

**HUMAN-RHESUS MACAQUE CONFLICT ALONG THE DARAUDI
RIVER BASIN GORKHA DISTRICT, NEPAL**



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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 other degree. All the sources of the information have been specifically acknowledged by references to the author(S) or the institution(S).

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This is to recommend that the thesis entitled **HUMAN-RHESUS MACAQUE CONFLICT ALONG THE DARAUDI RIVER BASIN GORKHA DISTRICT, NEPAL** has been carried out by Parashuram Pokharel for the partial fulfilment of master's degree of science in zoology with special paper ecology and environment. 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 in any institutions.

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LIST OF ABBRIVATION

BNP	Bardia National Park
BZUC	Buffer Zone User Committee
CF	Community Forest
CNP	Chitwan National Park
GIS	Geographic Information System
GPS	Global Positioning System
DNPWC	Department of National Parks and Wildlife Conservation
GCA	Gaurishankar Conservation Area
GON	Government of Nepal
HHs	Household Survey
HWC	Human-Wildlife Conflict
IUCN	International Union for Conservation of Nature and Natural Resources
M	meter
Km	kilometer
Km ²	square kilometer
Kg	Kilograms
%	Percentage
MBCA	Makalu Barun Conservation Area
MCA	Manaslu Conservation Area
M als	Meter altitude from sea level
NRs.	Nepali Rupees
NTNC	National Trust for Nature Conservation
PAs	Protected Area
PWR	Parsa Wildlife Reserve
SNP	Shuklaphanta National Park
SNNP	Shivapuri Nagarjun National Park
TU	Tribhuvan University
WWF	World Wide Fund for nature

ABSTRACT

The Human-wildlife conflict is less explored in the developing country like Nepal. It is closely related with the economic and social well-being of the local people. Its frequency has been raising annually worldwide. Daraudi River basin of different agricultural plots is one of the hotspots for Human-Rhesus conflict mainly because of crop depredation. This study aimed to explore the Human-Rhesus conflict in different gradients and to explore Human-Rhesus conflict in different gradient in terms of crop damages. Field survey was conducted from October to May 2019. Different community forest were used to survey the Rhesus population. The perception of local people towards Rhesus conservation and methods of mitigating Human-Rhesus conflict was assessed. Questionnaire survey was conducted in 124 households at different altitudinal gradient of Daraudi basin of different agricultural plots, Jarebar (437 m), Rangrung (900 m), Mandre (1400 m) and Barpak (1900 m).

Microsoft Excel 2010 and past software were used for data analysis. The average annual economic loss of crop was found to be NRs 9,59,857(US\$ 8494.734) and per household economic loss NRs 7673 (68.51US\$). Jarebar had the highest crop loss and Maize had the most frequent crop loss. Potential solution was discussed to undertake suitable and appropriate protective measures to minimize the crop losses. The local people perception was found to be negative for conservation of Rhesus. Most of the respondent were following the cropland due to Rhesus problem. Compensation for loss was needed to reduce Human-Rhesus conflict. Different programs such as habitat conservation, afforestation of fruiting trees and change in crop plantation might help to reduce the Human-Rhesus conflict in the study sites.

1. INTRODUCTION

1.1 Background

The Human-wildlife conflict is one of the most critical threats that many wildlife species are facing (Dickman 2010). In Nepal, HWC is a major's problem in most of the protected areas and community forest. However, the frequency and intensity of park people conflict mostly arise from crop and livestock depredation human injuries caused by wildlife, illegal logging, grazing and fodder collection, poaching and poor relations between local people and protection area units (Shrestha et al. 2007, Timalisina & Ranjitkar 2014). In the context of the world, some part of the world, increasing conflict is consequences of the habitat extension due to lack of better management and the conservation of buffer zones forests adjacent to the park and reserve. Increasing wildlife populations, shrink habitat, wildlife natural preference for agricultural crop, inefficient protection measures and destructions of community forests. The burning reason behind the increasing the conflict is due to increasing human populations and continued loss of natural habitat. Conflict between people and wildlife has become one of the fundamental aspects for wildlife management and is common phenomenon (Wang & Macdonald 2005).

HWC is due to decrease and fragmentation of habitat through different developmental projects and modernizations (Fernando et al. 2005). HWC is confrontation between human and wild animals, resulting crop and livestock depredation property damages capturing of wildlife (Elliotte et al. 2008). Carnivores are nuisance because of livestock depredation and attacks on human. Crop raiding is one of the causes of conflict from herbivorous animals which is mainly associated with farmers. Non-human Primates is one of them. The competition between human and non-human primates is a major problem (Priston & Underdown 2009). In some places, they are sharing same food resources (Lee & Priston 2005). Primates are however, more responsible for crop raiding when compared to other animals. Especially in Asia, Rhesus macaque (*Macaca mulatta*) seems to increase in number (Pienkowski et al. 1998). The main reasons behind Human-macaque conflict is massive cutting of fruiting trees and plantation of exotic commercial species which do not supply food to macaque. This compels the macaque to enter into human residential area and crop field (Ahsan 2014).

Rhesus macaque occurs in Asia ranging from Pakistan, India, Nepal and Tibet in the West to Northeast tip of the Japan and South of the Wallace line in Southeast (Thierry et al. 2004). Macaque are found in tropical rain forest across Asia, but may live at high altitudes in the Himalayas and other snowy winter places too (Chalise 2013). In Nepal, crop damage is very common in Midhills, High Mountains, Terai, nearby National Parks and Wildlife Reserves. Primates are considered as pest of crops that are grown in the field by farmers. Langurs are considered as enemies of crops in Swargdwari Forest of Pyuthan and Sangekola of Tanahun. Similarly, Assamese macaque are seen to destroy crops in Hariharpur Gadhi, whereas Rhesus macaque is a serious pest of agricultural land in Kailali, Swoyambhu, Thapathali and Sankhu and elsewhere (Chalise 2000).

Local people utilize the resources from the protected area such as fodder, fuel wood excreta (Seeland 2000). This can mainly affect the amount of food available for Rhesus macaque in the long term inside protected areas. This may result in crop raiding in the adjacent villages not only in the farms, Rhesus macaque are also responsible for the damage in the garden plants and fruits (Long 2003). Primates raid crops and fruits in the absence of sufficient food. Therefore, the problem of macaque and conflict with people is increasing (Chalise 2013). Raiding of crops depends on many factors such as season, spatial and temporal distribution of food resources, crop varieties and characteristics, wild food availability, distance from the forest and other farms (Hill 2000, Warren et al. 2007).

Locals are paying high costs living with closer proximity to them, imposing loss on farmers by destroying crops and wasting energy and finances while trying to protect fields (Hill 2002). In Uganda, cost of crop raiding by Primates and guarding varied from US\$ 96-519 per household per year (Hill 1997). Likewise, in Kenya, crop raiding costs US\$ 200-400 per house hold per years (Sillero-Zubiri & Switzer 2001) which is higher than in their daily incomes.

This study aimed to explore human-Rhesus conflict in terms of crop damage, crop raiding and human causality. Study has assessed causes and perceptions of locals towards the Rhesus macaque at the study area.

1.1.1 Primates

Primates is an order of mammals, which include macaque, apes, human and other similar forms typically having dexterous hand and feet, binoculars vision and well-developed brain. They are commonly called macaque, excluding only the tree shrews; the lemur like

form, apes and human and therefore embody the mendous evolutionary and adaptive arrangement of animals (Tattersall 1993) of all the primates, macaque, next to human have adapted to widely diverse environmental conditions which are found in tropical forest, dry savanna, mountains, village and temples and even large cities (Van Hoff 1990).

Macaque are included under the sub-order Haplorhini of order Primates. According to the geographical distribution, macaque are categorized into two types- New World and Old World macaque. The new world macaque lack cheek pouches and nostrils open two sides rather than down. Area between the nostrils is wide and flat. Most have prehensile tail and non-have callous pads on the buttocks, example Spider macaque, Capuchins etc. The old world macaque has protruded muzzle and well developed cheek pouches, nostrils set close together facing forward and downward. The tail is never prehensile and some species are tail less. Both hands and feet are adapted for grasping. Callous pads on the buttocks are often bright and in case of female, it is swollen during estrus period (Walker 1968).

Human and macaque share the same root of evolution. The living inquiring minds structure of the hand, social system and mother infant relationship and manipulative skills of the macaque certainly make us ponder about what Gilbert had said about man. 'Man however well behaved at best is only a macaque shaved'. In anatomy and behavior macaque are our closest relatives. They may hold key to our origin and the root of what we consider human characteristics of friendship, love, aggression and tool use (Subba 1998).

In Nepal, only three species of macaque (Rhesus, Assamese and Hanuman langur) are recorded up to date. Rhesus macaque (*Macaca mulatta*) are found freely ranging in wild as well as in urban religious places. Assamese macaque (*Macaca assamensis*) are reported from mid hills and high mountains forest of Nepal. The other species Langur (*Semnopithecus entellus*) is found freely ranging in wild forest and marginal area of Nepal (Chalise 2013).

1.1.2 Rhesus macaque

Rhesus macaque is the best know Simian species of family *Cercopithecidae*. According to IUCN, Rhesus Macaque is one of the least concerned primates in the world (Timmins et al. 2008). They are distributed in Southeast Asia from Northern Afghanistan in the East and South to Godavari River in India, Thailand, Laos, Cambodia, Vietnam, Nepal, Bangladesh, Tibet and China in the west (Roonwal & Mohnot 1997). It is frequently kept in zoos even in smallest zoological gardens. Rhesus macaque are considered pest species

by their nuisance behavior. *Macaca mulatta* is likely well adapted 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 in summer.

Rhesus macaque is heavily built with compact robust limbs. The silky hair is yellowish brown, the necked 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, whereas female is 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 macaque is characterized by a high degree of social flexibility four types of social groups can be described depending on the number of males in the groups. They are one male troop, multi-male troops, age-graded male troops and all male band (Chalise 2004 b). Most social groups ranged from 8-10 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 of *Macaca mulatta* is 135-194 days and usually one baby is born, sometimes 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 age of 2.5-4 years, while males 2-3 years after that female reach menopause at the age of 25 (Southwick et al. 1992).

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

1.1.3 Perception and status of Rhesus macaque in Nepal

Rhesus macaque are found in most of the temples and Gumba of Nepal. This species depends mostly on the human food for their survival in temples and Gumba due to the efficiency of getting food frequently in temples. People distributes food for them as good deeds. According to the Hindu Mythology, Rhesus macaque are believed to have relations with god Hanuman. Although Rhesus macaque is considered holy in most of South Asian countries, their behaviour outwards the belief of local (Medhi et al. 2007). Many people

have been badly affected by Rhesus macaque in Bangladesh, including Urban and Suburban area, so people often kill Rhesus macaque (Ahsan & Uddin 2014). The same problem was caused by the Rhesus macaque in Nepal. Among the Nepalese, if a person does a lot of mistake, they are named as macaque because of their notorious behavior. There is a saying in Nepali “A macaque does not make his own home and do not allow to others to make their home” because they destroy everthings. This shows the perception of people towards macaque. The Government of Nepal has not listed in the protected list. They are considered as pest by local farmers. Some people recognize that macaque steal edible food from their home and refer to them as ‘thieves’. They are also believed to be clever (Hill & Webber 2010). But in India, they are enlisted as Protected (Pirta et al. 1997). Previously, Nepal used to export Rhesus macaque to the United States laboratories for research. From 2009 onwards, that process is stopped due to the immense objection from public and non-governmental organization.

1.2 Objectives

1.2.1 General objective

The main aim of this study was to explore Human-Rhesus conflict along the Daraudi River basin Gorkha district, Nepal.

1.2.2 Specific objectives

- To estimate population status and distribution of Rhesus macaque.
- To explore people’s perception and the relationship between farming practices and Human-Rhesus macaque conflict.
- To estimate crop loss and human harassment by Rhesus macaque.
- To analyze local preventive measures.

1.3 Rationale of the study

This is the first study of Human-Rhesus conflict along the Daraudi River basin Gorkha District, Nepal. Conflict between Human-Rhesus has both direct and indirect costs for human beings. Conflicts poses serious challenges to the conservations of biodiversity around the protected area and community forests. Destructions and loss of crop, human harassment are the direct costs of Human-Rhesus conflict. So the knowledge gap that exists regarding the Human-Rhesus conflict of different agricultural plots of Daraudi River basin was explored. Due to fragmented landscapes and small patches the conflicts between Human-Rhesus has been explored. This study gives the idea about present status of conflicts between Human-Rhesus macaque and the pattern of crop grown and the most raided crops by the Rhesus macaque. Therefore, it attempts to explore the status of Human-Rhesus conflicts at the study site.

2. LITERATURE REVIEW

2.1 Population status and distribution of macaque in Nepal

In Nepal, Rhesus macaque are found in tropical rain forest of Terai to the valley 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 in the number in the religious jungles and temples like Pashupati, Swoyambhu, Sankhu, Bajrayogini etc. of Kathmandu valley (Chalise 1998). Nepal (2005) studied the habitat utilization of Rhesus and its conflicts with the people of Shivapuri-Nagarjun National Park. He found that the Rhesus macaque were distributed ranging from 1390 to 2300 m asl in Sundarijal Panimuhan and Roche area of Shivapuri-Nagarjun National Park with total population of 125 During his study period. Habitat type utilization was found maximum towards tree shrubs area (44.82%) which was followed by rocky area (23.02%) smooth ground (14.60%), stream side (9.68%) and crop land (7.88%) Chalise (1999 b) studied the behavior of Assamese macaque of Makalu-Barun area, Nepal (2005) find out that macaque spent (44%) of time in foraging (25%) in moving, in grooming and (18 %) time in resting.

Sharma and Acharya (2017) reported conflict between Human and Rhesus macaque at Pumdivumdi/Tallakodi in Pokhara valley in March 2016. Questionnaire survey was carried out in 60 households to assess conflict. Majority of the respondent (58.3) agreed the crops are damaged by Rhesus macaque. There is great amount of loss by macaque worth NRs 20000 in 2015 reported by (32 %) of the total household surveyed. Maize was the most raided crop (31%) followed by Potato (30%) and followed by others. Air (2015) reported conflicts between Human and Rhesus macaque at Jhor Mahakal and Goldhunga in Shivapuri-Nagarjun National Parks area that out of 100 respondents, 48 said that most raided crop is Maize and followed by others. Aryal and Chalise (2013) conducted research in the Akhale and Nayagaun VDC in Gulmi District and found that 64% raiding of crop with the extent of crop damage in the studied VDCs. Maize was highest preference (53%), followed by Wheat (23%), Paddy (16%) and Other (8%) by the macaque. The monetary loss of maize occurred highest than other crops.

According to the latest classification of conservation assessment and management plan (CAMP) workshop 2002, status of available Primates species has been classified for Nepal (Sanjay et al. 2003). CAMP designated Assamese macaque of Nepal as “Nepal population” from the existing two subspecies (*Macaca. 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 macaque (*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 parks and wildlife conservation Act 1973 and has considered in the endangered status (Chalise 1997 & 1998). Wada (2005) studied on distribution patterns of Assamese and Rhesus in Nepal in 1984. During his survey he found that Rhesus macaque dominated tropical, subtropical and temperate forests below 3,000 m from sea level all over Nepal.

2.2 Human-Primate Conflict

According to World Conservation Union, World Park Congress 2003, Human-Wildlife Conflict occurs when wildlife population overlaps with those of Human population creating cost to resident and wild animals. Direct contact with wildlife occurs in both Rural and Urban areas. It is mostly common inside and around protected area. In the place where the density of population is higher and mostly in the cultivated and grazing area. One of the main challenges facing wildlife conservation in the twenty first century concerns the concerns the increasing interaction between people and wildlife and resulting conflict that emerge (Sillero & Switzer 2001). Conflict between wildlife and people is an important factors affecting the relationship between protected area and the people who live near that places (Stdusrod & Wegge 1995). Across the globe primates are more frequently found crop raiding animals, from Africa to the Arabian Peninsula to Southeast Asia to Japan, primates come into conflict with human due to the renowned crop raiding behavior of many species (Sillero & Switzer 2001). Conflict occurs when non-human primates raid crops (Forthman 1986, Siex & Struhsakar 1999, Hill 2000). A large number of primates raids crops, but appears that terrestrial species are more likely to damage crops than arboreal species and non-folivores are greater crop raider than folivores. Among the old world macaque, the most common and better able to coexist with man species are from the genera *Macaca*, *Papio* and *Cercopithecus* in particular the several species of Baboon (*Papio* spp.), the Rhesus macaque (*Macaca mulatta*) and the Vervet macaque (Sillero & Switzer 2001). Rhesus macaque are the major crop pest in the hills and mountains of Nepal (Giri & Shah 1992, Chalise 1997, 2001, 2003, Ghimire 2000) increase in the population of Rhesus macaque (Malik 2001). Crop raiding by the Rhesus macaque is the serious problem in Bandipokhara VDC Palpa as in other parts of Nepal (Chalise 1997). Human-macaque

conflict in Jhor-Mahakal and Gold Dhunga area also facing conflict due to crop raiding (Air 2015). The Rhesus is the most common species than other primates in Nepal. It is also called the pest of farmers.

2.3 Monkey management

Crop raiding is not the new phenomenon by the non-human primates. Farmers used resourceful strategies to fight against the animals that damaging their crops. Methods that are employed by an individual's farmers are influenced by the resources at their disposal. In developed country the farmers have considerable levels of capitals 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 technique to tackle crop raiders. In India, crop fields and orchards from wildlife sanctuary (KWS) are protected by using many methods. The methods including the patrolling the fields, throwing the stones with Gophan, keeping dogs, fencing with thorny twigs, potash bomb etc. The most commonly used crop protection strategy in guarding their field by constant vigilance, during crop seasons (Chhangani et al. 2004).

3. MATERIALS AND METHODS

3.1 Study area

Gorkha district is located in Gandaki Province of Nepal. It is geographically Himali district in the Act of Local Government Act 2074. The latitude is 27°15' to 28°15'N and longitude 84°27' to 85°58'E. It is situated at the elevation of 330m to 8156m from the sea level and area is 3614.70 km². Gorkha had the high level of floral, faunal and ethnic's diversity. Two major rivers of Gandaki are flows from District- Daraudi and Budhigandaki. Among them Daraudi flows from the central part of the District. The study has been carried out along the rivers basin of different agricultural fields of Daraudi. The study was carried out in four different areas. They are Jarebar (437 m asl), Rangrung (900 m asl), and Mandre (1400 m asl), Barpak (1900 m asl). The study area contains historical, places, tourist area and epicenter of earthquake 2072. The study sites were situated at different at different elevations sites. Different cast and cultural people lives in the study area such as like Brahmins, Chettri, Janajati and Dalit. Among the respondents, the Janajati is the highest.

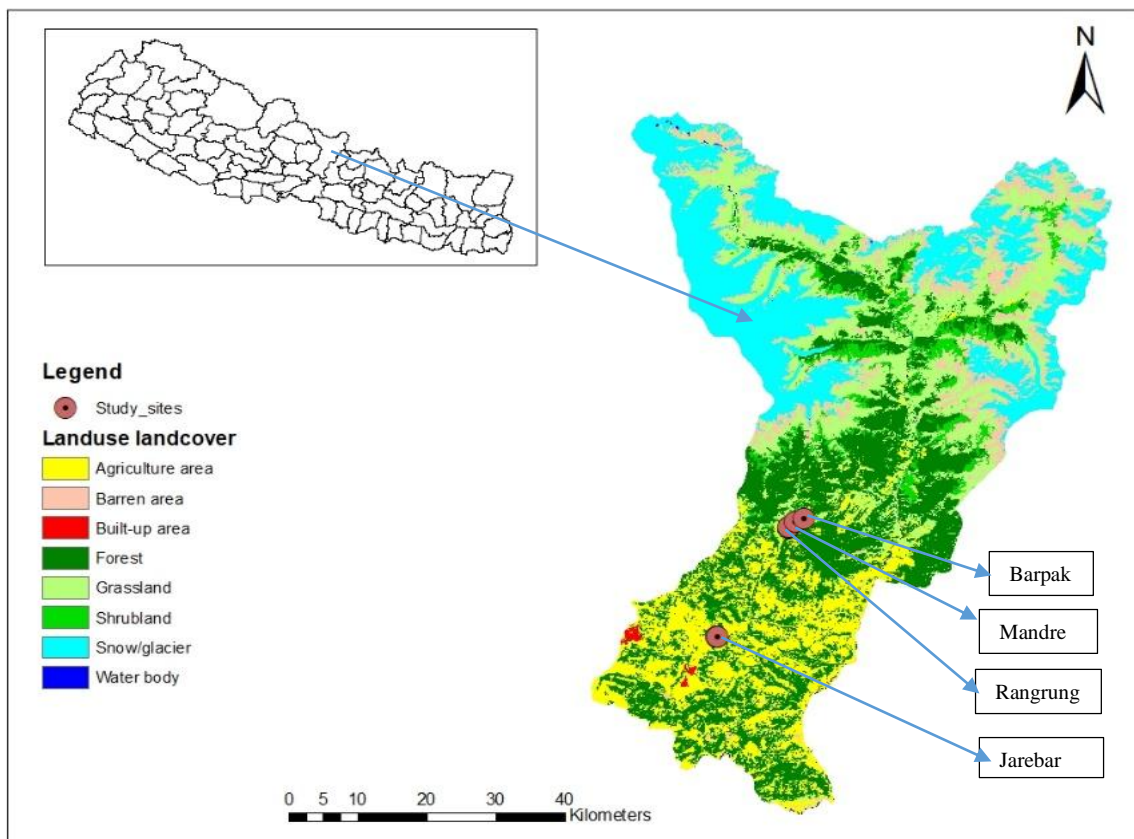


Figure 1. Map of the study area.

3.1.1 Climate

Climate play a major role in the distribution of species. Simply mixed types of climate were found in Gorkha, the maximum temperature is 27°C and minimum is 3°C. According to the altitudinal bases the climatic condition of Gorkha has Tropical to Alpine. The climatic condition of study site varies Sub-Tropical and cool temperate climate. The maximum temperature is 31.9°C in June and minimum temperature is 6.6°C in January. The maximum rainfall is 529.4mm at July (Annual Report of District Forest Office Gorkha 2074/2075).

3.1.2 Flora

According to the land cover types the forest of Gorkha district is divided into different types they are forest area, open areas, bushy area and pasturelands (Department of Forest Research and Survey 2015). The major tree species in mid mountain river basin are Sal, Sisso, Khayar, Katus, Chilaune, Uttish, Pine, and Others mixed types of vegetation's. In high mountains, the tree species like Uttish, Chilaune, Katush, Pine, and Rhododendron are found. In high Himalaya the medicinal plants such as Yarsagumba, Lotshalla, Chutro, Kaulo, pachaaule are mostly found (Annual Report of District Forest Office Gorkha 2074/2075).

3.1.3 Fauna

Gorkha district is rich in faunal diversity. The district provides the important habitat for Animals like Leopard, Northern red muntjac, Kasturi, Rhesus macaque, Langur, Jungle cat, Naaur. Different types of reptiles and amphibians are found (Annual Report of District Forest Office Gorkha 2074/2075).

3.1.4 Soils

In Gorkha District, different types of soils were found. Among them in southern parts of the District the Deep lateritic and Sub-tropical Podzolic to Forest Podzols types of soils were found. In northern area of District Tundra types of soils were founds (Annual Report of District Forest Office Gorkha 2074/2075)

3.2 Materials

Following equipment were used during field study

- 1) Binoculars (20×100)
- 2) Camera (Sony HD 12.0mp)
- 3) Data sheet

- 4) GPS
- 5) Topographic map of the study area

3.3 Research methods

3.3.1 Reconnaissance survey

The reconnaissance survey was conducted in February, 2019. During this survey period the study site were determine in where more conflict occurs in the River basin of agricultural plots, with the interaction of local peoples of that sites.

3.3.2 Data collection

Both primary and secondary data were collected during the research works.

3.3.2.1 Macaque population and distribution

The head count of macaque was done with the help of binoculars. First of all, the regular observation was performed in morning, day, and evening time to locate the distribution of Rhesus macaque in four different study sites. A regular watching was conducted without disturbing natural setting of distribution. Repeated observation was done to recognize their home range. Within the home range of macaque troop on every site the habitat was categorized according to physiographic and biological area the identified home range in the study area is as follows:

- 1) **Rocky area:** Covered with Rock no Tree but plant like Bhorlo plant and Herb were present.
- 2) **Tree-shrub area:** Covered by higher vegetation where sunlight penetration on the ground was partly restricted or fully restricted.
- 3) **Crop land:** Crop production plots or fallow due to crop raiding problems.
- 4) **Stream side:** Having streams and their banks.

3.3.2.2 Household questionnaire survey

The pre tested semi-structure questionnaire was used to interview the respondent. A questionnaire containing information like macaque related problems, mainly the crops which was raided by the Rhesus macaque, preventive measures used by the local etc. Were used to collect the information from respondent. Altogether 124 households were

interviewed using systematic random sampling methods in four different mainly affected agricultural site. The sites were Jarebar, Rangrung, Mandre and Barpark. Questionnaire survey were conducted to collected information about Human-Rhesus conflict during field survey (Appendix I, VI).

3.3.2.3 Focus group discussion

During the field survey focus group discussion were organized with the member of youth club of Mandre. The aim of group discussion was to investigate varieties of information regarding the status of human-macaque conflict, causes of conflict, mitigating measures that local used and role of local at conflict management.

3.3.2.4 Key informant survey

Key person interviews were conducted exclusively with those available during the household survey. The interviews were conducted to known the status of human-wildlife conflict. Questionnaire regarding the status of conflict, causes of conflict, attitudes towards monkey and their role in conflict management especially respected personalities in the community, school teacher and local leaders.

3.3.2.5 Secondary data collection

The secondary data were collected from different published and unpublished source of information related to human-macaque conflict in the study area. The secondary data were collected. By the related data were reviewed from different literature like, articles, research reports, dissertation, journal, library, news etc.

3.3.3 Sampling of household survey

Selected more affected village near the agricultural plots of Daraudi River basin, Sites were Jarebar, Rangrung, Mandre and Barpak. Approximately 28% of total household were chosen using a random selection process. These number were later selected using a random number table. The list of each household were achieved from the representative of that places. The total number of household selected by the random selection process in each Villages is represented in the table.

Table 1. Household sampling

S.N	Study site	Sampled HHs	Total HHs	Sampling intensity
1	Jarebar	35	125	28%
2	Rangrung	25	89	28%
3	Mandre	29	103	28%
4	Barpark	35	125	28%

Table 2. Age class wise distribution of respondent

Age class	Male	Male%	Female	Female%
0-19	3	2%	15	12%
20-40	24	19%	29	24%
41-60	16	3%	20	16%
Above 60	12	10%	5	4%
Total	55	44%	69	56%

3.3.4 Data analysis

The quantitative data obtained from the field was first coded, then entry into the computer software package. Both descriptive statistic (percentage, frequencies) and inferential statistics were used to analyze data. Bar diagrams, pie charts, tables and graphs were used to present the data in simple and understandable form or way, which was gathered from the semi-structured questionnaires survey. The economic value of crop damage was calculated on the basis of local market. To understand the attitude of respondent towards Rhesus macaque were calculated by using the Pearson chi-square test (two tailed), similarly compensation schemes. The map of the study area was interpreted by using ArcGIS software.

3.3.5 Crop loss calculation

To find per household crop loss in kg;

$$\text{Crop loss (kg per household)} = \frac{\text{total loss of crop in Kg}}{\text{total number of surveyed household}}$$

$$\text{Economic loss (NRs. per household)} = \frac{\text{total loss of crop in NRs}}{\text{total number of surveyed household}}$$

$$\text{Total crop loss (NRs.)} = \text{price of crop (NRs.)} \times \text{total crop loss (kg)}$$

4. RESULTS

4.1 Population status and distribution of Rhesus macaque

A total of 194 individuals of Rhesus macaque (*Macaca mulatta*) were observed in the four different study site, Jarebar, Rangrung, Mandre, and Barpak. The maximum number of Rhesus were reported from Jarebar whereas the minimum from Barpak (Table 3)

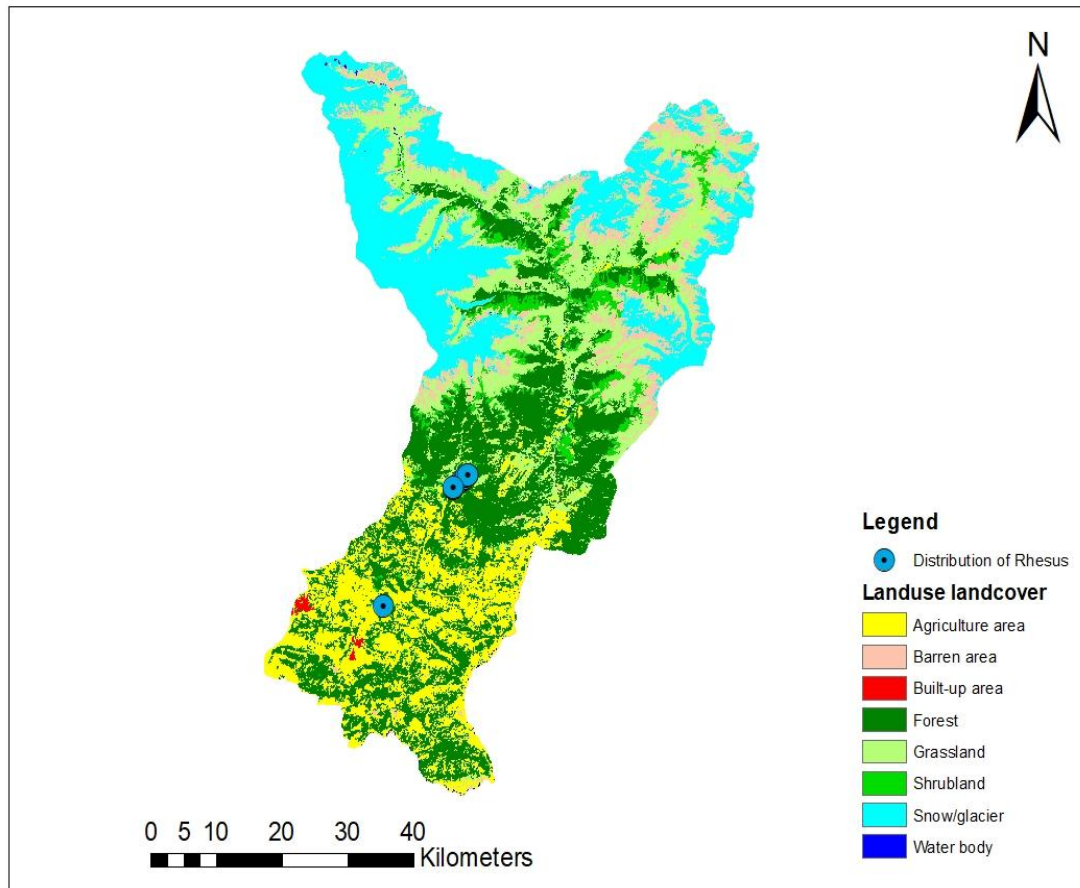


Figure 2. Occurrence of Rhesus macaque in the study area

Table 3. Rhesus macaque population in different study sites during study

Study site	GPS location	Altitude	Total number
Jarebar	28°.040996'N,84°.608375'E	439m	75
Rangrung	28°.191'N,84°.719'E	900m	49
Mandre	28°.200'N,84°.732'E	1400m	45
Barpak	28°.208'N,84°.741'E	1900m	25

4.2. People perception and relationship between farming practices and Human-macaque conflict

4.2.1 Socio-economic character of respondent

Among out of total 124 household interviewed, 55(44%) were male and 69(56%) were female respondent. They included 60% of Janajati, 17% were Brahmin, 10% were chettri and 13% were Dalit. These four study sites had total 442 households. Among them 124 HHs were selected for household sampling. The total agricultural land of these families were 2494 ropani. Among them 15 families have more than 40 ropani of land, 29 families have 25-40 ropani of land, 40 families have 10-25 ropani of land and 39 families has less than 10 ropani of land. None of the farmers in the four different study sites of sampling respondent were landless. The average agricultural land of per household was 20.11 ropani and all respondent had their own lands.

4.2.2 Level of conflict

The study in four different site showed that among the respondent of 124, 83(67%) of the respondent answered that the status of the conflict of Rhesus macaque was high, 24(19%) of respondent told that the conflict problem was moderate, 11(9%) of the respondent told the conflict was general and 6(5%) of the respondent did not know about the conflict problems (Figure 3).

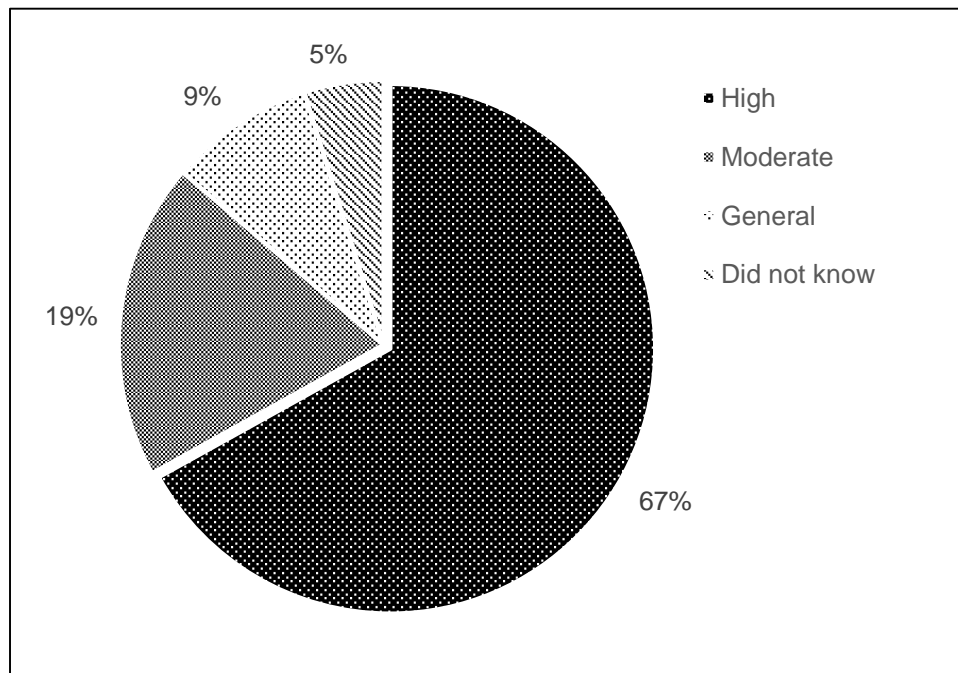


Figure 3. Level of human-Rhesus macaque conflict (N=124).

4.2.3 Respondent perception towards conservation of Rhesus macaque

Respondents demonstrated negative thinking about conservation of Rhesus macaque. Among 124 respondents, 75 (60%) did not like Rhesus macaque and wanted to eradicate them, while 49 (40%) liked Rhesus macaque. It means that they were negative towards Rhesus macaque conservation (Figure 4). Majority of respondents did not like Rhesus macaque. Perception towards Rhesus macaque conservation in term of age wise, gender wise and education showed that no significant differences: for age wise Pearson Chi-square $\chi^2=5.099$ df=9 p=0.82559 for Gender $\chi^2=11.738$, df =1, p=0.00061238 and Education $\chi^2=25.261$ df=6 p =0.00030542.

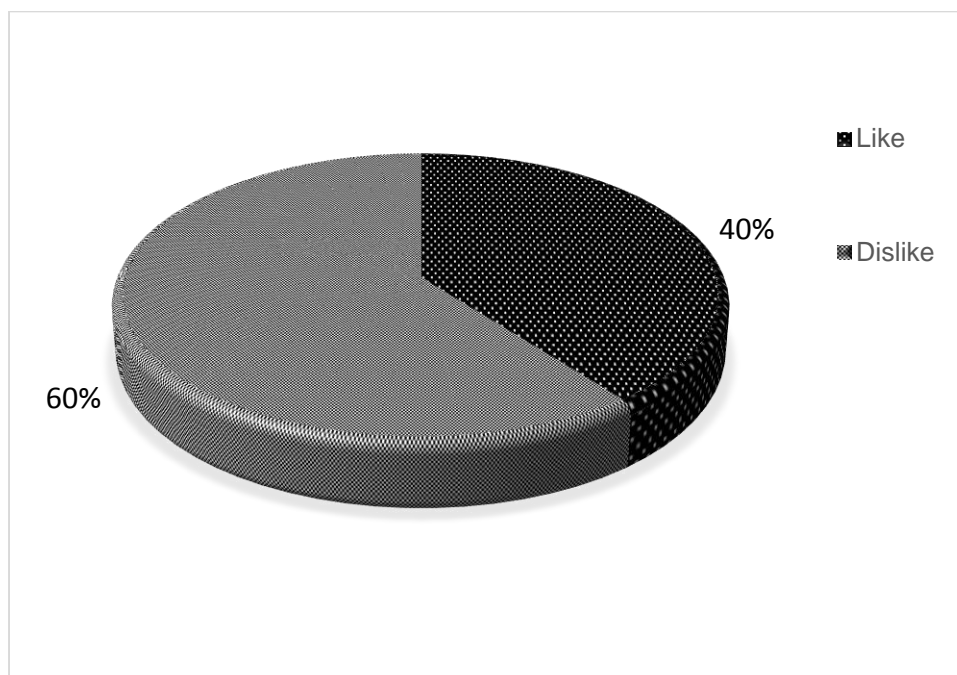


Figure 4. Showing respondent perception towards Rhesus conservation.

4.2.4 Farming practices and crop raiding by Rhesus macaque

Among the total 124 respondents of all study site. While interviewing with them the total crop damaged by Rhesus macaque was noted 24853 kg or 248.53 quintal in the whole year round. In that damage crops the highest proportion of the damage was maize which is 41% and the lowest proportion was millet 3%. The crop raided by the macaque potato 12%, wheat 11%, vegetables (which includes cabbage, cauliflower, bean, pumpkins etc) 20%, paddy 8% and other (which includes all types of fruits like banana, guava, etc and pulses) 5% from this study found that Maize is the most raided crops, among potato, wheat, millet, vegetables, paddy and others (Figure 5).

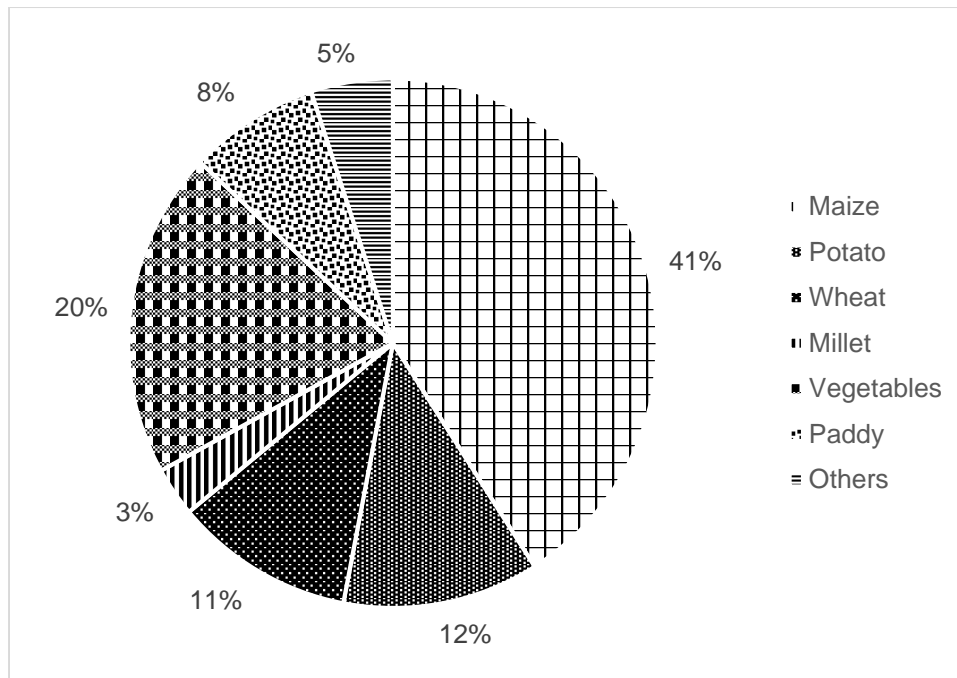


Figure 5. Farming practices and crop raided by Rhesus macaque in study site.

4.3 Crop loss and human harassment by Rhesus macaque

4.3.1 Crop damage

In different four study site, the respondent cultivated different species of the crops such as maize, potato, wheat, millet, vegetables, paddy, barley, mustard, pulses and many others crops and fruits. From the questionnaire survey of respondent, it was found that there were mainly two growing seasons. They are winter and monsoon seasons, winter season from (October to March) months and monsoon season crop included from (June to September). The winter season's crop included like, wheat, barley, mustard, potato, and vegetables. In the same way that the summer crop included maize, paddy, millet, potato and vegetables. From the questionnaire survey of respondent in the four different study site, it was found that the Rhesus macaque damages crops in both seasons and mainly damaged crops in the milky fruiting stage of the crops. Damage the crops lead substantial economic loss for the farmer. The crop damage by Rhesus macaque was identified quantitatively because damage varied between years to years and crop to crop.

4.3.2 Quantitative descriptions of crop loss in different study sites

The average annual loss of crop damage in the study area was found to be NRs 9, 59,857 (US\$ 8494.734). The highest crop damage was found to be Maize which was equal to NRs

3, 92,525 (US\$ 3473.846). Similarly, potato, wheat, millet, vegetables paddy and others crops were damaged by Rhesus macaque in the significant amount (Table 4).

Table 4. Average crop damage in kg and monetary value of crop damage per year in the study area

SN	Name of crop	Landcover in ropani	Harvested in kg	Loss in kg	Economic loss NRs	Economic loss Us\$	% of crop Loss
1	Maize	647	53725	11215	392525	3473.846	41%
2	Potato	167	16865	2870	114000	1008.9	12%
3	Wheat	973	68883	2777	105526	933.9051	11%
4	Millet	65	7476	878	28974	256.4199	3%
5	Vegetables	159	17814	3806	190300	1684.155	20%
6	Paddy	188	56256	2496	79872	706.8672	8%
7	Others	295	15872	811	48660	430.641	5%
	Total	2494	236891	24853	959857	8494.734	100%

On the basis of questionnaire's survey Jarebar was more affected by the Rhesus than other three sites, Rangrung, Mandre and Barpak. The total economic loss in Jarebar, Rangrung, Mandre and Barpak was 3686.83US\$, 2702.905US\$, 1247.549US\$ and 857.44995US\$ respectively (Appendix-IV). The economic loss was absolutely higher in Jarebar, than other site. Among different crop loss by Rhesus macaque. Maize was the most loss crop than potato, wheat, and millet, vegetables, paddy and other in four different site of the study area (Figure 6).

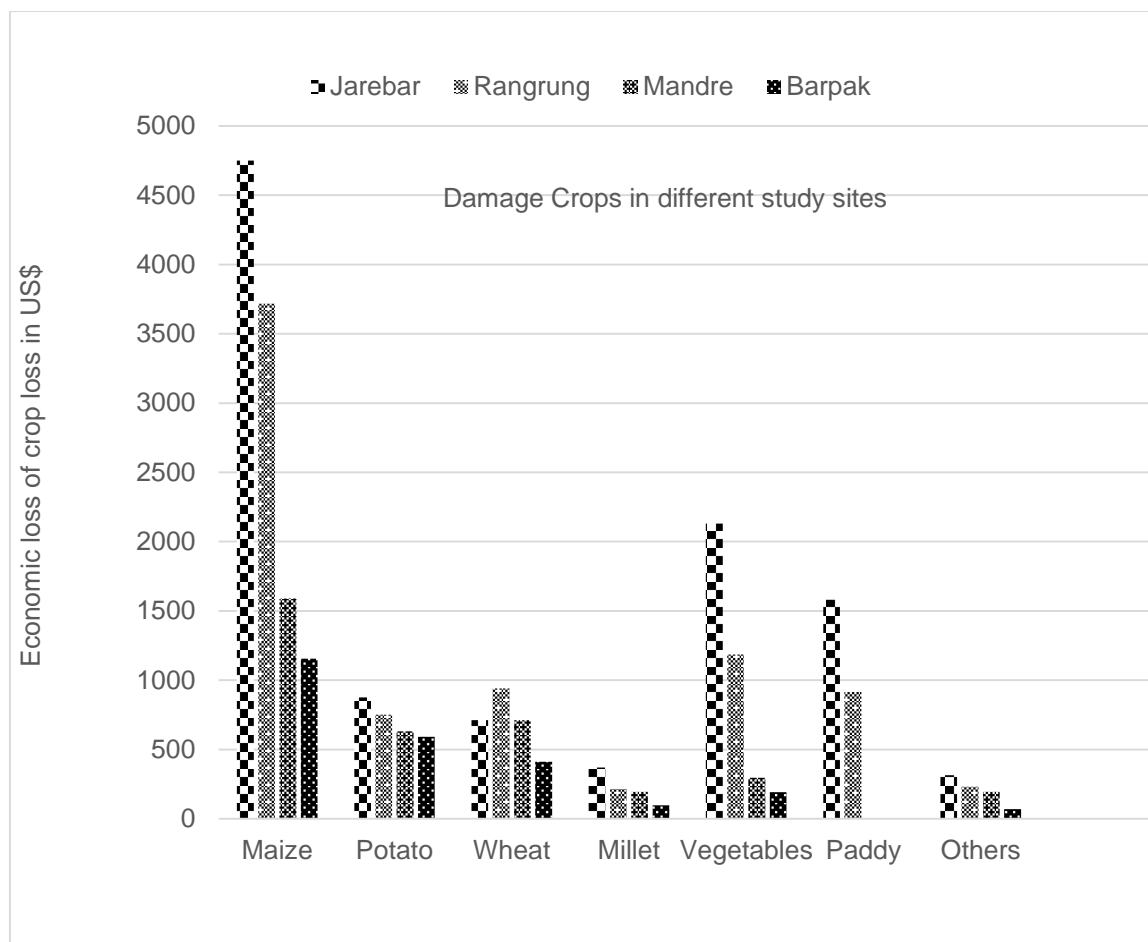


Figure 6. Comparative economic loss in different study sites

Similarly, the Jarebar site had the higher monetary loss of crop of US\$ 3686.83. Whereas the other three study sites Rangrung, Mandre and Barpark had the loss amount is US\$ 2702.83, US\$ 1247.55, US\$ 857.45 respectively. The average monetary loss of different crop varieties of HHs per annum in the study area was 68.51 US\$ (Figure 7).

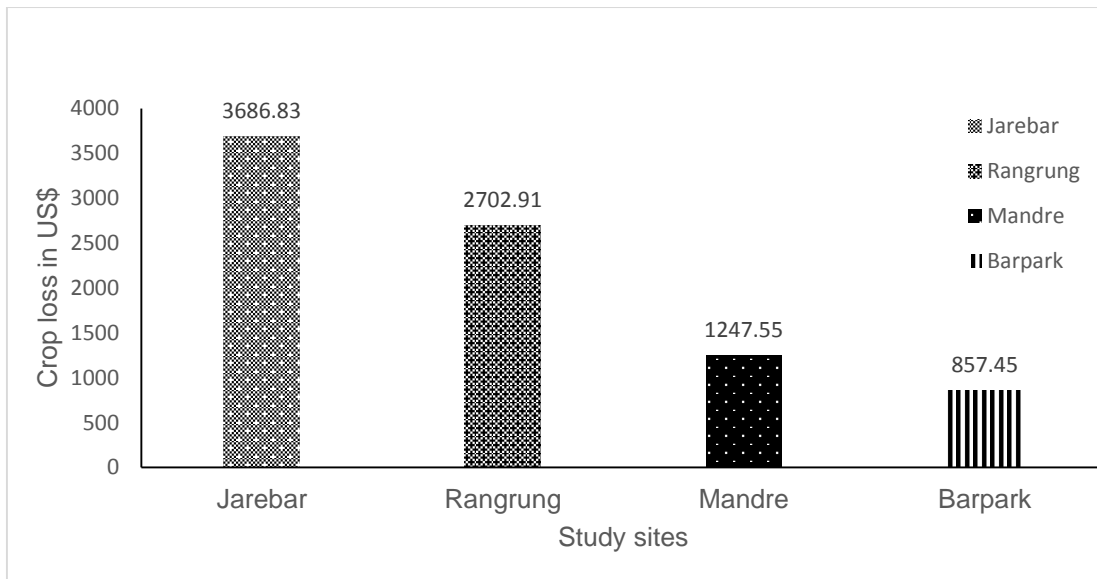


Figure 7. Economic loss of different crop loss in different sites.

In study sites Rangrung per HHs average loss of different crops loss was higher than other three sites, which was followed by Jarebar, Mandre, and Barpark. In Rangrung the average per HHs loss of crop was found to be 306.71 kg per year followed by Jarebar 306.71 kg, Mandre 124.86 kg and Barpark 72.03 kg (Figure 8).

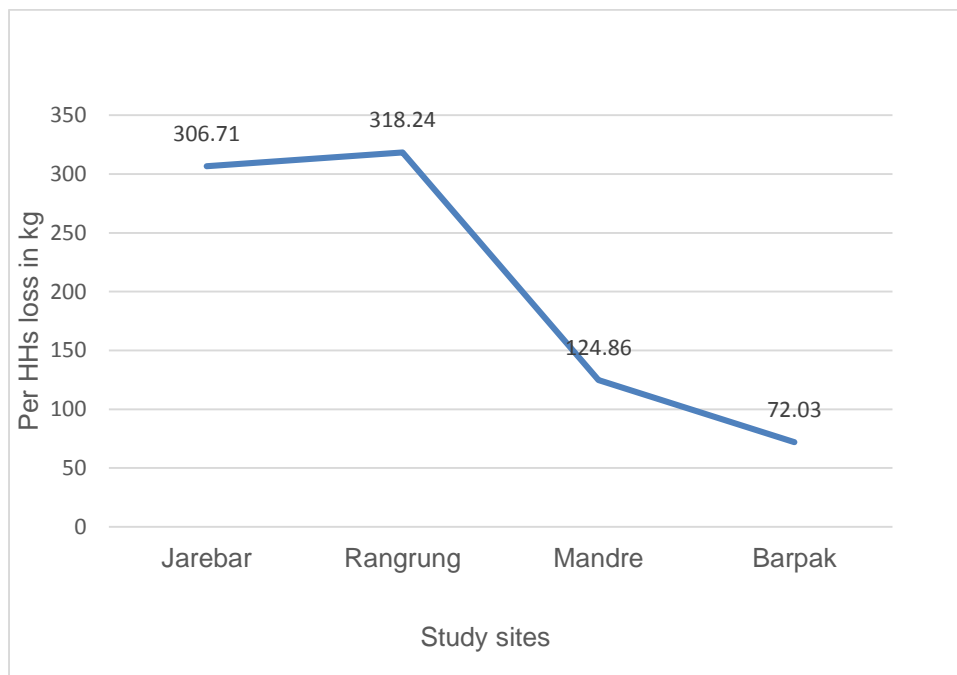


Figure 8. Per HHs average loss of different crops in different study sites.

4.3.3 Seasonal intensity of crop loss

Seasons wise incidents of crops loss showed that maximum of the incident occurred in summer seasons 48.39%, winter seasons is 17.74%, autumn 19.35% and spring 14.52% respectively and the least incident was occurred in spring season i.e. (14.52%) shown in (Figure 9).

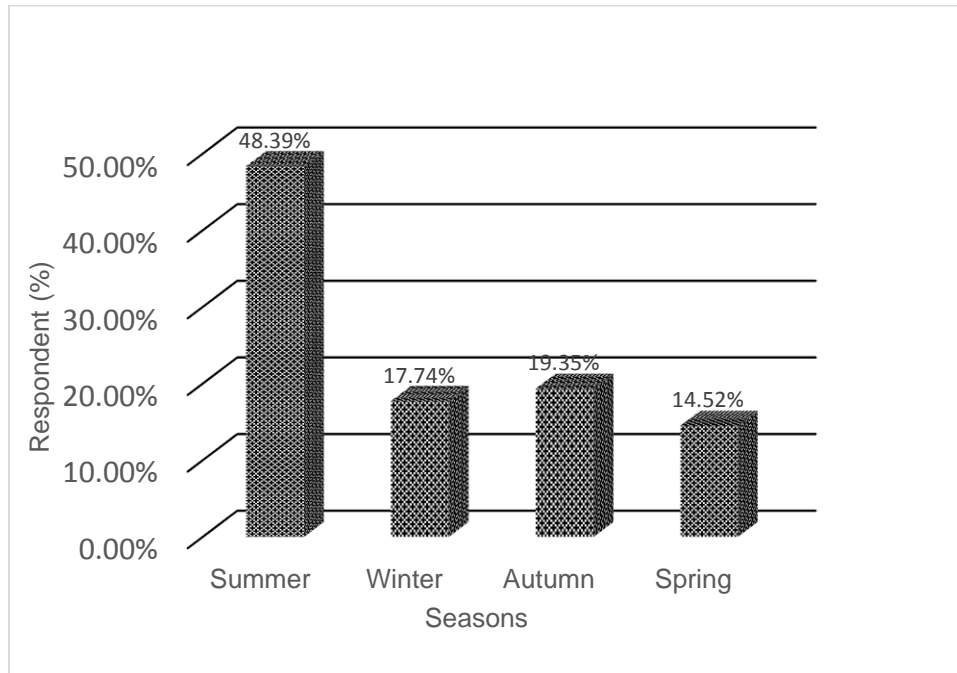


Figure 9. Season wise frequency of crop loss.

4.3.4 Human-harassment at four different sites

Among the 124 respondents of all the study sites Jarebar, Rangrung, Mandre, and Barpak the respondents were 35, 25, 29 and 35 respectively. Respondent of each side were harassment by Rhesus macaque which was followed by 33, 23, 19 and 18 of different sites Jarebar, Rangrung, Mandre, Barpak at different elevations of 437m, 900m, 1400m and 1900m respectively. Aomnge four different site the harassment was very high at Jarebar and Rangrung which is equal to 94% and followed by Mandre and Barpak (Figure 10)

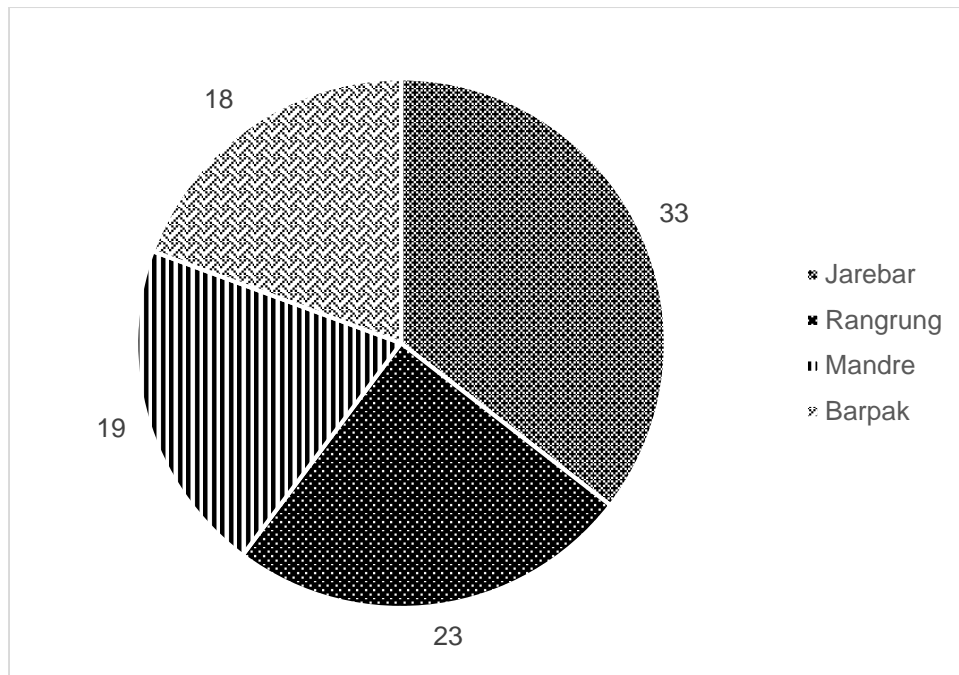


Figure 10. Human-harassment at four different sites.

4.3.5 Fallowing of crop land due to macaque problems

Most of the respondent of four different study site Jarebar, Rangrung, Mandre and Barpak were compelled to avoid the crop in the field due to the crop raiding problems by macaque. Out of them (65%) of the respondent had to leave more or less of their land fallow due to Rhesus macaque problems. Among total respondents (124), the remaining (35%) of the respondents did not fallow the land even the problems was high (Figure 11).

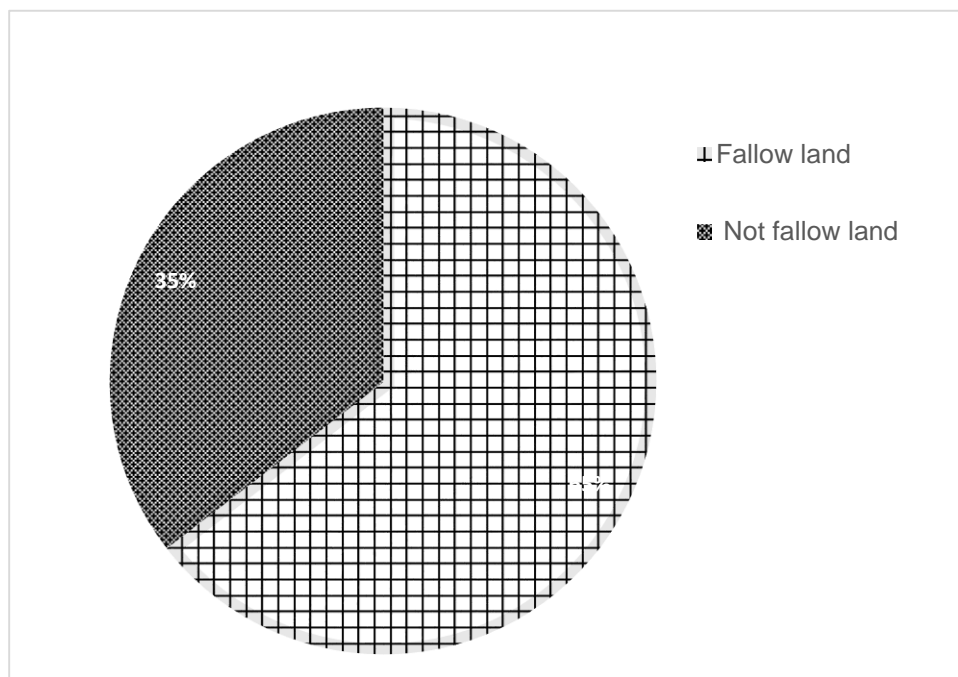


Figure 11. Showing crop land fallowing due to macaque problems.

4.4 Mitigation of human-macaque conflict

4.4.1 Deterrent methods against macaque problem applying by local

Among the 124 respondent of four different study site they used various methods to protect their crops in the field. From the respondent interviews about (29%) of the respondent shouted and followed, (23%) of the respondent using dog to chase Rhesus from the field, (13%) of the respondent used stone and catapult, (5%) of the respondent make domy of man (similar to man standing in the field) and 30% remainig of the other respondent used other methods among this, local farmers guarded their crop in field all over the day. In the Maize growing seasons they face more problems than in other seasons in that seasons they do rotation of eating their food in a day. According to the respondent opinion the shouted and followed is the best method to guared crop in their field (Figure 12).

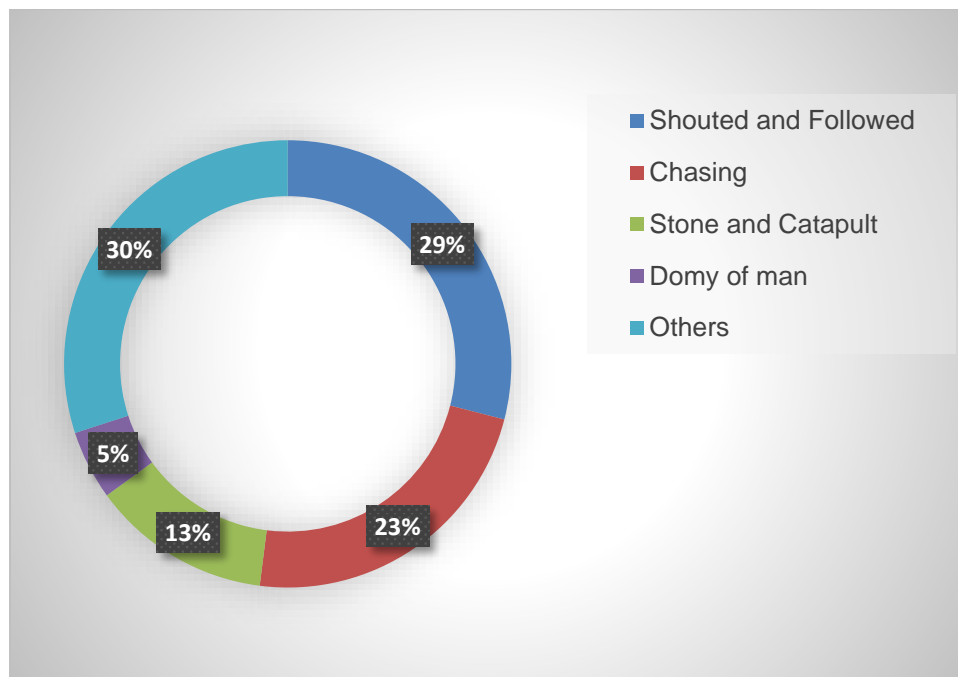


Figure 12. Methods used to chase macaque problems.

4.4.2 Remedial measures

According to the respondent of four different study sites Jarebar, Rangrung, Mandre and Barpak has different thought about the remedial measures of macaque problems. Maximum of the respondent of study sites were suggested that financial supports (41%), followed by others they are sterilizations (25%), translocation (25%), killings (13%) and (3%) of the respondent has no response to remedial measures (Figure 13).

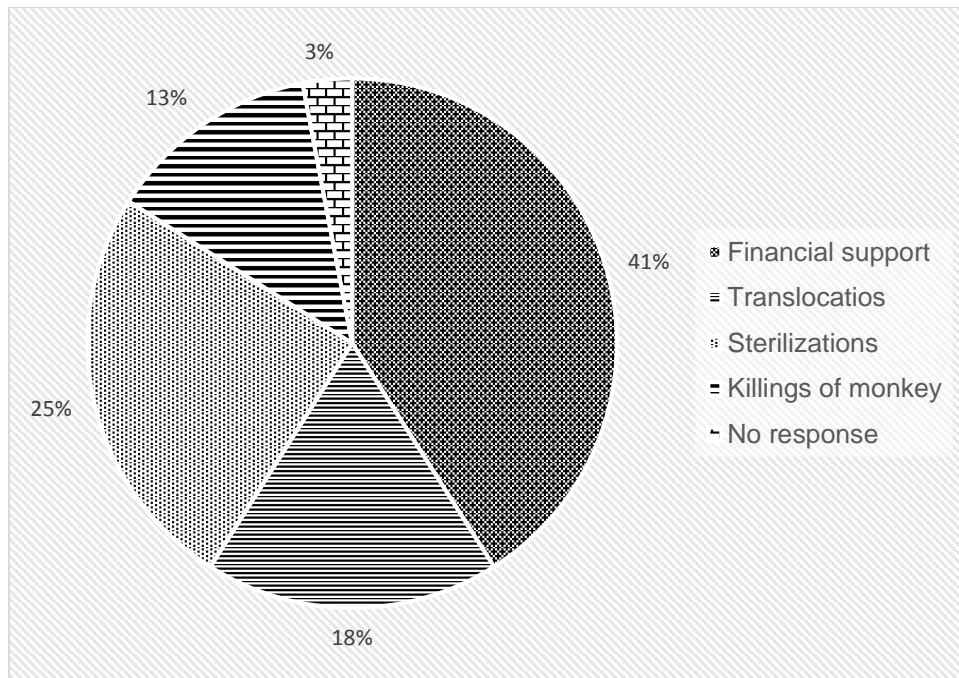


Figure 13. Remedial measures against macaque problems.

4.4.3 Trends of macaque problems

According to the respondents of Jarebar, Rangrung, Mandre and Barpak, the problems faced by the local community due to increased of Rhesus population. Respondents with in that area becoming serve. While interviewing with them, the respondents in the study site showed that the Rhesus macaque problem was increased year by years. While interviewing with 124 respondents of four different study sites Jarebar, Rangrung, Mandre and Barpak the problems of Rhesus macaque was increasing 65%, decreasing 12% and constant 23% (Figure 14).

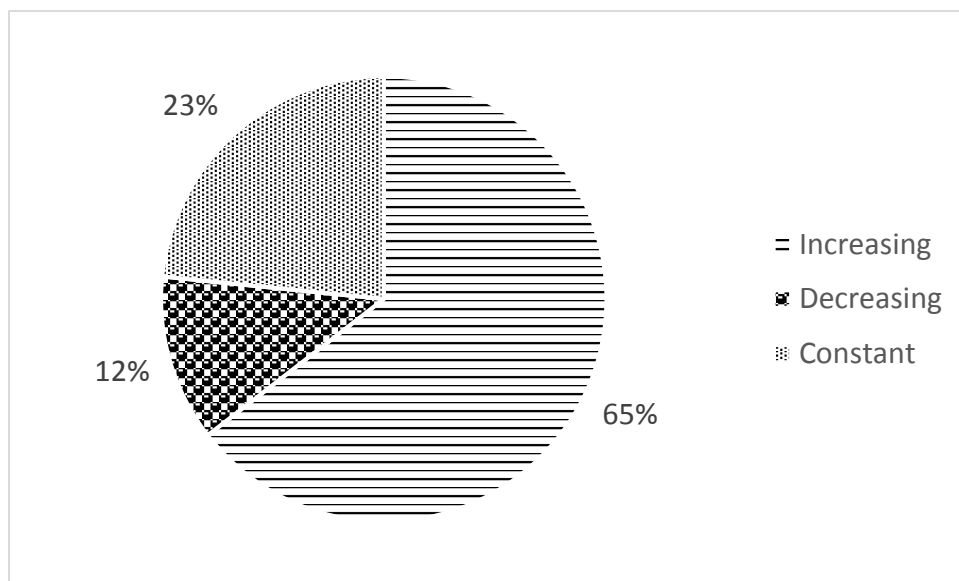


Figure 14. Trends of macaque problems in study area.

4.5 Compensation schemes

In the study area nearly all the HHs experienced problems created by Rhesus macaque as crop losses. They were not getting any compensations for their losses. In all the site, large number of the people are aware about the benefits of present governmental schemes. Among the 124 respondent of four study sites Jarebar, Rangrung, Mandre and Barpak. The most of the respondents 81(65%) known about the compensation schemes. Remaining of respondents 43(35%) unknown about compensation schemes (Figure 15). The knowledge about compensation schemes of respondents for age group, gender and occupation were not of significant differences (Pearson Chi-square age group $\chi^2=10.35$, DF =3 and $p=0.015815$, gender wise $\chi^2=2.3924$, DF=1 and $p=0.12192$ and occupation wise $\chi^2=3.3831$, DF=4 and $p=0.49587$).

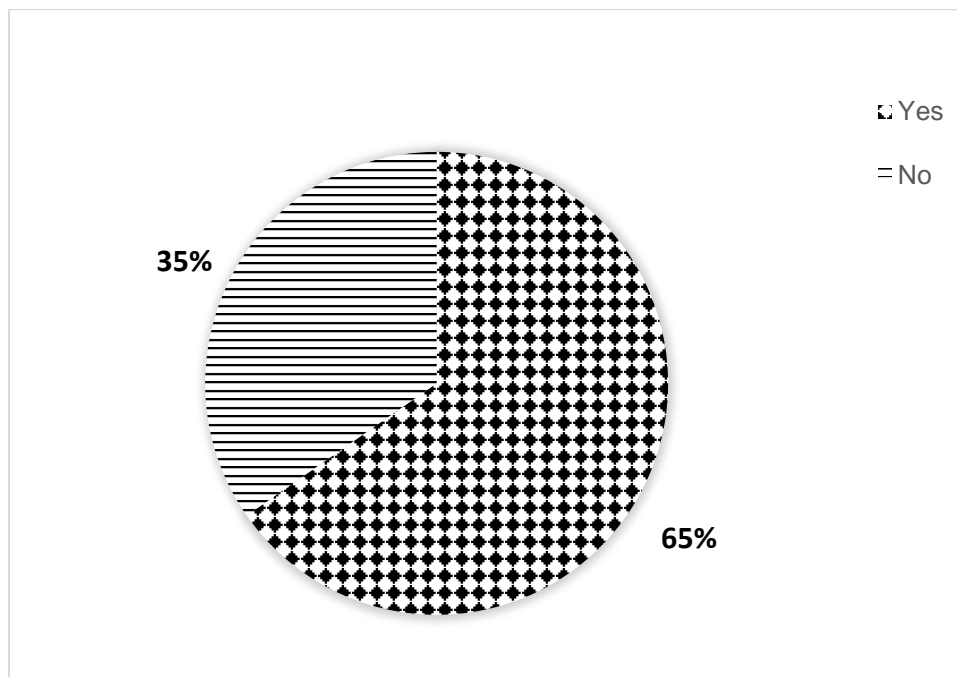


Figure 15. Showing compensation schemes.

5. DISCUSSION

In Daraudi river basin of different agricultural plots of study site, Jarebar, Rangrung, Mandre and Barpak near the forests of agricultural plots. The head count of the Rhesus macaque was found 194. Rhesus macaque was found distributed in all the forests of near the different agricultural sites. The troop with highest number of individual was found in Jarebar area. It may be due to the larger, flatter area and warm places than others three sites, lies at the altitudes of 437 m from the sea level. In these study sites Jarebar, Rangrung, Mandre and Barpak had face the crop damage by the Rhesus macaque was high. This can be discussed with the crop raiding is one of the causes of conflict from herbivorous animals which is mainly associated with farmers. Non-human primates are one of them. The competition between Human and non-human primates is a major problem by (Priston & Underdown 2009). With the foraging strategy of Rhesus macaque, As (Strum 1994) assumed that crop raiding is the foraging strategy with specific cost and benefits in the case of Olive Baboons (*Papio anubis*) in Kenya.

From the questionnaires survey of total 124 respondent, About 99% of the respondent reported that they faced crop damage problem due to Rhesus macaque in their agricultural fields. According to them increases of near community forests, barrenland, increases Population of Rhesus macaque and increased the habitat for Rhesus macaque causes higher damages. Similar results were found number of wildlife species had been increased and higher number of conflict were created by wildlife species of community forests in Dang by (Pokharel & Shah 2008). Similarly in GCA the number of wildlife had been increased after the establishment of CA and creates more conflict by (Awasthi 2014) and similar results was carried out in SNP by (Pant 2018). Rhesus macaque in the study sites, Jarebar, Rangrung, Mandre and Barpak were responsible for damage all types of crop mainly, maize, vegetables, potato, wheat, paddy, millet and others crops (Pulses & Fruits) on both seasons when farmer cropping in the fields. Rhesus macaque damage in all the stages of the crops but mostly damages crops in the milky stages. This also serve to increases the conflict and lead to substantial economic loss for the farmers by (Shah 2017). Rhesus are depending upon the types of crop grown in the field and have to choose more palatability crop and they damage more. Similar to the study of different palatability of the crop varieties (Poudel 2007). Chalise (2001) from langtang reported that in month of April they were mostly found around the crop field when there is less food in the forest areas. Similarity to my study sites of different agricultural places, the Rhesus macaque frequently

visited more in Summer Seasons of the months of June and July, During this seasons they grab maize easily from the field. Nepal (2005) in Shivapuri found foraging for maximum times (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 macaque spent only 25% 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 macaque with wild habitat, Natural feeding and similar climatic conditions. Different regarding the duration of feeding is due to the artificial provisioning by urban people in Swoyambhu and Pashupati . This study showed the similarity with Chalise (2001), Ghimire (2000) and Nepal (2005) but different with Others.

Khatri (2006) found 76% of the respondent of Vijayapur area of Dharan reported the crop raiding as the majors problems. Similarly in the study of McCourt (2005), It was reported that 92% of the respondent complained the harassment by macaque taking food spilling or eating from kitchen, porch or roof. Chalise (1997, 2001, 2003) reported that crop depredation by macaque is different in different crops. In MBCA they recorded highest loss of maize (32%) followed by potato (24%), rice (14%), fruits (12%), millet (11%) ,wheat (4%), buckwheat (2%) and pulses (1%). Nepal (2005) in SNNP, Kathmandu found highest loss of maize (35%), followed by wheat (30%) millet (16%), mustard (6%), paddy (5%), fruits(4%), vegetables (1.92%). Aryal (2012) in gulmi found highest loss of maize (21%) followed by wheat (20%), paddy (12%), fruits (10%), millet (9%), potato (9%), mustard (4%), barley (2%) and pulses (1%).

Crop raiding was found as major causes of conflict. Mostly the group raiding was seen in day time. From the interview of respondent reported that the Rhesus macaque are opportunistic in crop raiding when ever the field ready to harvest or when ever they plant maize and potatoes and they raid palatables and edible crops. These reports showed that, macaque and human aggression and interaction towards food. According to the respondent opinion of study sites the macaque problems was increasing and majority of the respondent (65%) had to leave more or the less of their land fallow due to Rhesus macaque problems. Rhesus were found to be frequented in the crop field occasionally. It was found that during the month of June-July macaque raided crop even 3 to 5 times in a day. But During the October-December-January macaque were not appeared around the crop field for many days.

In my study crop raiding was found as major causes of conflicts, in which Maize was highest proportion (41%) and millet is the least proportion (3%). The crop raided by the macaque included vegetables (cauliflower, cabbage, potato, pea and pumpkins) 20%, potato (12%), wheat (11%), paddy (8%) and other (fruits like guava, pear, pineapple etc) (5%). This fact is also supported by the finding of Chalise (1997, 2001, 2003). Chalise et al. (2001) reported that crop depredation proportion by macaque is different in different crops. In MBCA they recorded highest loss of maize (32%) followed by potato (24%), rice (14%), fruits (12%), millet (11%), wheat (4%), buckwheat (2%). Ghimire (2000) in Palpa found highest loss of maize (34.12%) followed by potato (23.05%), rice (12.01%), fruits (11.26%), wheats (5.97%), millet (5.13%), buckwheat (2.38%) and pulses (2.06). Khatri (2006) in Vijayapur recorded the damage of the maize in highest extent (43%) followed by fruits (27%). Finding from Aryal (2012) in Gulmi, the damage of maize is the highest extent (53%) followed by Wheat (23%), Paddy (16%) and Others (8%). Air (2015) in Jhor Mahakal and Golddunga area of Kathmandu found that the maize (48%) followed by potato (18%), wheat (14%) and other (20%). Finding from Sharma (2017) at Pumdiumdi in Pokhara reported that the highest loss maize (31%) followed by potato (30%) vegetables (cauliflower, cabbage and guard) (17%), rice (15%) and wheat (7%). Finding from Rijal (2015) the crop raiding by Rhesus and Assamese macaque was maize (57%), followed wheat (28%), millet (5%) and paddy (4%). In study site my finding is also similar to their finding of Rijal (2015), Air (2015), Sharma (2017) and Chalise et al. (2001) which was the raiding maize was (41%), potato (12%), vegetables (cabbage, cauliflower, bean etc) (20%), wheat (11%), paddy (8%), others (fruits and pulses) (5%) and millet (3%).

Among 124 respondent perception towards Rhesus was negative about conservation. Among all respondent 60% of the respondent did not like the Rhesus macaque and only 40% like. This means they have negative perception towards conservation because of high crop raiding by Rhesus in the different study sites. (Southwick & Siddiqi 1961) believed that the Rhesus macaque population of north India were declining because of changing attitudes of the Villagers of India towards Rhesus macaque. The study by Holmen et al. (2007) in Tanzania about large carnivores should be killed as a response to livestock depredation because they cause great amount of damage to farmer (Holmen et al. 2007) which is similar to my finding.

From the questionnaires survey of 124 respondent of study site of Jarebar, Rangrung, Mandre and Barpak. Conflicts with Rhesus macaque can be discussed in average annual

crop loss in different study site, Jarebar, Rangrung, Mandre, and Barpak was found to be NRs 9,59,857(US\$ 8494.734). The highest crop damage was found maize which is equal to NRs 392525 (US\$ 3473.846). Similarly, Among the four different study sites Jarebar which suffered from the highest monetary loss of crop which is equal to NRs 416591 (US\$3686.83) where as the study sites Barpak has the lowest crop damages of NRs 96,887 (US\$857.45). The average monetary loss of different crop varieties per household per annum in the study area was 68.51 US\$. Among the four study sites Rangrung is located near to the forest than other which lies at the altitudes of 900 m from the sea level. The average crop damage is also high in the Rangrung. The major principle crop cultivated agricultural field by the respondent was maize. Seasons wise incident of the crop damage was showed maximum in summer which was total damage of (48.39%) followed by others seasons Autumn (19.35%), Winter (17.74%) and Spring (14.52%) seasons. The least incident of crop damages by Rhesus macaque was seen in Spring seasons. From the above finding in Summer seasons the macaque habitat contain less amount of food in natural forest. Rhesus macaque go out from natural forest to the nearest field to eat more palatable food like maize and potato to change their test. This finding was similarity to the finding of wildlife go out from community forest to eat more palatable food which was abundant in crop field to change their test. Which was supported the finding of (Sukumar 2003, Neupane et al. 2014, Shrestha 2007). Maximum respondent of the study site were following of land due to macaque problem was high. Among the 124 respondent 65% of the respondent were following less or more land due to high intensity of Rhesus problems in the study sites which is similar to the finding of Rijal (2015).

The various techniques used by the people for crop protection. In my study among 124 respondent the chasing of Rhesus macaque was done by shouted and followed (29%), chasing (23%), stone and catapult (13%), domy of man (5%) and other (30%) which was similar to the finding (Khatri 2006, Mc. Court 2005, Adhikari 2013 & Rijal 2015). The people of the different study site were suggested the remedial measures which was found financial support (41%), translocation (18%), sterilization (25%), killing of macaque (13%) and no response (3%) , which is supported finding (Rijal 2015). Farmers suffering from macaque crop damage in eastern nepal was considering planting chili, garlic, and tobacco from the study some unpalatable crop, chilli, onion, garlic, ginger, etc. were reported to the local people to minimize the crop damage Chalise (2001).

Among 124 respondents, the trend of the macaque was also carried in the interviews. According to the respondent view the trends in crop raiding by the macaque was increasing (65%), decreasing (12%) and constant (23%) was found. The increasing of the conflict in this area was due to fragmented landscapes, small patches of agricultural land, baren land, construction of road from mid forest area, increases population of Rhesus, search of palatable food by Rhesus macaque. Graham (2004) reported the frequency of conflict has grown largely because of increases in human population and resultant expansion of human activities. Food deficiency, increases in number of wildlife, search of palatable food and water were the causes of conflict in Banke National Park (Ayadi 2011) which was similar to the findings of this study. Respondent of study sites experinced by crop damages problems created by Rhesus but they are not getting compensation schems from government. The large number of respondent (65%) known about the compensation schems. Usually the ward and local government is local unit where farmers can applied for their damage. The stakeholders are not responsible for the compensation of crop damage. There is also the chance of overstating the crop damage, these make compensatory programe more difficults and the loss associated with them is one of the important factors shaping the attitudes of the people including youth and children (Linkie et al. 2007). Among 124 respondents till now no one get compensation schems from government, 65% of respondents were known about the government compensation schemes.

6. CONCLUSION AND RECOMENDATIONS

The study was conducted in the Daraudi River basin of different site near the four different agricultural plots. The study site were Jarebar (437 m), Rangrung (900 m), Mandre (1400 m) and Barpak (1900 m). The Rhesus population of all different site were 194. The data were collected from semi-Structured questionare survey. The total household of the four sites were 442. Aomng these households, 124 were selected randomly from different sites of the study area. As we go higher altitude the population of Rhesus were decreases in number and troops size . The decresse in population of Rhesus is directly proportional to decrease in crop raids. The highest loss of crop damage is found in Jarebar and lowest in Barpak. The average annual economic loss of different crop was found to be NRs 9,59,857 (8494.734US\$). The perhousehold economic loss was NRs 7673.12 (68.51 US\$). Jarebar has the highest economic loss than other sites, maize was the most frequent crop loss than other in all four sites. The people of Jarebar and Rangrung are more negative to Rhesus than Mandre and Barpak. The man method used by people to chase Rhesus was shouted and followed. Most respondent are know about compensation but they are not get any compensation.

Based o the finding of research work in Daraudi River basin of four different gradient of four agricultural plots. To minimize conflict following work should be done:

- There should plant fruiting tree and flowering tree in the community forest to minimize conflict.
- Macaque unpalatable crop such as winter beens, ginger, tumeric, mustared and millet etc. especially in the area of maximum crop raids.
- Awarness program should be done about the about the ecosystem balanced by macaque and scientific research to local people.
- Habitat improvement of the macaque should be increases in the community forest especially by planting palatable plant and flowering plants.
- Strong wall with fire fencing should be constructed near the agricultural plots of different sites.
- Crop insurance policy should be opened for the people to make positive attitudes towards the wildlife.

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APPENDIX – I

Household Questionnaire

Date:

Name of respondent... Age Sex

Study site/Village..... Education level:
Occupation Cast/Ethnic group.....

Family size..... Male..... Female.....
elevation.....

GPS..... Latitude.....
longitude.....

Land owned.....

1) What are the main crops grown in your farm?
a) b) c) d).....

2) Are the Rhesus frequently seen in the farm area?
a) Yes b) no

3) If yes how often are they seen in the farm areas?
a) Daily b) Weekly c) Monthly d) Yearly

4) Which crops do Rhesus macaque raid most frequently?
Crop:
Maize Pathi /Kg. Paddy Pathi /Kg. Wheat Pathi /Kg. Millet
..... Pathi /Kg. Mustard Pathi /Kg. Potato Pathi /Kg. Vegetables
..... Pathi/Kg. Fruits..... Pathi/Kg. Others Pathi/Kg.

5) Which year they raid mostly?
Every year last year This year Never.....

Which crops are not raided by Rhesus?
a)..... b)..... c)..... d).....

- 6) Is there change in crop raiding pattern in comparison to last year?
 a) Yes b) no
- 7) Which season they raid most?
 a)..... b)..... c)..... d).....
- 8) Are you using any controlling methods to reduce the impact of Rhesus macaque?
 a) Yes b) No
- 9) What are they?
 a) b) c) d)
- 11) Do you like to have Rhesus macaque in your Surrounding?
 a) Yes b) No
- 12) What are the reasons to like Rhesus macaque in your Surrounding?
 a)..... b) c)..... d)
- 13) If you don't like what are the reason to dislike
 a)..... b) c) d).....
- 14) What are your suggestions to protect these animals?
 a) Awareness among people
 b) Maintaining food quality of these animals on their habitat
 c) Making fences along farms
 d) Planting the crops which are less likely to be raided
 e) Others
- 15) Have you killed Rhesus macaque while chasing them unintentionally?
 a)Yes b) No
- 16) Is there any injury to Rhesus macaque while chasing? a) Yes b) No
- 17) If yes how did you kill the Rhesus macaque?
 a)..... b)..... c)..... d).....

APPENDIX – II

Position of the agricultural field of different altitudes gradients.

Table-1

Study site	GPS location
Jarebar	28.0397'N,84.607927'E 28.04996'N,84.608375'E 28.041653'N,84.609026'E 28.039840'N,84.609222'E 28.03935'N,84.609484'E
Rangrung	28.186891'N,84.716008'E 28.187115'N,84.716280'E 28.187429'N,84.716385'E 28.187681'N,84.715851'E 28.188024'N,84.715674'E
Mandre	28.194669'N,84.726766'E 28.194045'N,84.725903'E 28.194537'N,84.726552'E 28.194726'N,84.726847'E 28.194163'N,84.725645'E
Barpak	28.198950'N,84.738509'E 28.1987785'N,84.738830'E 28.198959'N,84.738450'E 28.198803'N,84.738117'E 28.199158'N,84.738503'E

Table-2

Distribution of Rhesus at different altitudinal points

Study site	GPS location	Altitude
Jarebar	28°.040996'N,84°.608375'E	439m
Rangrung	28°.191'N,84°.719'E	900m
Mandre	28°.200'N,84°.732'E	1400m
Barpak	28°.208'N,84°.741'E	1900m

APPENDIX-III

Maize 1 Mann = 40 kg

Paddy 1 Mann = 40 kg

Wheat 1 Mann = 40 kg

1 Bigh = 20 Kattha

13 Ropani = 1 Bigh

1 Ropani = 1.54 Kattha

1 Kattha= 20 Dhur

According to the Crop Production in Field

Maize in 1 Ropani = 300 kg

Paddy in 1 Ropani = 300 kg

Wheat in 1 Ropani = 180 kg

Wheat in 1 Kattha = 3 Mann

Paddy in 1 Kattha = 5 Mann

APPENDIX-IV

Local market price of different crops

Common name	Market rate per Kg NRs
Maize	35
Potato	40
Wheat	38
Millet	33
Vegetables	50
Paddy	32
Others	60

APPENDIX-V

1 NRs = 0.00885US\$

Average crop production and damage in Jarebar

Sn	Name of the crop	Actual yield in kg	Damage in kg	Damage NRs	Damage in US\$
1	Maize	25950	4750	166250	1471.313
2	Potato	5751	875	35000	309.75
3	Wheat	35611	712	27056	239.4456
4	Millet	2015	371	12243	108.3506
5	Vegetables	7963	2131	106550	942.9675
6	Paddy	37965	1581	50592	447.7392
7	Others	9567	315	18900	167.265
	Total	124822	10735	416591	3686.83

Average crop production and damage in Rangrung

S.N	Name of the crop	Actual yield in kg	Damage in kg	Damage NRs	Damage in US\$
1	Maize	15625	3718	130130	1151.651
2	Potato	4191	751	30040	265.854
3	Wheat	17963	941	35758	316.4583
4	Millet	1521	215	7095	62.79075
5	Vegetables	5971	1185	59250	524.3625
6	Paddy	18291	915	29280	259.128
7	Others	4215	231	13860	122.661
	Total	67777	7956	305413	2702.905

Average crop production and damage in Mandre

Sn	Name of the crop	Actual yield in kg	Damage in kg	Damage NRs	Damage US\$
1	Maize	7619	1591	55685	492.8123
2	Potato	3211	631	25240	223.374
3	Wheat	9518	712	27056	239.4456
4	Millet	2550	195	6435	56.94975
5	Vegetables	2711	297	14850	131.4225
6	Paddy	0	0	0	0
7	Others	1195	195	11700	103.545
	Total	26804	3621	140966	1247.549

Average crop production and damage in Barpak

Sn	Name of the crop	Actual yield in kg	Damage in kg	Damage NRs	Damage US\$
1	Maize	4531	1156	40460	358.071
2	Potato	3712	593	23720	209.922
3	Wheat	5791	412	15656	138.5556
4	Millet	1390	97	3201	28.32885
5	Vegetables	1169	193	9650	85.4025
6	Paddy	0	0	0	0
7	Others	895	70	4200	37.17
	Total	17488	2521	96887	857.45

APPENDIX-VI PHOTOPLATES



Photo 1. Questionnaires with respondent



Photo 2. Rhesus at study sites



Photo 3. Dummy of man



Photo 4. Crops in study sites



Photo 5. Vegetation at study sites