rajpurohit et al., 2006).

People from urban areas are more likely to be bitten than those living in rural areas, largely due to fact that they are ignorant of primate behavior, and Indian states like Delhi, Uttar Pradesh, Haryana and Himachal Pradesh are the worst affected, reporting the maximum number of cases. The reasons for this are many, namely: (1) Extensive urbanization (2) Increased encroachment of forests (3) Haphazard trapping of forest monkeys for biomedical research leading to chaotic fashioning and the related dispersal of monkeys to nearby human habitations (4) Decrease in the number of forest trees, that provide natural food to monkeys (5) Decreased availability of water in the monkey's natural habitat (6) Decreased human tolerance to other life forms in the same environment (7) Increase in the population of Rhesus monkeys (Malik, 2001).

Crop raiding by Rhesus monkeys is one of the serious problems in Bandipokhara VDC, Palpa as in other parts of Nepal (Chalise, 1997).Assamese monkeys are found in the foothills of high mountains of Annapurna Conservation Area destroy cultivated crops occasionally and people occasionally kill these animals simply while chasing away them from the crops (Gurung, 2002). Consequently, there is also an increase in man–monkey conflicts and in the absence of a management plan of both forests and commensal monkeys, this problem of man–monkey conflict is only going to increase in future (Malik, 2001)

2.3 Commensalism and coexistence

Primatologists describe the rhesus as one of the most commensal of all primate species (Southwick and Lindburg, 1986). They have adapted exceptionally well to human encroachment and can be found living in villages, town temples, railway station, and even some isolated spots in large cities(Teas,1978).

Chance and Jolly (1970) stated : Rhesus monkeys of today have taken advantage of an ecological niche provided by man in which food is plentiful and it seems likely that they have done so for the past five thousand years. Some of their success at co-existing with humans is due to Hindu, Buddhist and animist religion, all prevalent in the east. Monkeys are highly valued because of Buddha's camaraderie with a monkey during one of his incarnations (Majupuria, 1977). All of these religions discourage the killing of animals. Monkeys in particular are revered in the Hindu religion. In literature, Hanuman is usually depicted as a langur (*Presbytis entellus*), a more arboreal species than rhesus. Langurs are still found in or around Hindu temples in India, where they are fed and protected (Southwick 1962). Respects for animals extend beyond the cow to other living creatures, including monkeys in Hindu religion (Chapple, 1993). Monkeys are often considered sacred in Hinduism because they are symbolic incarnations of Lord Hanuman, the Monkey god. Monkeys in India such as the Rhesus macaque and the Hanuman langur represent living incarnations of Lord Hanuman and Hindus would be remiss if they did any harm or failed to help them (Carter & Carter, 1999; Wolf, 2000). Those associated with Hindu temples, especially Hanuman temples, are protected within temples grounds. Singh (1969) observed that monkey populations were higher in cities of practicing Hindus than elsewhere. The role of religion is theoretically one contributing factor to the commensal nature of rhesus monkeys (Southwick et al., 1965).

Rhesus often prefers to live along forest edges, close to human habitation, thus this species inhabits villages, towns, cities, road sites, temples and rail stations where it is highly adapted to the presence of humans. Southwick et al. (1965) estimated that only 2% of 802,000 rhesuses in North India resided in forests, while the other 78% resided in human habitations. While the forest groups tend to be shy and rely almost exclusively on natural foods, the urban groups have become increasingly bold.

Recent evidence suggests that in human modified tropical landscapes, in some agro ecosystems may be important to sustain vertebrate biodiversity, including primate biodiversity, by providing temporary habitat, increasing area of vegetation and availability of potential resources, and by providing shelter and connectivity for isolated segments of populations in a broad spectrum of animal species (Daily et al. 2003; Estrada et al. 2006b; Greenberg 2004; Harvey et al. 2004).Similarly studies of the ecological value of forest-dwelling primates have stressed their roles as potential pollinators, seed dispersers and as plant and seed predators. This reveals the importance of primate survival for continued forest dynamics and existence (Bollen et al. 2004; Chapman .et al 1998),and for local human population and economies, especially where humans use the seeds of tree species(Lambert and Garber 1998). Economic value of primates has focused on their importance as a source of meat in many areas of Central and West Africa

(Refische and Koné 2005) and in Brazilian Amazonia, where annual consumption is estimated at 3.8 million primates (Chapman and Peres 2001). Trading primate meat has also been pointed out as an important component of local economies in some African countries. For example, it has been estimated that the exploitation of primates in the Tai region of Ivory Coast represents a market value of $124,031-136,688 per annum (Refische and Kone 2005; Anadu et al. 1988; Auzel and Wilkie 2000) and in Southeast Asia (Clayton and Milner-Gulland 2000). Interestingly, no information exists on the potential ecological (e.g. seed dispersers, pollinators, enhancement of primary productivity, nutrient input) and economic benefits (e.g. increase in crop production) of the presence and activities of primates in agro ecosystems.

2.4 Monkey Problem Management

Crop raiding is not a new phenomenon. Farmers have evolved resourceful strategies to fight back against the animals responsible for damaging their crops. The methods that are employed by an individual farmer are deeply influenced by the resources at his disposal. In developed countries farmers have considerable levels of capital and expertise to summon to combat crop raiding. In developing countries farmers have small incomes and little access to technology. A range of methods has evolved in such countries, relying on simple, manpower based techniques to tackle crop raiders.

To protect crop fields and orchards from wildlife and langurs farmers of Kumbhalgarh Wildlife Sanctuary (KWS), India use many methods. These methods include patrolling the fields, throwing stone with "gophan", keeping dogs, fencing with thorny twigs, potash bomb etc. The most commonly used crop protection strategy in guarding their fields by constant vigilance during crop seasons. (Chhangani et.al.2004). Of all the non-destructive control measures, shifting of problem creating animals was found to be the best method(Southwick et al, 1984; Else, 1991) Before the monkey scaled off in Aligarh, Utter Pradesh of India Siddiqi and Southwick(1993) had earlier suggested to shift some of the Rhesus Monkeys from the district. On account of their oppressive behaviour, some commensal monkeys from other parts of India have been shifted earlier(Imam and Yaha, 2002).

In 1995, five groups of Rhesus monkeys comprising of 40 individuals were moved from National Zoological Park , New Delhi and released in Tughlaqabad Fort, New Delhi (Imam and Malik, 1997) and in the same year seven individuals trapped from Friendicos, New Delhi were also released in Tughlaqabad

Fort. In one of the world's largest monkey capture and release exercises, 600 monkeys from Vrindaban(Mathura district) were captured and released in different forest patches (Imam et al , in press). Imam and Malik(2006) has suggested 3 measures to manage monkey problem, namely cessation of feeding by people, translocation and fertility control.

2.5 Threats to macaques

While not endangered, the rhesus is under constant threat of natural habitat destruction due to increasing human population. In Bangladesh, forest dwelling rhesus macaques are threatened because of cattle grazing, illicit timber and fuelwood harvesting, and settlement pressure. The forests in which they are found are not continuous or undisturbed (Sazedul Islam &Zahirul Islam 2001). When forests are not totally cleared, they are still often impacted through illegal timber extraction, livestock grazing and lopping. As a result, primate populations are being reduced or eliminated in many parts of the world (Wolfheim, 1983, cited by Richard et al., 1989).

The highly adaptable, commensal rhesus moves into human habitats to acquire its daily needs, often taking up permanent residence alongside humans. Conflict between rhesus and humans is bound to occur. At first it is humans who appear to be the victims of such conflict, however, if left unabated, the roles are reversed and it is the monkeys who become the victims through changing attitudes from that of tolerance and reverence to frustration and anger. In many areas of India where rhesus macaques are in contact with humans they are menaces: threatening or biting children and the elderly, stealing food from people, raiding crops and damaging property leading to decreased tolerance and persecution of rhesus macaques in some areas (Imam et al. 2002; Rao 2003).Nepal is not immune to this activity. Ale and Gurung (1995) reported hunting of rhesus in the lower Manang region by farmers seeking relief from crop raiding.

Mitigating human-monkey conflict is necessary to prevent the change in attitudes towards macaques that could lead to further persecution and population decline. Translocatingparticularly problematic rhesus monkeys or entire groups also is not a widespread option because there simply are not enough suitable forest patches in which large numbers of rhesus can live (Imam et al. 2002).

Perhaps innovative engineering could lead to monkey-proof containers in which people can store household items and food and prevent local rhesus from raiding their kitchens. Deterrent fencing or other protective measures could also be established around gardens and agricultural crops to prevent

rhesus macaques from crop raiding. On the other hand, Bercovitch and Berman (1993) found that on Cayo Santiago, mothers who had sons had a delay in the next reproduction, and therefore there is a higher cost in producing males, not females. Decreasing opportunities for conflict between local humans and rhesus macaques will lead to maintained tolerance of these monkeys that have nowhere to retreat from human encroachment. Thus forest conservation is an obvious priority. In conclusion, the long-term status of rhesus is dependent on both habitat conservation and addressing the immediate problems experienced by humans.

The main threat of primate conservation in Nepal is habitat loss for agriculture expansion, logging and shifting cultivation followed by the revenge feeling of farmers due to their crop damage (Chalise, 2003).

2.6 Monkey Research in Nepal and perspective of biomedical research use of monkeys

Monkey research in Nepal was started around 1970s on Rhesus monkeys of urban areas mostly of religious places. An insight into the Rhesus monkeys of Nepal, for the first time was given by Southwick and other members of Earth Watch team. In 1978, Teas submitted a dissertation on Behavioural ecology of Rhesus monkeys in Kathmandu valley. Bajracharya(1979) studied the feeding behaviour of Rhesus monkeys of Swoyambhu area focusing on provisioned food. In 1990, Dr. Paul Winkler started research on Langurs living around Ramnagar village of Chitwan and establised a monkey research project in Ramnagar in 1991in collaboration with Natural History Museum, TU.

Mukesh Kumar Chalise in 1995 did his Ph.D. on the comparative study of feeding Ecology and Behaviour of male and female langurs. Chalise (1997) surveyed the primates of Makalu Barun Conservation Area. In 1998 and 1999, the Assamese monkeys of Makalu Barun Conservation Area were studied (Chalise 1999). Till now research on monkey is elaborated in different part of country from Tarai to High hills and study on population, ecology, feeding behaviour as well as conflict with locals has been done.

Experiments involving non-human primates (NHPs) include toxicity testing for medical and non-medical substances; studies of infectious disease, such as HIV and hepatitis; neurological studies; behavior and cognition; reproduction; genetics; and xenotransplantation. Most are purpose-bred, while some are caught in the wild according to the Department of Agriculture of USA. Most of the NHPs used are one of three species of macaques, accounting for 79% of all primates used in research in the UK, and 63% of all

federally funded research grants for projects using primates in the U.S.(Conlee, Kathleen M; Hoffeld, Erika H; Stephens, Martin L (2004). Lesser numbers of marmosets, tamarins, spider monkeys, owl monkeys, vervet monkeys, squirrel monkeys, and baboons are used in the UK and the U.S. Licenses approving the use of great apes, such as gorillas, chimpanzees, and orangutans, are not currently being issued in Britain, though their use has not been outlawed ("Testing on apes 'might be needed'", BBC News, June 3, 2006.) but chimpanzees are used in the U.S., with 1,133 in research laboratories as of October 2006. NHPs are used in research into HIV, neurology, behavior, cognition, reproduction, Parkinson's disease, stroke, malaria, respiratory viruses, infectious disease, genetics, xenotransplantation, drug abuse, and also in vaccine and drug testing. According to The Humane Society of the United States, chimpanzees are most often used in hepatitis research, and monkeys in SIV research.

Because monkey are physiologically similar to humans, though their use is controversial. According to the Nuffield Council on Bioethics, NHPs are used because their brains share structural and functional features with human brains, but "while this similarity has scientific advantages, it poses some difficult ethical problems, because of an increased likelihood that primates experience pain and suffering in ways that are similar to humans.(http://www.nuffieldbioethics.org/go/browseablepublications/ethicsofresearchanimals/report_230.html.) Some of the most publicized attacks on animal research facilities by animal rights groups have occurred because of primate research. Some primate researchers have abandoned their studies because of threats or attacks. Testing hair from Asian monkeys living close to people may provide early warnings of toxic threats to humans and wildlife(http://www.news-medical.net/news/20100105/Macaques-living-close-to-people-may-provide-early-warnings-of-toxic-threats-to-humans-and-wildlife.aspx).

Rhesus monkeys are used extremely as an experimental animal in many primate centers, bio-medical institutes and psychological research because of similarity of Rh factor in human blood and in Rhesus monkeys. Similar diseases have been found in Rhesus and human such as small pox, measles, tonsillitis, harps ‘B’ causes by viruses, tuberculosis, bronchitis, tetanus, cold and cough by bacteria. The medicine against AIDS has been experimentation on Rhesus monkeys, which are most successful events in the medical sciences that increase the life span of human by the use of medicines. The other dangerous disease such as hepatitis B, swelling of liver, cancer has been experimented on them and the successful result has overcome to save human life (Chalise, 2004 b).

III

STUDY AREA

3.1 General description

Nepal, a Himalayan Republic lies at the transition point of Indo-Malayan and Palaearctic biogeological realms. It has magnificent, rich and varied fauna and flora owing to the diverse topography and to a wide range of altitudinal and climatic zones. Giant mountain peaks, enveloped in snow and icy winds, tower high above the warm jungles of the lowland Tarai. Nepal has an area of 147,181 square kilometers extending along the east-west 885 km and 145 to 241 km from north south with Tibetan plateau at north and Gangetic plain fertile alluvial soil at south. It is located between longitude 80º4'E to 88º12'E and latitude 26 º22' N to 30 º27' N.

Nepal is landlocked between India and China. The country rises from the Indo-Gangetic plain about 60m to world's highest peak, Mount Everest 8,848m. Topographically the country Is divided into three distinct regions from north to south; the Himalayan region, hilly region and flat plain of Tarai.

Due to this diverse topography, almost all the climatic zones of the earth are found in Nepal: tropical, sub-tropical, temperate and alpine. The mean annual temperature is about 15 degree Celsius; however, summer temperature could rise 40 degree Celsius in some places and chilling cold towards north. Rainfall varies greatly from place to place from 250mm to 4,000m and about 80% of the precipitation occurs during the monsoon.

Nepal is one of the richest natural animal reserves in the world considering its relatively small geographical area (Majupuria and Majupuria, 2006). According to governmental data 39.6% of the total area of country is covered by forest on which about 25% is natural forest.

3.2 Study Site

3.2.1 Location

The study was carried out in Gulmi District of Lumbini Zone in the Western development region of Nepal. The district lies in the mid hill region and located between latitude 27 º55' N to 28 º27'N and longitude 83º10'E to 83 º35' and range on the elevation between 465m to 2690m. It is surrounded by six districts ; Syanja and parbat towards east, Pyuthan towards west, Palpa and Arghakhanchi towards south and Baglung towards north. Almost of the land of this district lies in Mahabharat range. Out of the total area of about 1,149km² (124937.97 ha) 68.67% (85670.26 ha) is covered by agricultural land and 25.47% (32144.76 ha) by forest. But only 34,102 ha of agricultural land are used for cultivation.

Both Arkhale and Nayagaun VDCs lie in southwestern part of Gulmi District. Arkhale VDC is one of the 79 VDCs of Gulmi district. Arkhale VDC has an area of 20.45 Square Kilometers. According to the census of 2001, population of Arkhale VDC is 6,650, with 2,990 males and 3,660 females. There are 1,346 households in Arkhale VDC. Out of the total area forest covers 841.32 hectors.

Similarly, Nayagaun VDC has an area of 16.38 square Kilometer with 3oo hectors of natural forest. Total population of Nayagaun VDC is 5,535 with 978 households. Most of the people of these VDCs have been engaged in agriculture. Chhaldi Khola, Panaha Khola ,Mareng Khola are the main streams of this area .

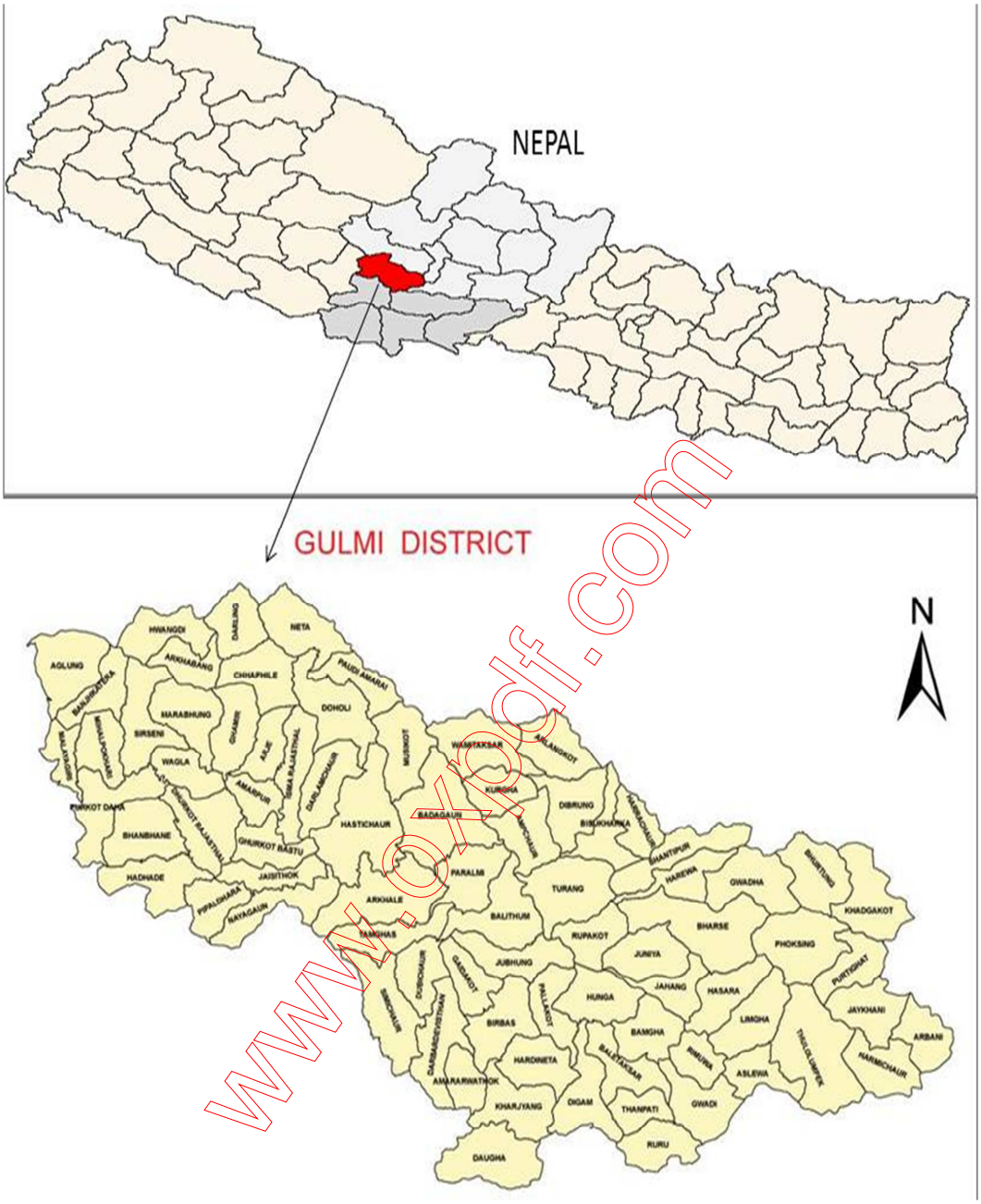
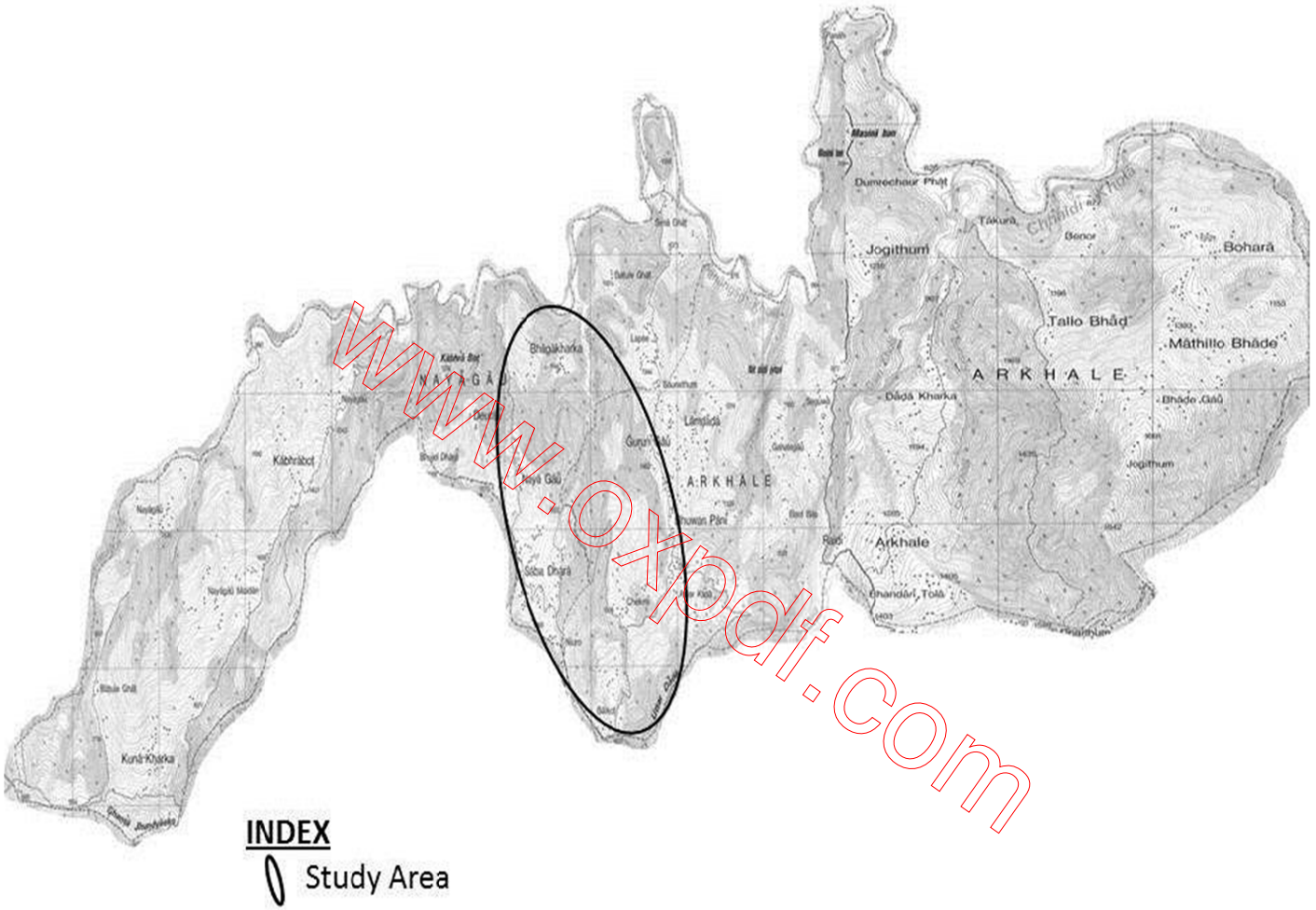


Fig 1: Map of Nepal and Gulmi District



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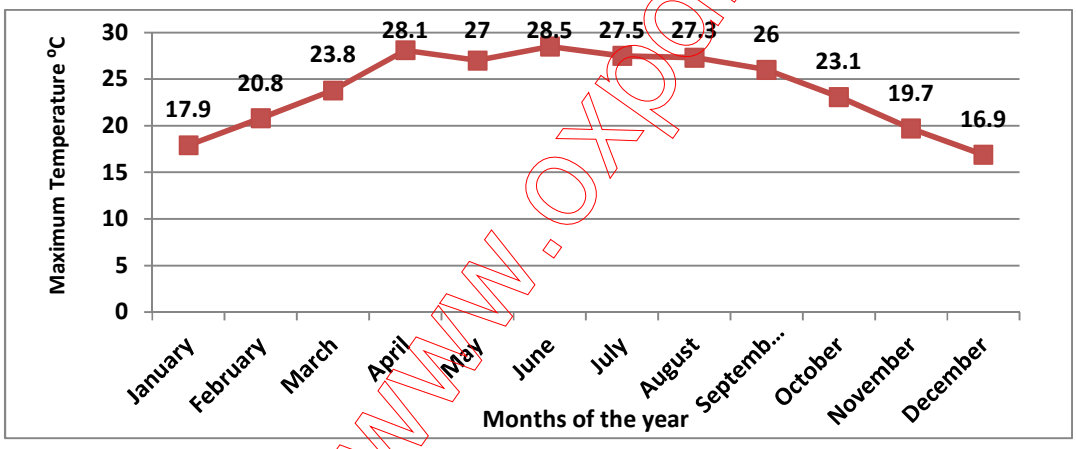
Study Area

Fig 2: Map of study area

3.2.2 Climate

Climate of Gulmi district is of temperate type. But the areas below 1000 meters have sub-tropical climate. Meteorological data of 2009 shows that maximum temperature of Gulmi district ranges from 28.5ºC to 16.9ºC and minimum temperature ranges from 18.9ºC to 6.2ºC. Thus maximum temperature of Gulmi district reaches to 28.5ºC and minimum temperature goes to 6.2ºC. Similarly relative humidity in the month of august is maximum (92.8%) and in April is minimum (51.2%). Likewise rainfall in august is maximum i.e. 594.8 mm and in January and December there was no rainfall. The average annual rainfall of the district is 1939 mm. Monsoon comprises 80 percent of total rainfall and remaining 20 percent rainfall occurs in other seasons.

Temperature



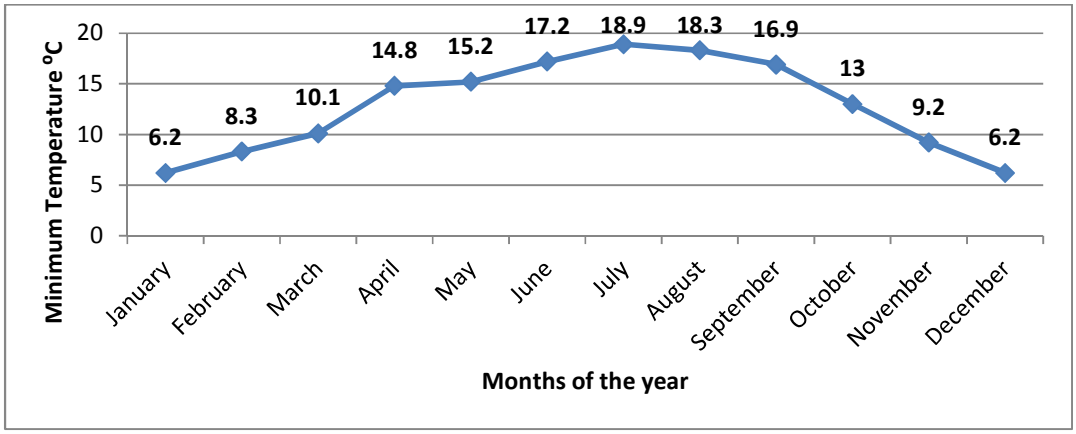


Fig 3: Mean monthly temperature of Gulmi district, 2009

Humidity

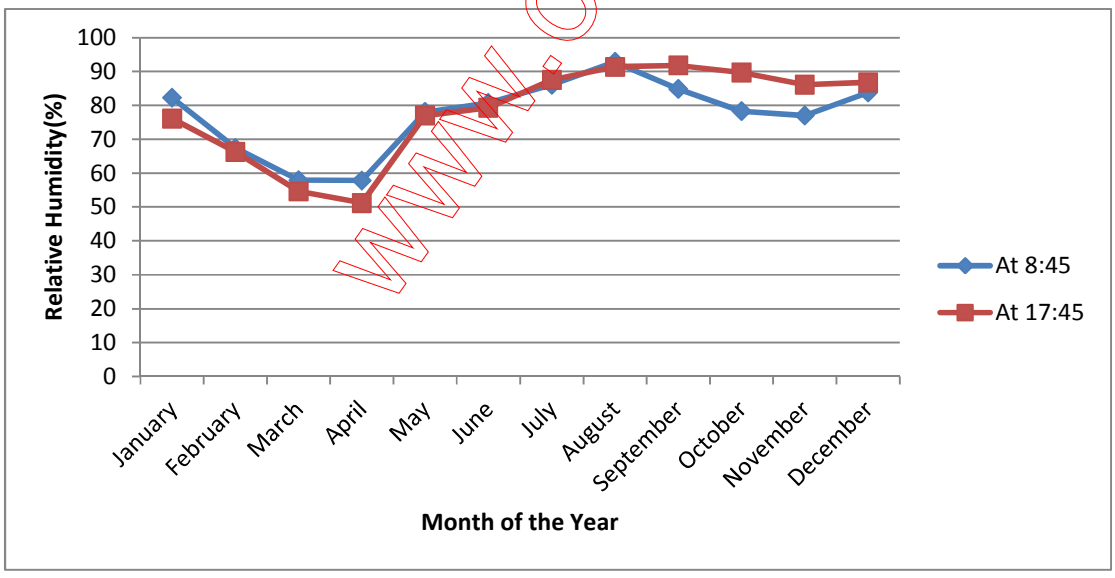


Fig 4: Mean monthly relative humidity of Gullmi district, 2009

Rainfall

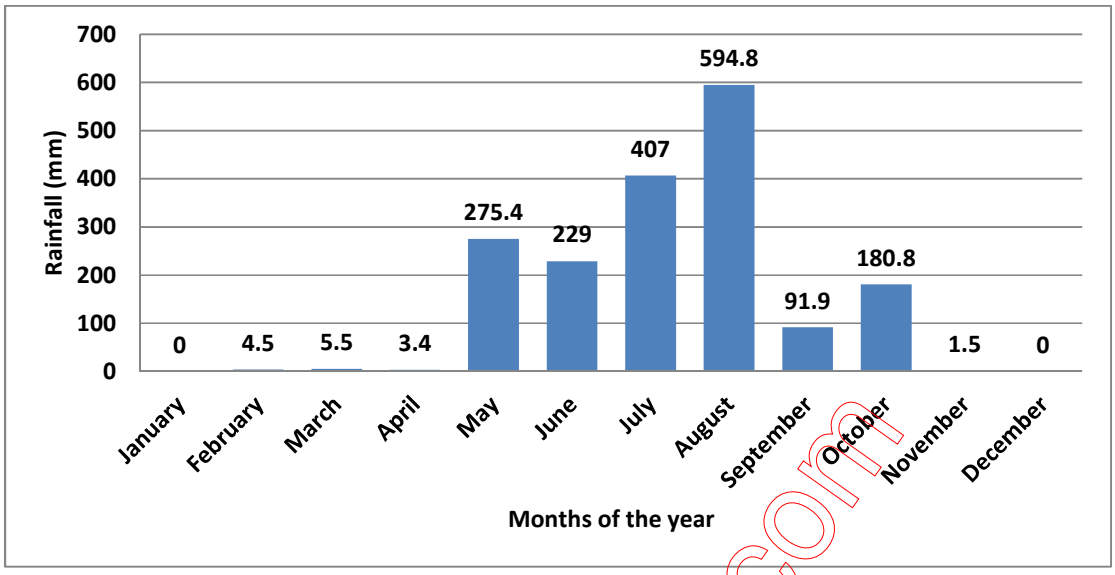


Fig 5: Mean monthly rainfall in Gulmi district, 2009

3.2.3 Flora

Both Arkhale and Nayagaun consist diverse forest type. The forest of study area is predominantly subtropical and temperate. At higher altitude as well as the land facing towards south there are forest patches of pine trees.

Lower lands as well as north facing slopes consist mixed forest of Catanopsis-Sachima species. In general, main floral types of Arkhale and Nayagaun of gulmi district consist Pine (*Pinus ruxbergi*), Sal (*Shorea robusta*), Chilaune (*Sachima wallichi*), Katus (*Catanopsis indica*), Uttis (*Alnus nepalensis*), Kafal (*Myrica esculenta*),Chiuri(*Aesandra butyracea*), Simal (*Bomba cebia*), Gurans (*Rhododendron arboreum*) and Mayal(*Pyrus pashia*).

3.2.4 Fauna

There are some wild animals in the forest of Arkhale and Nayagaun. Leopard (*Panthera pardus*), Jungle cat (*Felis chaus*), Common langur (*Prebistys entellus*), Rhesus monkeys (*Macacca mulatta*), Common

mongoose (*Herpestes edwardsii*), Porcupine (*Hystrix indica*) etc. The bird species are Owl (*Bubo bubo*) , Black Kite (*Milvus migrans*), Vulture species, Eagle (*Spilornis cheela*), Kalij pheasant(*Lophuraleucomelana*), Cuckoo (*Cuculus* sps.), Common myana (*Acridotheres tristis*), House crow (*Corvus splendens*), Woodpecker (*Picus* sps.) etc. Gohoro (*Varanus* sps.), Garden lizard (*Calotes versicolor*) and snake species are also found in the study area. Many domestic cattle are present in Arkhale and Nayagaun , which depend on the forest for fooder.

IV

MATERIALS AND METHODS

4.1 Equipment

Following equipment were used during the field study

a. Binoculars b. Measuring tape c. Digital camera d. Topo map

4.2 Methodology

4.2.1 Reconnaissance Survey

A preliminary survey of the study area was done on April 2010 to find out the monkey distribution, habitat and monkey affected areas in Arkhale and Nayagaun before starting of regular fieldwork. The survey process included field observation, interaction and pretesting of questionnaire with local people.

4.2.2 Field Survey

Fieldwork was carried during August 2010 to June2011. During the field survey related information were collected by using various methods.

4.2.3 Sampling Method and Sample Size

Four wards were selected; two from each, Arkhale and Nayagaun VDC (wards 1 and 2 from Arkhale and 8 and 9 from Nayagaun). Fifty percent of the households from these wards were taken randomly as a sample for survey (Table 1).

Table 1: Sample size in Arkhale and Nayagaun

Wards	1	2	8	9	Total
Total households	160	110	95	117	482
Number of households sampled	80	55	48	59	242

4.2.4 Data Collection Methods and Procedures

Both the primary and secondary data were collected for the study.

4.2. 4.1 Primary Data Collection

4.2.4.1.1 Households questionnaires

A pre-tested semi-structured questionnaire was used to interview the respondents. A questionnaire containing information like the monkey visitation, monkey related problem, preventing methods used by the locals, possible remedial measures of conflict etc. was used to collect the information from respondents (see appendix I). Most questions were fixed alternative for easy scoring and analysis.

Secondary data related to the study was reviewed from different books, annual reports, news article, research report, dissertation, journal, website, visiting different concern offices, and library.

4.2.4.1.2 Monkeys population and distribution study

The head count of monkey population was done with the help of binoculars. First of all, the regular observation was done both early morning and evening time to locate their distribution in different study sites. A regular watching was conducted without disturbing natural setting. Repeated observation was made in focal troop to identify individually and to recognize their home range.

4.2.4.1.3 Troop composition and age/sex composition

Troop composition was separated by direct counting the individuals in each group and age sex ratio were distinguished by their body color, body proportion, height and body size as described by Roonwal and Mohnot in 1977.

The closest animals in a troop with distinct territory are taken as the individuals of one troop. The composition of the troop was differentiated into Adult males, Adult females, Sub adult males, young-adult females, Juveniles and infants according to their body size, coloration and behaviors.

Adults were those attained the maximum height and body maturity. Adult males were distinguished by large and hanging scrotal sacs. Females were distinguished with small head and protruded nipple.

Young and sub adults were those who attained the height however not matured in body fitness and sexual activities. They were grown up one and independent.

Juveniles are the individuals that are left nipple contact (weaned) and depend on natural foods and mostly following their kins.

Infants are those who still suck the nipple as their main food and following mother.

4.2.4.1.4 Ad-libitum sampling

This is a sampling technique in which additional information on rare events and on general occurrence (behaviors) in the troop is noted down systematically (Chalise, 1995). This method was adopted to take information was adopted to take information about the events of conflict and other behaviors that are not in fix time period.

Following events of conflict were categorized and considered for his study.

1. Aggressive Interaction by Monkey

Threat: One or more of the events with direct eye contact with the recipient such as head bob facial grimace, charge threat etc.

Biting and nail scratch: Monkey inserting its nail or teeth into skin or any part of human.

Food snatching: Grabbing the food carried by human or stored in the house

2. Aggressive interaction by Human beings

Stone throw/catapult: Throwing stone, rock or wooden log towards monkey by hand or via catapult.

Chase out: running towards monkey with or without carrying stone. Stick or any weapons may be used.

Charge threat: Monkeys head bob stimulation, small steps towards monkey and giving throw the motion of throwing object towards monkey.

Shout: Yelling high sound in the direction of monkey.

Encroachment of Habitat: Cut trees or clear the natural vegetation or collection of firewood, fodder or natural foods including cattle grazing.

4.2.4.1.5 Quadrat method

In the study site there are five community forests with total area of 192.79 hectare. But the natural forest is distributed in four patches interrupted by human settlement. Thus, to study the vegetation pattern of the natural forest each patches is divided into two transect of more or less equal difference.

And to study the true of each side, a Quadrat of 25×25 was laid down randomly. The plant local name was identified by the experienced local persons.

Statistics used for this study to identify dominance and diversity of vegitation types is:

Simpson's index of Dominance $(C) = \sum \left(\frac{ni}{N} \right)^2$

Shannon Index of general diversity $\overline{H} = -\sum \left(\frac{ni}{N} \right) \log \left(\frac{ni}{N} \right)$

Where,

ni = importance value

N = Total no. of importance value (Odum, 1996; Krebs 1994)

$$\text{Relative Density (R.D.)} = \frac{\text{No. of individual Species 'X'}}{\text{Total no. of all Species}} \text{X} 100\%$$

4.2.5 Data Analysis and Presentation

Household's questionnaires responses were carefully processedand arranged to make sense to researcher for report writing. The collected data was edited, coded and tabulated. The editing was done thoroughly for analysis and interpretation. Both descriptive statistics (percentages, frequencies) and inferential statistics were used to analyze the data. Charts, table, graphs, and bar diagrams were used to present the data in most simplified and understandable form.

V

RESULT

The study was carried out from June 2010 to August 2011. Two wards from each Arkhale and Nayagaun VDC were taken for detail study.

5.1 General Distribution

A total of 4 troops of Rhesus monkeys counting 128 in number and one troop of Langur were observed during the field study. One troop of Rhesus in each was found in the forest of Sitheni, Mulaghari, Khannichaur-Harrachaur, and Gurung Gaun (Table 2). Only one troop of Langur was found. The one-male troop with 14 individuals was found to be migratory between the forest of Khannichaur-Harrachaur and GurungGaun. No Langur was observed in the forest of Sitheni and Mulaghari (Table 4).

Table 2: Population of Rhesus monkey in the study area.

Site	GPS location	Number of troop	Total individual	Habitat
Sitheni	28°4'40''N, 83°12'50''E	1	30	Pine/Mixed forest
Mulaghari	28°4'50''N, 83°13'0''E	1	23	Pine/Mixed forest
Khannichaur	28°5'35''N, 83°12'45''E	1	44	Pine/Mixed forest
GurungGaun	28°5'30''N, 83°12'30''E	1	31	Pine forest

5.2 Troop Composition

The total population of Rhesus monkeys i.e. 128 in the study area was composed of 4 troops. The first troop (A) in the forest of Sitheni composed of 30 individuals with 2 adult males, 6 adult females, 4 sub-adult males, 4 sub-adult females , 9 juveniles and 5 infants. The second troop(B) in the forest of Mulaghari was composed of 23 individuals in whom 2 adult males, 4 adult females, 6 sub adult males, 4 Young-adult females, 5 juveniles and 2 infants were found. The third troop(C) in the forest of

Khannichaur-Harrachaur composed of 44 individuals with 3 adult males, 8 adult females, 7 sub adult males, 6 sub adult females, 14 juveniles and 6 infants.

The fourth troop (D) which was found in the forest of GurungGaun composed of 31 individuals. Troop D was with 3 adult males, 7 adult females, 5 sub-adult male, 3 young-adult females, 7 juveniles and 6 infants.

Among the total population of Rhesus i.e. 128 the total number of adult males was 10, adult females 25, sub-adult male 22, young-adult female 17, juveniles 35 and infants 19 (Table 3).

The average group size of the rhesus monkey was found to be 32 monkeys per troop and population density 6.64 per km². Similarly, group density of rhesus monkey was 0.207 per km².

Table 3: Troop composition of Rhesus monkey

Name of troop	Number of Individuals						Total
	Adult male	Adult Female	Sub-adult male	Young-adult female	Juveniles	Infants	
A	2	6	4	4	9	5	30
B	2	4	6	4	5	2	23
C	3	8	7	6	14	6	44
D	3	7	5	3	7	6	31
Total	10	25	22	17	35	19	128

Population composition of the monkey troops recorded in the study area showed the highest percentage of Juveniles i.e. 27% followed by adult female 20%, sub-adult male 17%, infants 15%, young-adult females 13%, and adult male 8%.

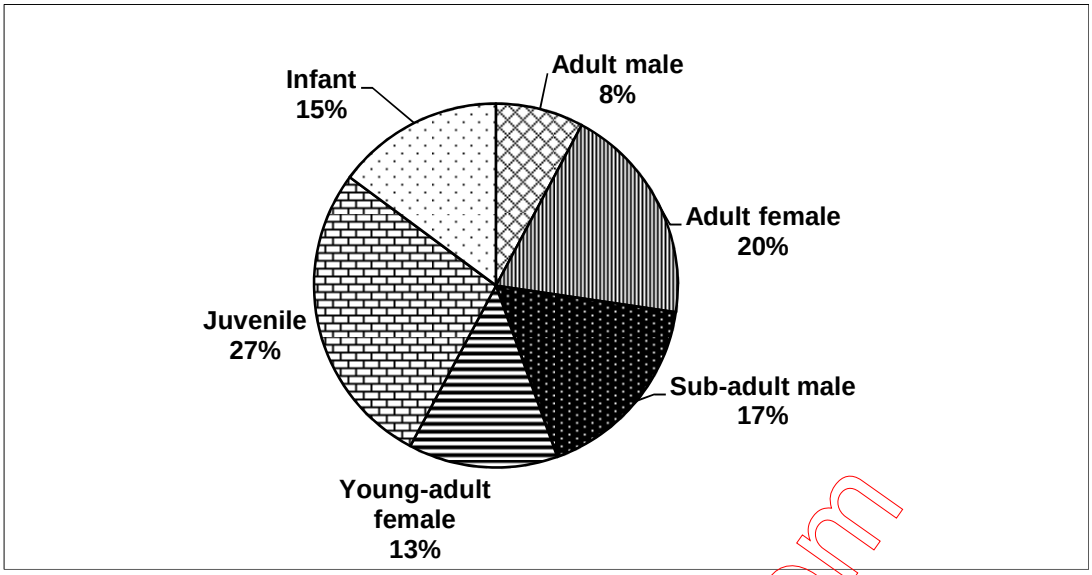


Figure 6: Group composition of Rhesus monkeys in Arkhale and Nayagaun of Gulmi, Nepal

There was only one troop of langur found in study area with 14 individuals. (Table 4) The troop found to be sharing the forest of GurungGaun and Khannichaur-Harrachaur. Out of total population of langur i.e. 14 there was only one adult male, 2 adult female, 3 sub-adult male, 2 sub-adult female, 4 juvenile and 2 infants. The population and group density of langur was found to be 0.73/km² and 0.052/km² respectively.

Table4: Population of Langur:

Individual	Total population
Adult male	1
Adult female	2
Sub adult male	3
Young adult female	2
Juvenile	4

Infant	2
Total	**14**

Population composition of langur troops recorded in the study area showed the highest percentage of Juveniles i.e. 29% followed by sub-adult male 22%. Percentage of young-adult male, infants and adult male was same i.e. 14%, followed by adult male 7%.

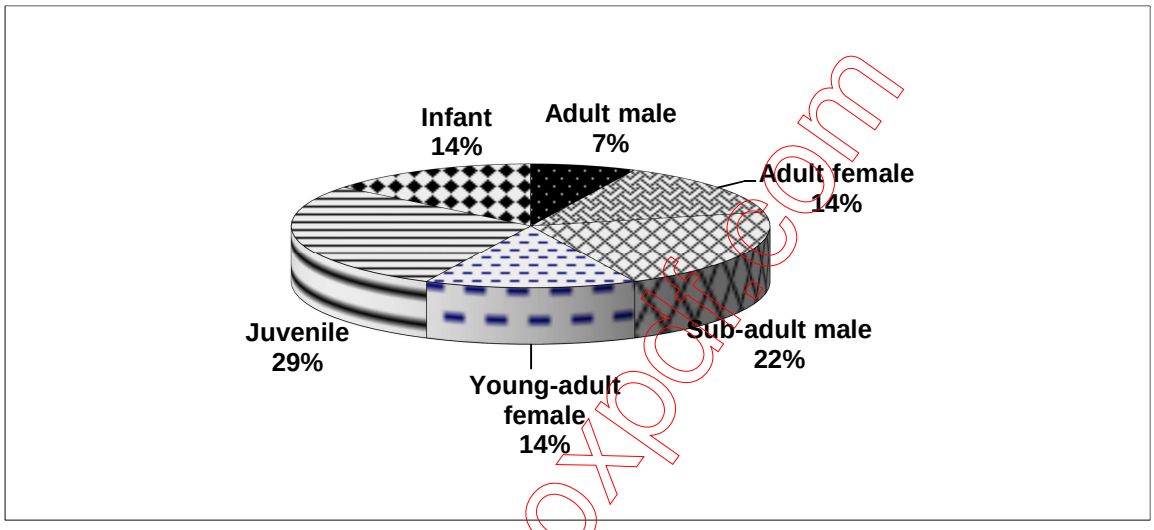


Figure 7: Composition Langur in Arkhale and Nayagaun of Gulmi, Nepal

5.3 Vegetation Plots

Two quardats of 25x25m was laid down in each forest patches or study block. Thus altogether 8 quadrats of 25x25m were laid down for vegetation sampling. By quardat sampling, 23 plant species with 191 number were recorded. This study revealed that Khote Salla (*Pinus ruxbergi*) is the dominant plant species of Arkhale and Nayagaun with relative density 30.89% and relaive frequency 13.043%. Out of the total 191 plants 59 were found to be pine plants. The vegetation records of the habitat is shown in the following table:

Table 5: Sampling of the monkey habitat in the study area by using quardate size 25m x 25m

Vegetation plots	Name of plants	Scientific Name	Total number	Edible parts for monkeys
plot1	Khote Salla	*Pinus ruxburghii*	2	Seedlings
	Chilaune	*Schima wallichi*	1	Non-edible
	Katus	*Catanopsis indica*	1	Fruits
	Mayal	*Pyrus pashia*	3	Fruits
	Chiuri	*Aesandra butyracea*	1	Fruits
	Teeju		4	Fruits
	Kaphal	*Myrica esculata*	1	Fruits
	Angeri	*Berchemia edgeworthii*	4	Non edible
	Mahuwa	*Madhuca longifolia*	2	Non edible
	Dhairo	*Woodfordia fruticosa*	10	Leaves
	Bilaune	*Maesa chisia*	6	Leaves
	Uttis	*Alnus nepalensis*	2	Nonedible
Total	**no. of sps. 12**		**37**	
2	Khote salla	*Pinusruxburghii*	18	Seedlings
	Banjh	*Quercus glauca*	2	Non edible
	Chilaune	*Schima wallichi*	2	Non edible
Total	**3**		**22**	
3	Chilaune	*Schima indica*	5	Non edible
	Mayal	*Pyruspashia*	4	Fruits
	Katus	*Catanopsis indica*	2	Fruits

	Mauha	*Madhuca longifolia*	3	Non edible
	Laliguras	*Rhododendron arboreum*	3	Flower
	Masure Katus	*Catanopsis tribuloides*	2	Leaves
	Angeri	*Berchemiaedgeworthii*	4	Non edible
	Kaphal	*Myrica esculata*	2	Fruits
	Siris	*Albizia procera*	1	Leaves
	Tiju		2	Fruits
Total	**11**		**28**	
4	Khote salla	*Pinus ruxburghii*	9	Seedlings
	Khanyu	*Ficuas semichordata*	4	Fruits
	Mauha	*Madhuca longifolia*	3	Non edible
	Mayal	*Pyru spashia*	5	Fruits
	Chilaune	*Schima wallichi*	4	Non edible
	Tuni	*Toona ciliata*	1	Non edible
Total	**6**		**26**	
Plot5	Khote salla	*Pinus ruxburghii*	19	Seedlings
Total	**1**		**19**	
Plot6	Khote salla	*Pinus ruxburghii*	7	Seedlings
	Bhalayo	*Semecarpus anacardium*	2	Non edible
	Sal	*Shorea robusta*	8	Non edible

Total	***3***		**17**	
Plot7	Chilaune	*Schima wallichi*	4	Non edible
	Katus	*Catanopsis indica*	7	Fruits
	Bhalayo	*Semecarpus anacardium*	1	Non edible
	Mayal	*paschia Pyrus*	5	Fruits
	Teeju		2	Fruits
	Mauha	*Madhuca longifolia*	2	Non edible
	Laliguras	*Rhododendros arboreum*	4	Flower
	Jamun	*Syzigium cumini*	2	Fruits
Total	**8**		**27**	
plot8	Khote salla	*Pinus ruxburghii*	4	Seedlings
	Aamala	*Phyllanthus emblica*	5	Fruits
	Bakaino	*Melia azedarach*	2	Non edible
	Tuni	*Toona ciliata*	3	Non edible
	Kaphal	*Myrica esculata*	1	Fruits
Total	**5**		**15**	

Table 6 : Table showing Density and Frequency of vegetation in the study area

S.N.	Plant species	Total number	Density	Relative density	Frequency	Relative frequency
1	Khote Salla	59	0.0118	30.89	75	13.043
2	Mayal	17	0.0034	8.9	50	8.7
3	Chilaune	16	0.0032	8.34	62.5	10.87
4	Dhairo	10	0.0020	5.24	12.5	2.17
5	Mauha	10	0.0020	5.24	50	8.7
6	Katus	10	0.0020	5.24	25	4.35
7	Angeri	8	0.0016	4.19	25	4.35
8	Teeju	8	0.0016	4.19	37.5	6.52
9	Sal	8	0.0016	4.19	12.5	2.17
10	Laliguras	7	0.0014	3.66	12.5	2.17
11	Bilaune	6	0.0012	3.14	12.5	2.17
12	Amala	5	0.0010	2.62	12.5	2.17
13	Tooni	4	0.0008	2.09	25	4.35
14	Khanyu	4	0.0008	2.09	12.5	2.17
15	Kaphal	4	0.0008	2.09	37.5	6.52
16	Bhalayo	3	0.0006	1.57	25	4.35
17	Uttis	2	0.0004	1.05	12.5	2.17
18	Banjh	2	0.0004	1.05	12.5	2.17
19	Masure Katus	2	0.0004	1.05	12.5	2.17
20	Bakaino	2	0.0004	1.05	12.5	2.17

21	Jamun	2	0.0004	1.05	12.5	2.17
22	Chiuri	1	0.0002	0.52	12.5	2.17
23	Siris	1	0.0002	0.52	12.5	2.17
Total	**No. of speceis=23**	**191**			**575**	

Thisstudy revealed that Khote Salla (*Pinus ruxburghii*) is the dominant plant species of Arkhale and Nayagaun with relative density 30.89% and relaive frequency 13.043% which is followed byChilaune (*Schima wallichi*, *)* relative density 8.34 and relative frequency 10.87. The forest of Arkhale and Nayagaun though having variety of plants, edible plants taken by monkey were not abundant.The seedlings of pine are hard to get by monkey because of the hard structure of the plant part having seedling. Fruiting of other edible plants is also seasonal indicating that monkeys cannot get their food from their natural habitat throughout the year. So they have to go in the crop field of the local people.

5.4 Behavioural study

Behavioural study is an important aspect of an ecological study of animal. Continuous focal sampling was conducted to collect the behavioural data of monkey. Focal animals were contacted for 200 hours. Behavioural study was conducted for same duration in rhesus and langur. Among the four types of behavior recorded (feeding, moving, resting and grooming) feeding was found maximum in both rhesus and langur monkeys. But rhesus was found to spend more time (43.30%) in feeding than langur (36.5%). Langur spent more time in resting(30.6%) than rhesus (23.95%). Langur groomed more (13.40%) than rhesus (11.25%) whereas moving was higher in rhesus (21.5%) than in langur (19.5%).

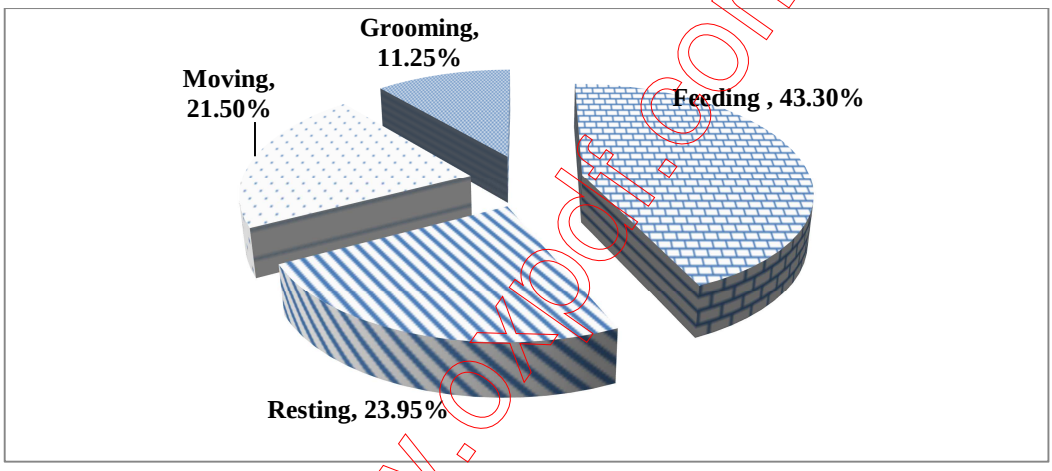


Fig 8: Activity Budget of Rhesus monkey in Gulmi Nepal

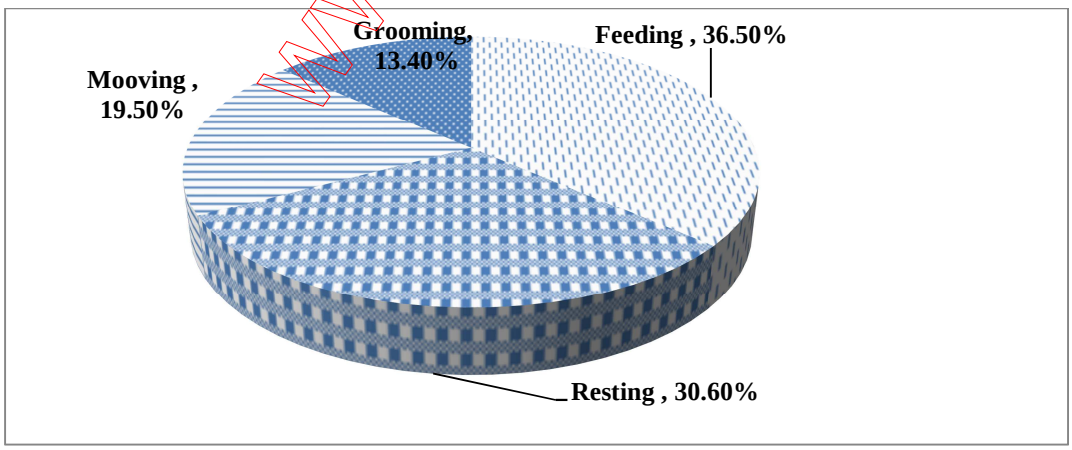


Fig 9: Activity budget of Langur in Gulmi Nepal

5.5 Problem caused by monkey

Crop raiding was found to be the major problem caused by monkey. Out of the total sample population (i.e.242), one hundred and fifty five respondents (i.e. 64%) answered crop damage as the major problem. Physical hurt and harassment was the second with 65 respondents (i.e. 27%), whereas 22 respondents (i.e. 9%) were found with other problems due to monkey, like stealing household goods and some socio-economic burden

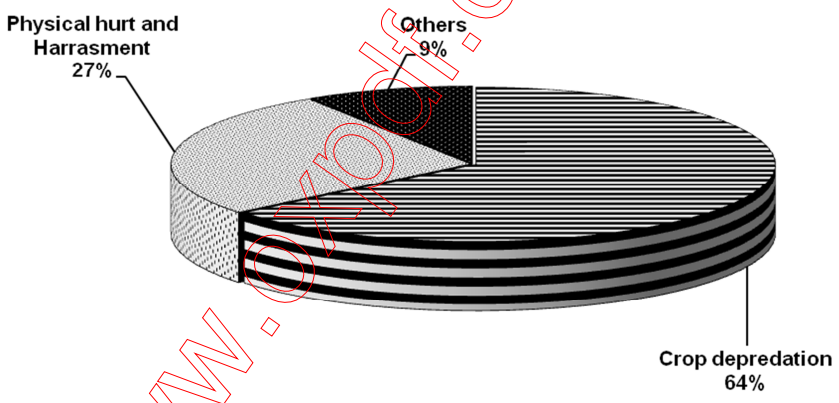


Figure 10: Problem caused by monkey in Gulmi Nepal

. Some of the local people said that they have to quit their job to care after the crop field against monkey, local children were deprived of going to school as they have to guard their crop field all over the day (Fig 10, Table 7).

Table 7: Response of households to the problem caused by monkeys

Block	Sample size	Crop Damage	%	Physical hurt and Harassment	%	Others	%
A	80	50	62	17	22	13	16
B	55	32	59	17	31	6	10
C	48	35	73	11	22	2	5
D	59	37	63	18	31	4	6
Total	242	154	64	63	27	25	9

5.6 Extent of monkey problem

People living around the study area were found to be highly affected by the monkey as only few of them said the problem was in low extent. Majority of the respondents said that the monkey problem was high. Though, significant numbers of people were also of the opinion that the problem caused by monkey was moderate.

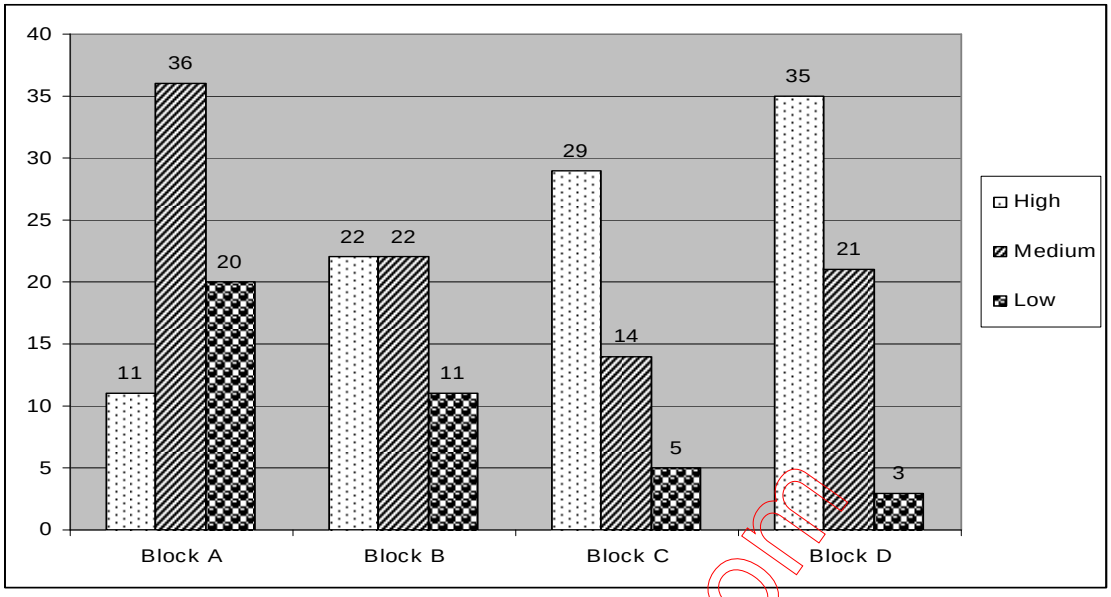


Fig 11: Extent of monkey problem in Gulmi Nepal

5.7 Frequency of crop raiding by monkey

The frequency of crop raiding by monkeys varied, though frequency of monkeys entering to crop fields occasionally was most common in all wards. Majority of the respondents (38%) said that monkeys occasionally entered to the crop field without any particular time frame. Twenty nine percent of respondents replied that monkeys entered their fields 2-3 times a week.

The monkeys frequented daily in crop fields was found to be 21%, whereas only 12% of the respondents replied that monkeys raided their crop one time a month.

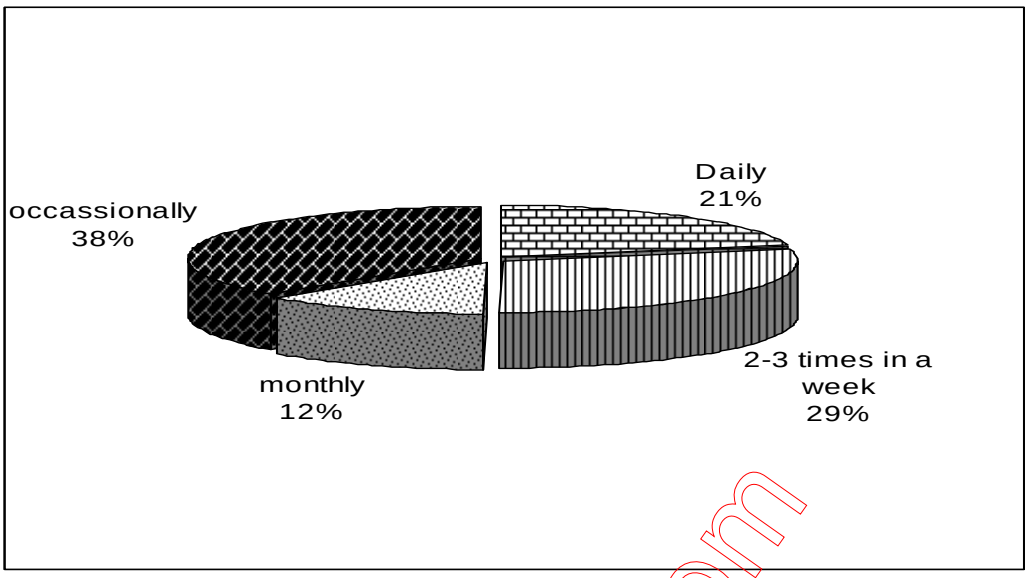


Fig 12: Frequency of crop raiding by monkey in Gulmi, Nepal

Monkeys of the study area were opportunistic as they entered the crop field at any time except night. Sixty four percent of respondents said that monkeys could come at any time. The second more problematic time was afternoon followed by morning. Only five percent of the respondents said that monkeys entered the crop field at evening.

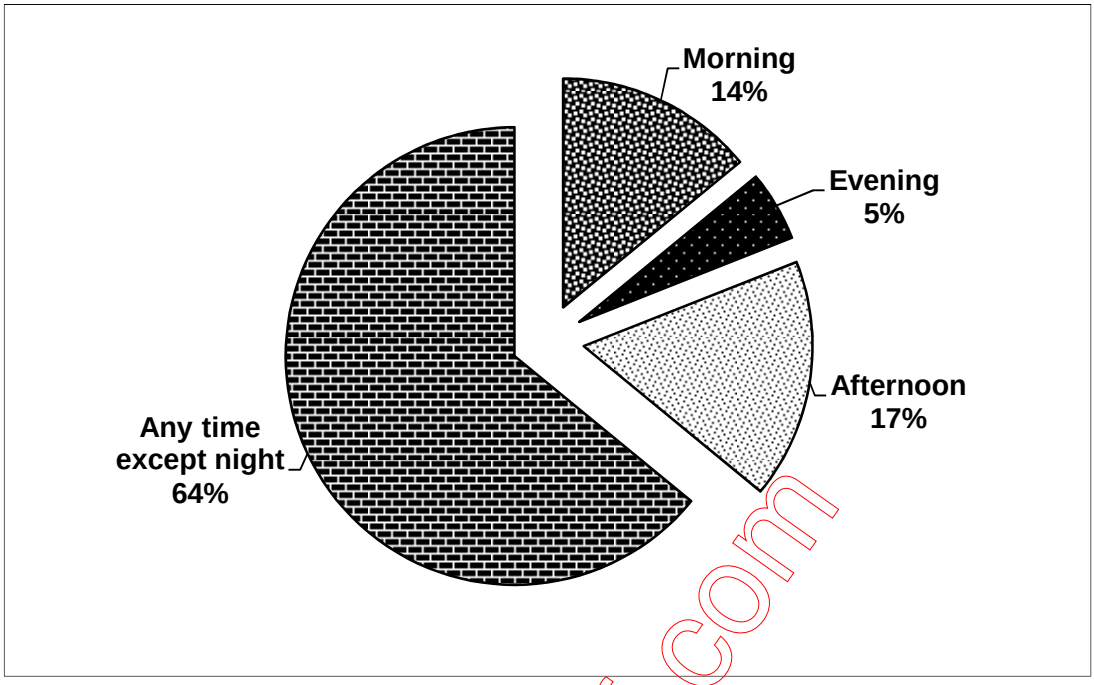


Fig 13: Monkey problematic time in Gulmi, Nepal

5.8 Species of monkeys damaging more

Population of rhesus monkey was far higher than that of the Langur in the study area. The extent of damage of rhesus was also high. Sixty five percent of farmers in the study area said the rhesus monkey was more damaging to crop and thirty five percent of the respondents replied that both of the monkeys equally damaged their crop.

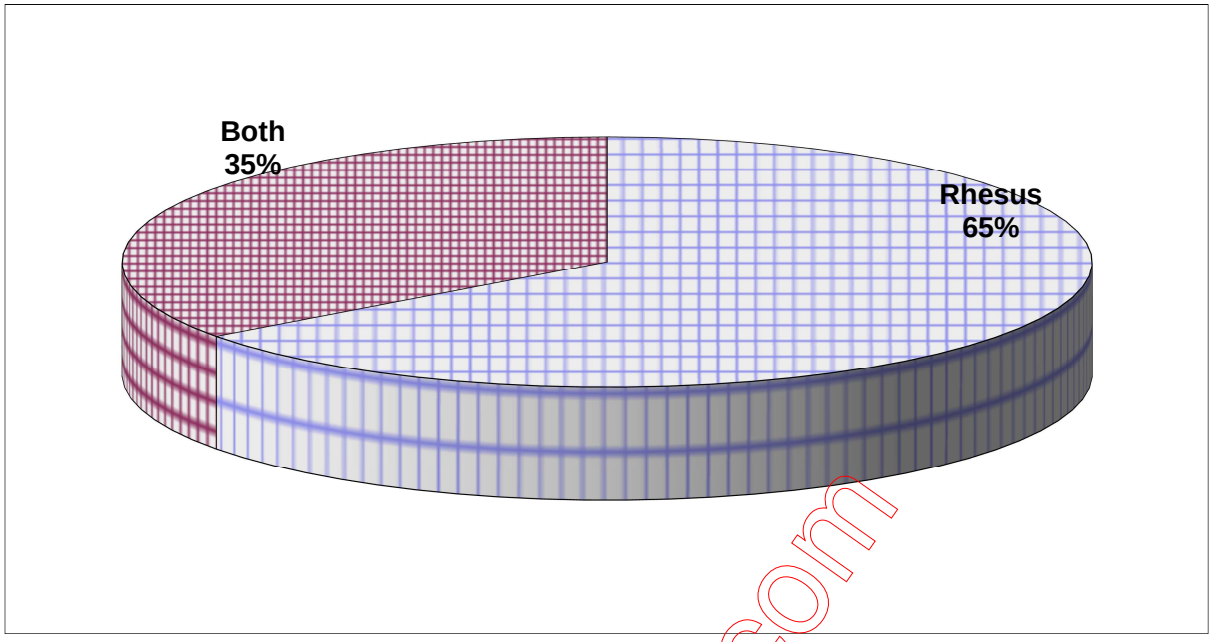


Fig 14: Crop damaging intensity of monkeys in Gulmi, Nepal

5.9 Percentage of Crop raiding by monkeys

From the analysis of crop depredation in the study area, it was found that maize was the highest attraction of monkeys that followed by wheat, paddy and others like potato, fruits, mustard, millet, barley, pulses, etc.(Fig 15). Fifty percent of respondents said that monkeys preferred maize, twenty three percent wheat, sixteen percent paddy and eight percent other crops. The extent of damage was also different in various stages of growth.

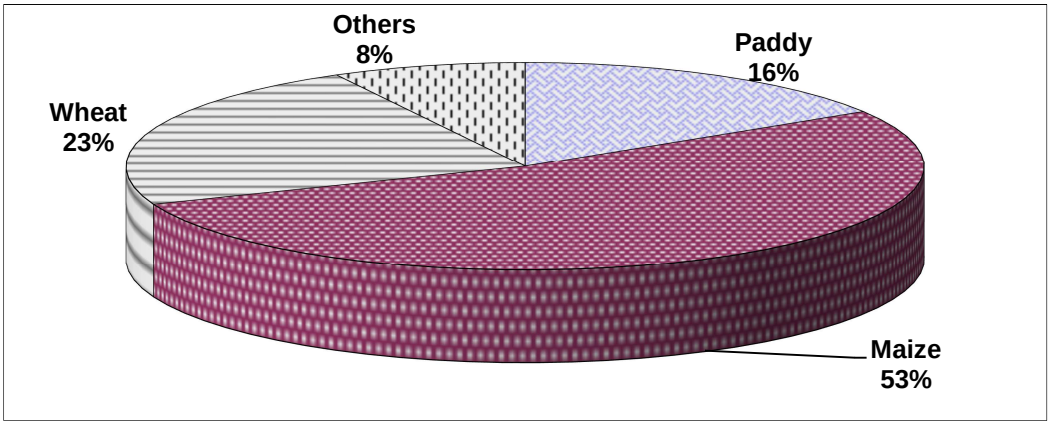


Fig15: Crop preference by monkey in Gulmi, Nepal

Crop raid percentage of Arkhale and Nayagaun also showed that maize was the mostly raided crop. (Table 8). More than 21 percent of the total yield of maize was found to be raided by monkey followed by Wheat, 20%. Pulses are the least raided crop, only 1.94% raided by monkey. Regarding the monitory loss of crop depredation maize comprises about 48%, followed by fruits of about 17%. Barley has least share on monitory loss.

Table 8: Different crop raided by monkey in Gulmi, Nepal

S.N.	Major crop loss	Total crop land (Ropani)	Expected yield (Kg)	Total raid (Kg)	Raid (%)	Monetary loss (Rs)
1	Maize	600	32,000	13,600	21.25	2,38000
2	Wheat	300	16,000	3,200	20	56,000
3	Paddy	300	32,000	4,000	12.5	60,000
4	Fruits	300	41,600	4,250	10.22	85,000
5	Millet	200	12,000	1,120	9.33	16,800

6	Potato	150	7,000	645	9.2	19,350
7	Mustard	500	9,600	400	4.17	15,000
8	Barley	100	8,000	160	2	2000
9	Pulses	500	12,400	240	1.94	9000
	Total	2,950				5,01,150

5.10 Fallowing of land due to monkey problem

Most of the farmers of Arkhale and Nayagaun were compelled to avoid cropping in their field because of the crop raiding by monkeys. Sixty seven percent of the respondents had to leave more or less of their land fallow due to monkey problem.

Of the remaining 33%, more than half of the respondents said that even the problem of monkeys was very high they had not to leave land fallow for their livelihood as they could not afford to do so due to small size of land holdings.

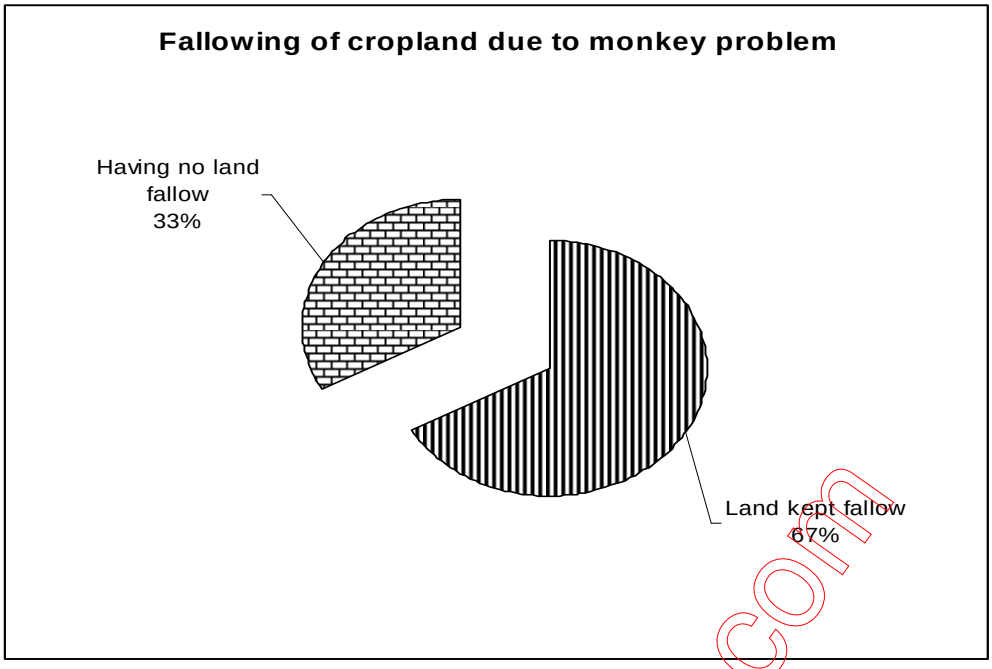


Fig 16: Fallowing of cropland due to monkey problem in Gulmi, Nepal

5.11 Trend of monkey problem

Crop raiding as well as other problem due to monkey in the study area was found to be increasing. Eighty two percent of the farmers replied that the problem of monkey was increasing. Thirteen percent of the respondents said the problem was decreasing and few respondents perceived the problem as usual.

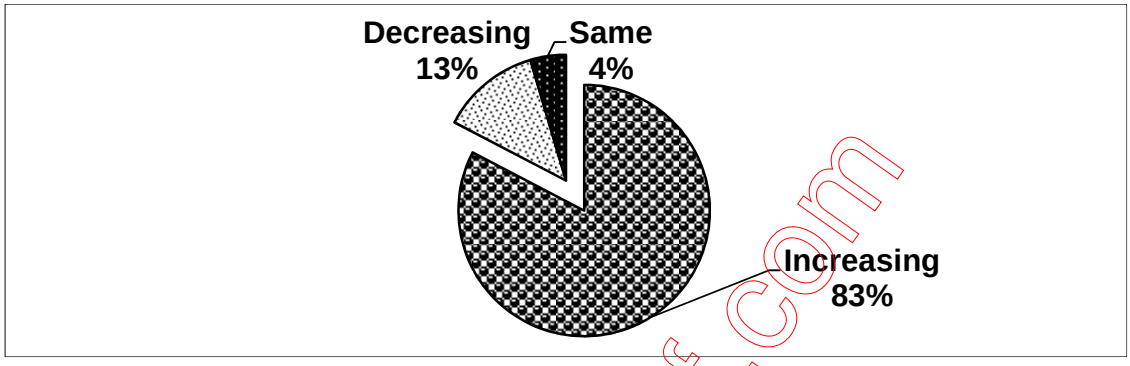


Fig 17: Trend of monkey problem as responded by the local people of Gulmi

Lack of palatable food for monkey in its natural habitat was found to be the major cause of crop raiding. Thirty four, out of 242 respondents were of the opinion that monkeys came to their crop field to eat as there was no food in the forest. People thought the increase of monkey population was the next major cause for the increase of problem. Lack of arms and no provision of killing the monkeys, increase of forest, crop field very near to forest etc were other major issues marked as responsible to heighten the problem of monkey as responded by the local farmers.

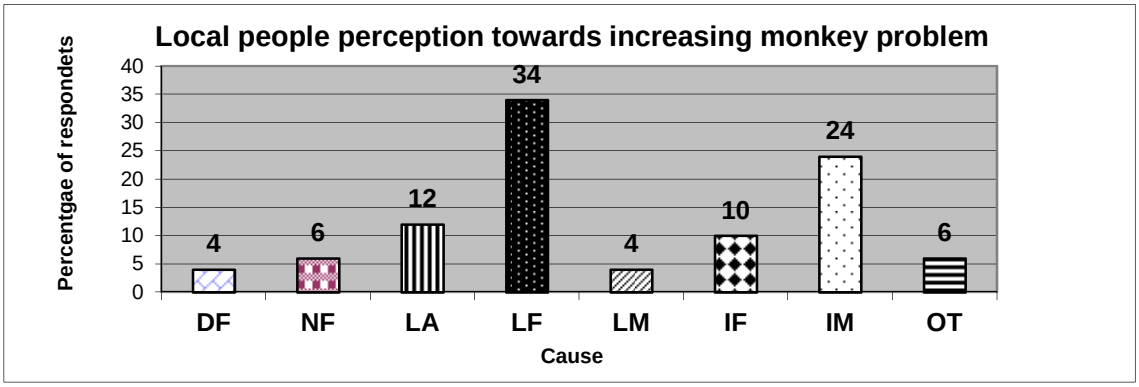


Fig 18: Cause of increasing monkey problem

(DF= Deforestation, NF=Crop fields near to forest, LA=Lack of arms, LF=Lack of food in forest, LM= Lack of manpower, IM=Increase of monkeys population, IF- Increase of forest, OT= Others)

5.12 Deterrent methods against Monkey

Local peoples adopted various methods to protect their crops form the monkeys. About 30% of the people shouted and followed monkeys to chase from the field and about 24% of the people used stone and catapult. Similarly chasing the monkeys by dog as well as hitting tin boxes was other methods used by local people. Some of the people said that they used gun, fire cracker and elbow to chase the monkey. Local farmers including their farmers guarded their crop fields all over the day in local hats called *Tharkus* (Photograph 2). Lighting fire in the edge of field, playing music through cassette player or radio with loud sound as well as planting thorny plants and non-palatable crops were the major strategies adopted by the farmers to keep monkeys out of the crop fields.

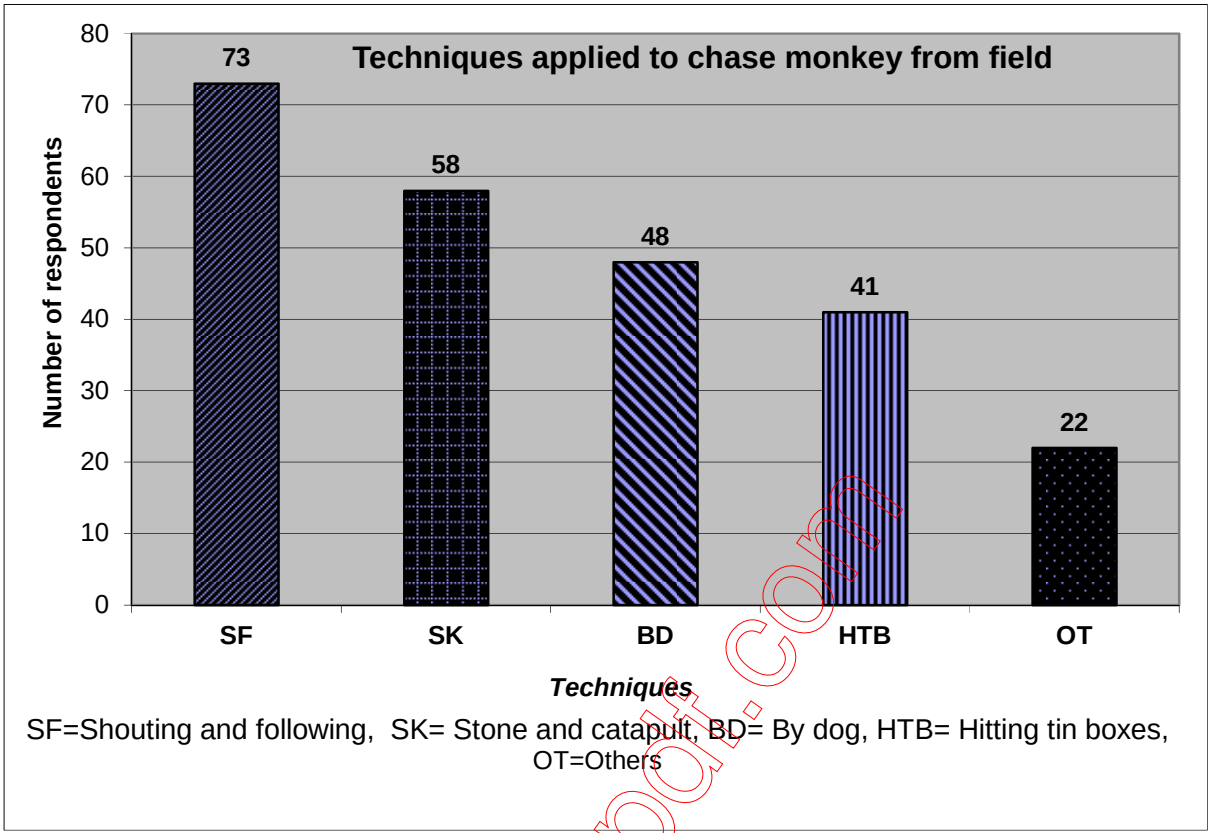


Fig 19: Methods applied to chase monkey

5.13 Measures intending to apply in future

Most of the farmers of Arkhale and Nayagaun used to guard their field to keep their crop safe from monkey so most of them said that they will continue to do so in future. But tolerance of people was found to be in breaking point and considerable number of farmers said that they will buy gun to kill monkey and some said they will catch and kill the monkeys. Some people were also of the intention of keeping dog to chase monkey as well as using firecrackers. Twenty two respondents said that they had no any new measure to keep their crop safe and fifteen respondents were going to migrate by keeping land fallow.

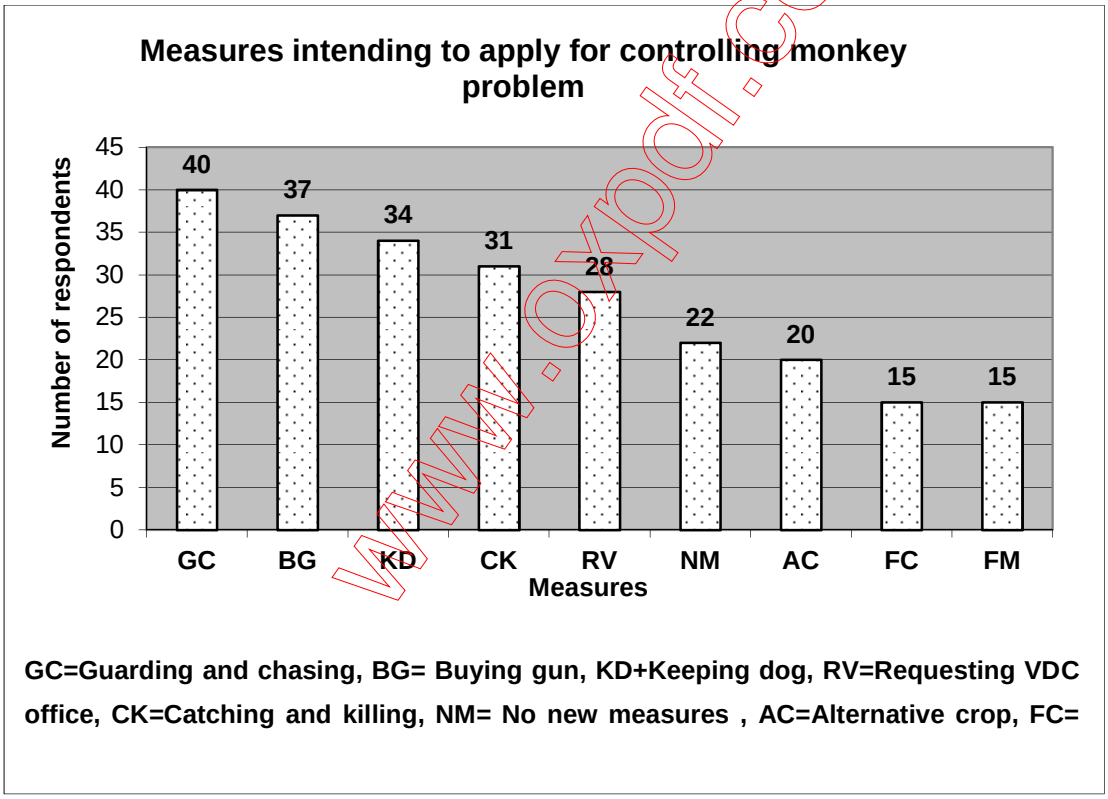


Fig 19: Deterrent methods against monkey intending to use in Gulmi, Nepal

5.14 Remedial Measures

Most of the people of Arkhale and Nayagaun (39%) suggested worth compensation as best remedial measure of monkey problem. Catching and killing (26%), mass chasing (21%) and alternative crop (14%) were the other measures suggested by local farmers.

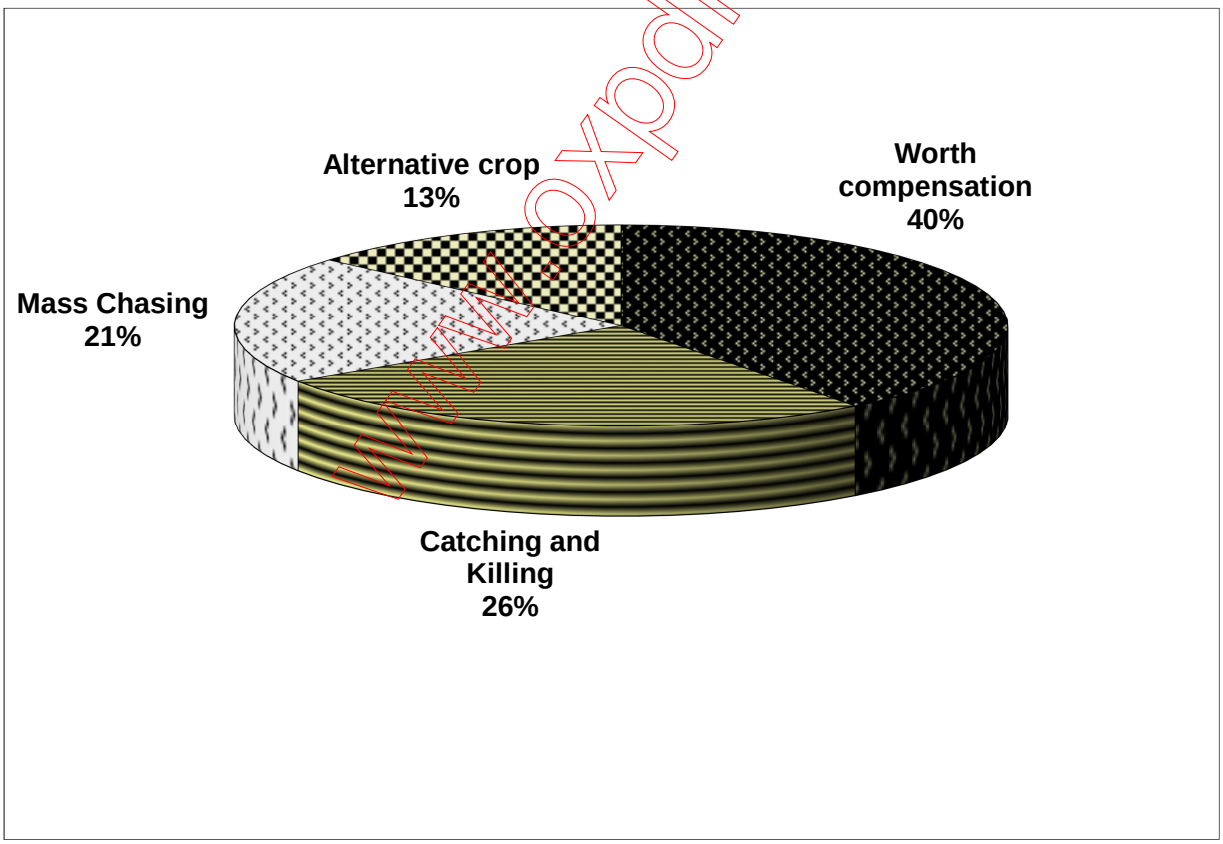


Fig 20: Possible remedial measures of monkey problem as suggested by local people

VI
DISCUSSION

Among the three different species of monkeys reported from Nepal, only two species of Monkey Rhesus monkey (*Macaca mulata*) and common Hanuman Langur (*Semnopithecus entellus*) were found in Arkhale and Nayagaun of Gulmi district . Assamese monkey (*Macaca assamensis*) was not found in the study Area.

Rhesus monkey was found in highest number with total head count of 128. It may be due to its most commensal characters to human. Langur population was found to be 13. The lesser number of Hanuman Langur may be due to the availability of small natural habitat and being less commensal to human (Khatry 2006).

The Rhesus monkey was found distributed in all forest of the study area. But the troop with highest number of individual was found in the forest of Khannichaur-Harrachaur forest followed by the forest of Gurung Gaun . That may be due to the prevalence of human settlement near to the forest as Rhesus monkeys are more commensal to human. Khatry (2006) also found that the troop with highest number of population was found near to human settlements which were nearest from natural habitat than deep forest. Sajet al (2001) also reported the agricultural area adjacent to forest area worst affected by the vervet monkey. Farm located within 300m of forested boundary incur the greatest risk of crop raiding. As Rhesus monkeys are defensive in nature and opportunistic in crop raiding, to avoid the predator and to get food with less effort, they are likely to find in periphery of human habitation (Van hoof, 1990). Bashyal (2005) also supports the situation of rhesus behaviors of this kind. He has recorded the Rhesus monkey in different sites of Shivapuri National Park (ShNP) mainly near the edge of cropland and human settlements areas. Kattel (1993) reported that in Shivapuri, Rhesus monkeys were mainly found in Schima-Catatopsis habitat on the lower periphery and Oak-laurel (Quercus Sps.) in the middle elevation adjacent to human habitations.

Chalise (2001) from Langtang reported that in month of April they were mostly found around the crop field in summer season when there is less food in the forest areas. But in my study monkeys frequented more around the human settlement during rainy season as they could grab maize easily from the field and there were no abundant fruits in the forest during rainy season for monkeys.

Behavioural study of monkey showed that the time spend in feeding was maximum. Rhesus monkey spent 43.3% of its total time in feeding. Nepal (2005) in Shivapuri also found foraging for maximum time (42.69%). Ghimire (2000) reported 43.5% feeding in community forest troop of Nepal. Southwick (1967) reported that they spent 60% time on feeding. But Teas (1978) in Swoyambhu found that rhesus monkeys spent only 25% time on feeding. Panthi (1997) also in Swoyambhu reported 17.13% and Shakha (1999) in Pashupati reported 24% time on feeding. This study shows similarity with Nepal (2005) and Ghimire (2000) as the rhesus monkeys with wild habitat, natural feeding and similar climatic condition. Difference regarding the duration of feeding is due to the artificial provisioning by urban people in Swoyambhu and Pashupati. Similarly resting was found second (23.95%) to feeding, similar to Nepal (2005) 24.97%, Ghimire (2000) 21.82% but different from Teas (1978) 8%, Sakha (1999) 29% and Panthi (1997) 14.56%. Moving (21.5%) also was found similar to Ghimire (2000) 20.25% and Nepal (2005) 21.82% but slightly different (25%; 24%; 18.44%) than Teas (1978), Sakha (1999) and Panthi (1997). During the total observation period, the total grooming time was calculated as 11.25% in total spent time. Ghimire (2000) recorded 12.14%, Nepal (2005) 10.52%, Teas (1978) found 15%, Sakha (1999) found 16%, Southwick (1967) found 34% and Panthi (1997) found 15.36% grooming. Present study showed similarity with Ghimire (2000) and Nepal (2005) but different with others. This also shows climatic conditions, location and topography of the study area affect the grooming and other behavior of monkeys.

In case of Langur time spent to feeding was also found to be higher (36.5%). This is similar to Chhangani and Mohnot (2002) 34.6%. Sayers and Norconk (2008) in Langtang National Park also found the similar type of result and recorded 39.8% feeding. This study shows similarity in other behavior as that of Sayers and Norconk (2008) like resting 30.6% and 29.2%, moving 19.5% compared to 29.2%, and grooming 13.40% compared to 9.5%.

Crop raiding was found as a major cause of conflict though physical hurt and harassment, grabbing and taking of food materials were also reported as the problems caused by monkeys. Among the respondents crop raiding was reported by 64%. But the extent of crop raiding was found to be different in different areas. Crop raiding was found to be highest in the village near to the forest of Gurung Gaun (73%) followed by the village of Khannichaur-Harachaur. Village near to the forest of Mulaghari reported least to the crop raiding (59%). Higher extent of crop raiding in former two is due to the settlement and crop field very near to the forest. Khatry (2006) found that 76% of the respondents of Vijayapur area of Dharan reported the crop raiding as the major problem. Similarly in the study of Patty Mc. Court (2005), 92% respondents of Hetauda were found to suffer from crop damage from monkeys. 87% of respondents complained the harassment by monkey by taking food spilling or eating from the kitchen, porch or roof.

Mc Court (2005) in Hetauda found 85% household members were frightened by monkey usually as a result of charge threat, chase, facial grimace or vocalization. In her report 37% household reported that someone in their house had been either directly or indirectly harmed by monkey with different events of injuries such as fell down (23), scratch (12) and bite (6). Ojha (1976) found 90 victims who received 104 wounds and most of bites were during food snatching from house and mother monkeys protecting her infants. Thus all these report showed that, monkey aggression towards human is mainly concerned with the food and human interference of the habitat

People of Nayagaun and Arkhale were highly affected by the monkey as about 40% of the respondents replied that they perceived the problem in higher extent. Only 16% of the respondents said that the monkey problem was low. Khatry (2006) in Vijayapur also found the monkey problem in higher extent with 46% of the respondents. Relatively low proportion of the respondents on this category in my study may be due to the significant number of farmers (38%) living in inner part of village said the problem is medium. But the problem of monkey was increasing and majority of the people (67%) had to leave more or less of their land fallow due to monkey problem.

Monkeys were found to be frequented in the crop field occasionally. It was found that during the months of rainy season monkeys raided the crop even twice or thrice a day. But during autumn

and spring monkeys were not appeared around the human settlement for many days. So the daily encounter of monkey all over the year was low with 21% of respondents saying so. In case of the particular day, monkeys were opportunistic in crop raiding. Most of the respondents (64%) reported, monkeys whenever fill safe from the villagers they raid palatable crop at any time in the day time. Though crop raiding was significant in morning and afternoon.

Of the different crops raided by monkeys, maize was of highest preference of monkey. Maize was reported by 53% followed by wheat 23%, paddy 16% and others 8%. Regarding the monitory loss also maize occupied highest loss (48%), fruits shared 17%, paddy 12%, wheat 11%, potato 4%, millet 3%, mustard 3% and pulses 2%. Barley has least share in the monitory loss with about 0.5%. Raid percentage of crop also followed nearly similar trend. Maize was highly raided crop and about 21.5% of the total yield destructed by monkeys followed by wheat (20%), paddy (12.5%), fruits (10.22%), millet (9.33%), potato (9.2%), mustard (4.17%), barley (4%) and pulses (1.94%). This fact is also supported by the previous findings. This fact is also supported by the finding of Chalise (1997, 1999, 2001, and 2003). Chalise *et al* (2001) and Chalise and Johnson (2005) reported that crop depredation proportion by monkeys is different in different crops. In MBCA they recorded highest loss of maize (32%) followed by potato (24%), rice (14%), fruits (12%), millets (11%), wheat (4%), buckwheat (2%) and pulses (1%). Ghimire (2000) in Palpa found highest loss of maize (34.12%) followed by potato (23.05%), rice (12.01%), fruits (11.26%), wheat (5.97), millets (5.13), buckwheat (2.38%) and pulses (2.06%). Khatry(2006) in Vijayapur also recorded the damage of maize in highest extent (43%) followed by fruits (27%). Thus, the loss of maize was found highest in most of mountainous areas. This could be as maize is more palatable, easy to raid and mostly grown in every hill parts of Nepal in summer and rainy season when natural fruits are not plenty enough in the forest areas. The amount and types of raided crops could also be depending upon the types of cultivated crops, availability of natural food, distance of cropland from the forest and number of individual in the monkey troop.

Fallowing of land to get rid from the problem of monkey was in high intensity (67% of the farmers kept their land fallow). Local people could not yield sufficient food to fulfill their family need as raided by monkeys and fallowing of land. As perceived by local farmers, lack of natural food in the forest was the major cause compelling monkey to raid the crop. Thirty four, out of 242 respondents were of the opinion that monkeys came to their crop field to eat as there was no food in the forest. People thought the increase of monkey population was the next major cause for the increase of problem. Lack of arms

and no provision of killing the monkeys, increase of forest, crop field very near to forest etc were other major components responsible to heighten the problem of monkey as responded by the local farmers. .

Different preventive measures were applied to deter monkey, though chasing of monkey by shouting and following was found to be most effective and widely used measure. Local peoples usually guarded their crop field and chased monkey by shouting and following. Small hut, locally called *Tharku* were made to guard the field. Use of catapult and stone, use of dog to chase monkey, hitting tin boxes, as well as other method like radio and cassette players, fire crackers as well as planting alternative crops were also found. Khatry (2006) in Vijayapur found the use of catapult to frighten the monkeys to be most effective. Mc Court (2005) also reported the use of stone throw catapult (84 respondents), close door (44 respondents), stick wave (26 respondents), shout (22 respondents) other (9 respondents) in Hetauda as monkey deterrence methods. Regmi and Kandel (2008) showed that 60 % of the farmers were found to guard the fields by themselves, 20 % were using scarecrows, and 15 % were using dogs and remaining 5 % used tin-boxes and catapults for scaring and driving the macaques from the crop fields in Langtang National Park.

Chalise (2001) reported that farmer's suffering from monkey crop damage in eastern Nepal was considering planting chili, garlic and tobacco. From the study, some unpalatable crops for monkey were also reported, so to minimize the crop raiding problems. Ginger, garlic, chili, pidalu etc. were the major alternative crops planted by the local people. People should give priority for alternative farming like mushroom cultivation, planting of chili, lady's finger, ginger, garlic etc. Alternative crop was found to be effective to lessen the loss by monkey.

From the study, conflict between human and monkey was found to be increasing thus the hostility will be more in future. Though significant number of people said that increasing of monkeys population was responsible for heighten the problem but no any scientific data of the population of monkey is available inhabiting on the forest of Arkhale and Nayagaun in the past. Thus it can be speculated that problem of monkey may have increased due to the encroachment of natural forest by local people with increase of human population. It can also be said that the population of monkey may decrease in future if there remained hostility and no proper measure taken to manage human-monkey conflict.

CONCLUSION AND RECOMMENDATION

CONCLUSION

Two symptatirc species of monkey, Rhesus monkey (*Macaca mulata*) and Common Hanuman Langur (*Semnopithecus entellus*) of the total population 128 and 14 were found in the Aarkhale and Nayagaun area. Rhesus was found in all study blocks and Langur only confined in two sites. Among the two groups of monkey, conflict of human with Rhesus monkey found to be more severe than the Hanuman Langur. It may be due to its higher population, aggressive nature and highly commensal.

Monkey problem was found to be serious in all part of the Arkhale and Nayagaun, though villagers near to the forest were in higher confrontation with monkey. Villagers of Khannichaur and Harrachaur as well as Gurung Gaun have to face the problem of monkey in higher intensity as the villages lie near to the forest. Conflict between human and monkey found to be soaring so as to develop as a serious social and environmental problem.

Among the different problems due to monkey, crop raiding problem was found to be more in Arkhale and Nayagaun. Grabbing and taking food, harassment and physical hurt to locals was also found. Monkeys were found opportunistic entering on crop field at any time and agricultural fields, grab food items and other household materials, intimidate people and occasionally harm them. Maize was the mostly destructed crop both by quantity and monitory value.

Fallowing of crop land due to monkey problem is high with two third of respondents keeping their land fallow. Shouting and followingCatapult is the most effective and widely used means of deterrent monkeys for local people. But it does not seem to act as panacea to avoid crop raiding by monkey. Negative attitude of local people towards monkey is growing and people are seeking long-term solution of the problem or compensation of the crop raided from local government. From the study carried out, increasing monkey population, destruction of abuse of increasing monkey problem Sothe problem caused by monkey in Arkhale and Nayagaun must be managed to check the possible future bad confrontation.

On the basis of literature review and observation made, causes of conflict identified were as follows:

- monkey being most commensal non-human primate
- habitat destruction
- accessibility to human food in areas adjoining to forest
- religious faith about monkeys believing them as a sacred animal..

Recommendations

Nature gives suitable habitat forevery living species. But, due to some outer disturbance animals tend to shift their habitats. As in case of monkeys the same phenomenon is happening thus the conflict between human and monkeys is getting intensified. Iincrements of human population and pressure on monkey natural habitathas resulted in the conflict between man and monkeys.

For the survival of monkeys in their natural condition, the habitat should be stable naturally. The habitat must be fulfilled by the requirements to support the viable self-sustaining population at natural density. If the natural habitat of monkeys is such that they dont need to roam anywhere for the fulfillment of their daily requirements no interference with human being is generated. But in Arkhale and Nayagaun such ideal situation has been already breached thus there is an ultimate need of the problem management. It is obvious that there is no single solution of this problem. The strategy shuld be directed towards minimizing as well as mitigating the conflict. Though this study was a short-term research and is not devoted full year of devoted study. However, the following recommendations are offered for consideration by concerned authorities and local people for the protection of monkey as well as reducing the conflict of human with monkeys.

Short-term Strategies

- People should plant the monkey unpalatable crops such as spinach, lady's finger, winter beans, coriander, ginger, turmeric, chili etc especially in the area where there exists high crop raiding by the monkey.
- Not to tease or kill monkey, which will increase further conflict.Predation by domestic dogs should also be checked.

- Grazing by domestic livestocks of the surrounding villages should be minimized in the habitat of wildlife and primates.
- Students (child) and women should walk in a group while moving through the monkey problematic areas.
- Further human settlement in and around the habitat of the monkeys should be discouraged.
- Medical service and timely anti rabies vaccination for the victims of monkey bite should be provided by local government.
- Relocate or translocate them in suitable habitat from human settlements.

Long-term Strategies

1. Habitat Improvement

The natural habitat of monkey should be improved in the community forest especially by planting the monkey palatable plants and also to provide provision of drinking water in their habitat.

2. Conservation of NaturalForest

Local people browse and collect fodder for their cattles, which provide the food for monkeys in natural habitat. So, this activity should be checked.

3. Conservation programmes

VDCs or District forest Office should launch the conservation programme at local level in different ward at school and provide the education about its importance, scientific and religious value. And also provide the knowledge for the mitigation of conflict with monkeys while staying with them.

4. Awareness Program

People should be made aware about the do's and doesn't while staying with the monkey.

- About zoonotic disease transferable from monkey to human and vice versa.

- About behaving with monkey
- About likes and dislikes of monkey etc.

5. Monitoring of Population

Continuous study is necessary to know the population and conflict to make proper management from the University, ResearchCenter and Line agencies.

6. Strict legislation on the preservation of monkey species should be implimented.

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APPENDIX I

Survey Questionnaire for the Research

Date:.....

1. **Details of respondents**

a. Name Sex VDC

Ward Village/Tole

b. Total land holding Bigha Katha dhur

2. What were the crops that you cultivated last year? How much land waa used for each crop ? What was the yield of each crop? How much crop was damaged by monkey ?

SN	Crop Cultivate	Land used (Dhur /Katha /Bigha)	Total yield when no damage	Area damaged	Amount damaged	Remarks

			(Quintal)	(D/K/B)	(Kg/Q)	
1	Paddy					
2	Maize					
3	Wheat					
4	Mustard					
5	Ginger					
6	Potato					
7	Banana					
8	Vegetables					

2. Do you have any problem from monkey?

Yes No

4. If yes what kind of problem do you have?

a. Crop damage b. Harassment c. Both a and b d. others

5. How often monkeys enter your field ?

a. every day b. every morning c . 2 times a week d. occasionally

6. During which month there is high intensity of crop depredation bymonkey?

7. Are monkeys selective on crop? If yes what type of crop do they prefer most?

a. paddy b. maize c. wheat d. mustard e. others

8. Do you chase monkey from your field?

Yes No

9. What kind of technique do you apply?

a. Shouting and following b. Chasing with stones

c. Shouting d. hitting tin boxes. e. Others

10. Do you leave some land fallow due to monkey problem?

Yes No

11. If yes how much lands do you leave fallow?

12. Are you able to support your family from agricultural production?

Yes No

13. If no is this because of your crops being damaged by monkey ?

Yes No

14. What could be the better way to solve this problem?

15. What type of compensation do you expect for the conservation of monkeys ?

Month	Rainfall(mm)

16. How do you think usage of wildlife in your area for economic incentives?

17. Any othe idea on primate conservation or sustainable use, local income generation?

January	0.0
February	4.5
March	5.5
April	3.4
May	275.4
June	229.0
July	407.0
August	594.8
September	91.9
October	180.8
November	1.5
December	0.0

APPENDIX II

Rainfall amount of Gulmi in 2009

APPENDIX III

Relative humidity of Gulmi in 2009

Month	RH at 8:45	RH at 17:45
January	82.3	76.1
February	67.4	66.3
March	57.9	54.6
April	57.8	51.2

May	78.0	77.0
June	80.7	79.3
July	86.1	87.5
August	92.8	91.4
September	84.8	91.8
October	78.3	89.7
November	77.0	86.1
December	83.8	86.8

APPENDIX IV

Maximum and Minimum temperature of Gulmi in 2009

Month	Max. Temperature(°C)	Min. Temperature(°C)
January	17.9	6.2
February	20.8	8.3
March	23.8	10.1
April	28.1	14.8
May	27.0	15.2
June	28.5	17.2
July	27.5	18.9
August	26.5	18.3
September	26.0	16.9
October	23.1	13.0
November	19.7	9.2
December	16.7	6.2

APPENDIX V

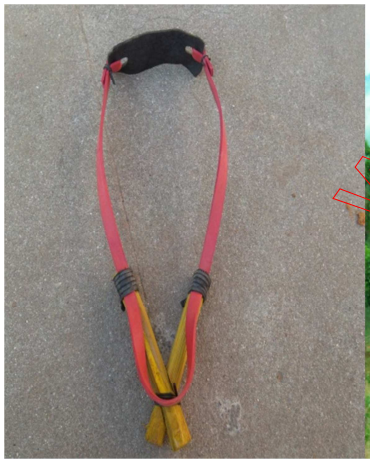
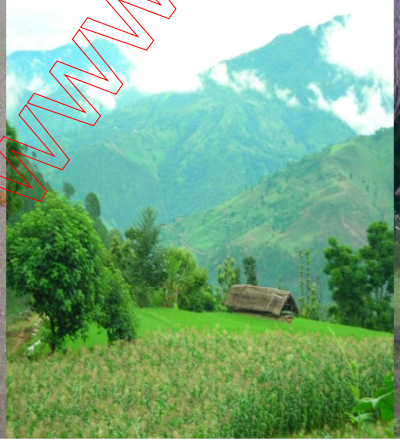
Rhesus troop

Langur troop

Photograph 1: Troop of Rhesus and Langur

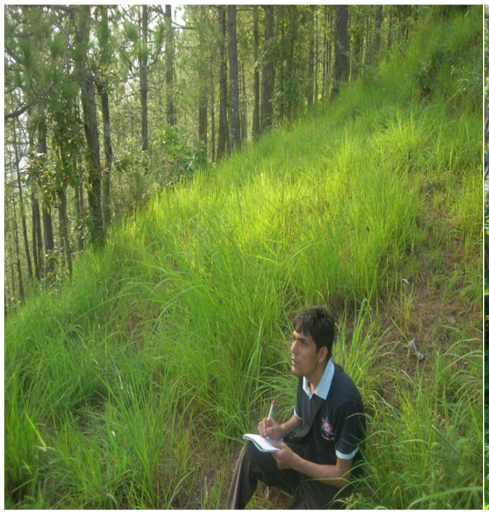

Maize damaged by monkey


Wheat field destructed by monkey Sugarcane damaged by monkey


Catapult Seasonal house Boys guarding crop fields

Photograph 2: Photographs showing human-monkey conflicts



Recording monkey's behaviour

Interviewing with local people

One of the villages inside study area

Natural forest as monkey's habitat

Chiuri (*Aesandra butyracea*) fruits eaten by monkey

Crop field left fallow

Photograph 3: Photographs of field work