

**FOREST RESOURCE UTILIZATION AND MAMMAL
SPECIES OCCURRENCE AT GANESH COMMUNITY
FOREST, KANCHANPUR, NEPAL**



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Kirtipur, Kathmandu
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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 for any degree. All sources of information have been specifically acknowledged by reference to author(s) or institution(s).

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The thesis work submitted by Ms. Manisha Pandeya entitled “**FOREST RESOURCE UTILIZATION AND MAMMAL SPECIES OCCURRENCE AT GANESH COMMUNITY FOREST, KANCHANPUR, NEPAL**” has been accepted as partial fulfillment for the requirements of the degree of Master of Science in Zoology with special paper Ecology and Environment.

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LIST OF ABBREVIATIONS

Abbreviated form	Details of abbreviations
CF	Community Forest
CFUG	Community Forest User Group
DFO	District Forest Office
GCF	Ganesh Community Forest
GCFOP	Ganesh Community Forest Operation Plan
GPS	Global Positioning System
NTFP	Non-Timber forest produc

ABSTRACT

Anthropogenic activities have posed a serious threat to forest resources, leading to their degradation. Overuse of community forests has contributed significantly to the depletion of these resources. The primary objective of this study is to identify the utilization of forest resources and the occurrence of mammal species at Ganesh Community Forest in Kanchanpur, Nepal. The research was conducted from September to November 2021. A questionnaire survey was used to gather information on the types of resources used by local communities, their access, and quantity. The study also calculated the monetary values and annual demands of different grades of wood by local people. To determine mammal occurrence and the impact of resource extraction on mammal species, five line transects were established from South to North, with an interval of approximately 400 m. Along each transect, a 10 m X 10 m plot was established at an interval of 100 m, where direct observation of mammal species, their footprints, scats, and burrows were recorded. The study found that the major forest resources extracted by the user group from the Community Forest were grass, leaf litter, wood, firewood, fodder, and medicine. Of the seven mammal species identified, five were directly observed, including Wild Boar (*Sus scrofa*), Rhesus Monkey (*Macaca mulatta*), Indian Grey Mongoose (*Herpestes edwardsii*), Barasingha (*Rucervus duvaucelii*), while pugmark of Royal Bengal Tiger (*Panthera tigris*), footprint of Asian Elephant (*Elephas maximus*), and faecal matter of Nilgai (*Boselaphus tragocamelus*) were observed through their signs and activities. Wild Boar was the most abundant mammal observed (51%), followed by Nilgai (22%), Rhesus Monkey (13.4%), Indian Grey Mongoose (5.5%), Barasingha (2.7%), pugmark of Bengal Tiger (2.7%), and footprint of Asian Elephant (2.7%). The study found that mammal species occurrence decreased with increasing canopy cover, distance to nearest road, water source, and agricultural land, while it increased with increasing distance to the nearest settlement. Local respondents agreed that the wildlife has significantly increased due to the availability of suitable habitat and establishment of community forests in the areas. Therefore, this study sheds light on the relationship between forest resource utilization and mammal species occurrence, providing a basis for the development of effective management strategies to promote sustainable resource use and protect biodiversity in Community Forest ecosystem.

1. INTRODUCTION

1.1 Background

Nepal's remarkable biodiversity is evident through its ability to sustain over 3% of the world's known flora despite occupying only 0.1% of the global area, boasting an impressive 35 forest types, 75 vegetation units, and 118 ecosystems (MoFSC 2014). The forest in the country occupies a substantial 40.36% of the total land area, equivalent to 5.96 million ha. (DFRS 2015). The country boasts a remarkable richness of biodiversity, with a recorded count of approximately 13,067 plant species, encompassing 2,467 species of fungi (Adhikari 2016), 805 species of lichens (Baniya and Bhatta 2021), and 41 species of gymnosperms (Shrestha et al. 2018). The remarkable diversity of vegetation in the region can be attributed to Nepal's vast landscape, spanning from the tropical climate of the Tarai to the Alpine Tundra of the high Himalayas, providing an ideal environment to cultivate a wide range of forest and Non-Timber Forest Products (NTFPs). Forests, in particular, play a critical role in elevating the livelihoods of rural populations in developing nations, as they offer access to NTFPs which can be gathered from the forest and traded, including Indian gooseberry (*Phyllanthus emblica*), Wolf's bane (*Aconitum heterophyllum*), Chirayata (*Swertia chirayita*), Indian bay leaf (*Cinnamomum tamala*), Black morel (*Morchella elata*), Jatamansi (*Nardostachys jatamansi*), Jhyau (*Parmelia nepalensis*), Kutki (*Picrorhiza kurroa*), Long pepper (*Piper longum*), Indian soapberry (*Sapindus mukorossi*), Common valerian (*Valeriana officinalis*), Sugandha kokila (*Cinnamomum glaucescens*) and Common pricklyash (*Zanthoxylum armatum*) (Poudel 2007).

Nepal is primarily an agrarian nation, with almost two-thirds of its population relying on agriculture and forest resources to maintain their livelihood (MoFSC 2009). Rural farmers are heavily reliant on forests to fulfill their daily requirements, such as fuel wood, fodder, leaf litter for compost and fertilizer (Roy and Pokharel 2000). In Nepal, the goods and services that originate from forests are of paramount importance for a significant portion of the population, as access to and governance over forest resources can be critical for subsistence (Chhetri et al. 2012a, Chhetri et al. 2012b).

Biodiversity of Nepal contains 4.2% of mammals, 8.5% of all birds and 2.2% of all flowering plants on earth including threatened flagship species such as the Royal Bengal Tiger (*Panthera tigris*), Asian Elephant (*Elephas maximus*), Greater One-horned Rhino (*Rhinoceros unicornis*) and River Dolphin (*Platanista gangetica*) (Shrestha et al. 2001). Two hundred and twelve species of mammal have been known to occur in Nepal till now, out of these 23% are considered to be Nationally Threatened with extinction, with 4% of species considered Critically Endangered, 12% Endangered, 7% Vulnerable and 3% are considered Near Threatened. Thirty-five percent of Nepal's mammals are considered Least Concern, and 38% are considered Data Deficient in the near future (Jnawali et al. 2011).

Richness of mammal species and threatened mammals were positively associated with natural forest area. Detections of threatened mammals increased with greater proportions of natural forest (Ng et al. 2021). Sustainable management of tropical forest resources is crucial for maintaining essential ecosystem services and reducing the loss of biodiversity (Sodhi et al. 2010, Struebig et al. 2015). Mammals are particularly vulnerable to habitat loss and overexploitation and have consequently received much conservation attention (Wilcove et al. 2013). The capacity for selectively logged forest to support vertebrate species, including large to medium-sized mammals, pressing conservation issue (Norris et al. 2008, Brodie et al. 2015). Several species of mammal play keystone roles in ecosystem by dispersing seeds, maintaining the composition of plant communities through grazing (Young et al. 2013), or maintaining biodiversity through the cascading effects of predation (Terborgh et al. 2001). Large charismatic mammals are important conservation flagships and umbrellas through their sensitivity to human disturbance, co-occurrence with other species of conservation concern and large area requirements (Caro 2003, Brodie et al. 2015).

Studies conducted on the community forestry program in Nepal have highlighted its potential in effectively addressing issues related to resource scarcity and environmental degradation through proper management techniques (Maharjan 1998, Ojha et al. 2009). The implementation of community forest management programs plays a crucial role in meeting the needs of rural communities (Adhikari 2005). The sustainability of heavily utilized forests is largely depends on the structural characteristics of local forest-governing institutions (Gautam and Shivakoti 2005) . Additionally, the physical

properties of resources are known to impact the level of participation of local communities in forest conservation efforts (Smith et al. 2003).

Community Forestry (CF) has emerged as a powerful tool for landscape restoration, although its effectiveness varies depending on the context (Shrestha et al. 2010). Despite these variations, the conservation of forests ultimately aims to enhance the well-being of communities living in close proximity to forests (Harbi et al. 2018). Additionally, CF has been found to contribute significantly to poverty reduction in developing countries (Rasmussen et al. 2017). In Nepal, the people's dependence on forests, particularly CF, for their basic needs for forest products and livestock, is deeply ingrained in the farming systems (Roy and Pokharel 2000). Poor households tend to rely on CF for livestock rearing, while the wealthier households often rely on private forests for collecting forest products (Thoms 2008). This distribution of dependency highlights the importance of managing forests effectively to ensure equitable access to forest resources for all members of society

The majority of community forest users are local, small-scale subsistence farmers who have long relied on the interdependent relationship between people, livestock, and forests. The community forestry program has been regarded as a triumph in terms of forest conservation and socio-economic development, especially in the foothills of Nepal (Gilmour 2003, Tachibana and Adhikari 2009). Community forestry programs have become a key method for forest management in Nepal, operating under a common property management regime (Agrawal and Ostrum 2001). The success of these programs can be attributed to the active participation of local communities in forest management, ensuring sustainable use of forest resources and equitable distribution of benefits. The active management of forests by local users has the potential to increase the regular supply of forest products without degrading forest resources (Nagendra and Gokhale 2008). For this to be successful, the participation of forest user groups in forest protection, resource utilization, and decision-making activities is crucial. These essential ingredients can help to realize the potential of forest user groups in achieving more effective forest management. In addition, widespread participation and consensus among households can significantly enhance the effectiveness of forest user groups in managing forest resources sustainably. By involving local communities in forest management, we can promote responsible resource use, protect biodiversity, and improve the livelihoods of rural communities that depend on forest resources.

The government of Nepal has made CF a top priority and has successfully implemented it by supporting decentralization in resource allocation and promoting social aspects of land use (Jorge and Diez 2012). Currently, around 2.9 million households, or 29, 07,871 individuals, are involved in the community forestry management program (DoF 2018). To date, 22,266 Community Forestry User Groups (CFUGs) have been formed, including 1072 women-only committee members. Furthermore, a total of 22, 37,670 hectares of National forest have been handed over as community forests, which represents about 41% of the national forest of the country (DoF 2018).

Previous studies on community forestry management practices have primarily focused on documentation (Shrestha 2009), or floristic diversity in a community-managed forest (Pandey and Ghimire 2020). However, in western Nepal, there is still a lack of research on forest resource utilization from CF and the impact of resource extraction on faunal species occurrence. This has raised concerns that logging may lead to the local extinction of many species. Therefore, this study has been undertaken to address these gaps in knowledge. Specifically, the study aims to identify the forest resources utilized by locals and mammal species occurrence at Ganesh Community Forests, Kanchanpur, Nepal. By improving our understanding of the relationship between forest resource utilization and mammal species occurrence, this study could inform the development of more effective management strategies to promote sustainable resource use and protect biodiversity in CF ecosystems.

1.2 Objectives

1.2.1 General objective

To assess the resource utilization by local people and occurrence of mammal species at GCF in Kanchanpur, Nepal.

1.2.2 Specific Objectives

- To assess the forest resource used by local people at GCF.
- To identify the occurrence of mammal species at GCF.

1.3 Rationale of the study

Community forestry is a crucial aspect of forest management in Nepal, where local communities play a vital role in decision making and resource management, with the

support of government and related organizations. In the western of Nepal, community forestry has played a significant role in supporting local livelihoods in various ways. While some studies have been conducted on community forestry in Nepal (Baral et al. 2018), including inventory and management practices, there is a lack of information on the proposed study area's objectives. This study aimed to investigate the positive and negative impacts of community forestry on the resource utilization by human beings, occurrence of mammal species due to establishment of CF and impacts of resource extraction on mammals in the Ganesh Community Forest of Kanchanpur district, Nepal. The study evaluated the role of local communities in forest management and identify any negative impacts on community forestry caused by local people. This study aimed to contribute to the overall management of biodiversity and promote healthy human life in the area. Additionally, the proposed area has the potential for ecotourism, which can be realized through better and planned management. This study on the Ganesh Community Forest of Bedkot Municipality (Kanchanpur) can provide valuable insights into the integration of community forestry and the overall management of biodiversity in the region.

2. LITERATURE REVIEW

2.1 Community forestry

Community forests are valuable resources that offer opportunities for conservation and economic growth that are compatible with promoting livelihoods and it provides a way for communities to take an active role in managing their forest resources, a paradigm shift from the traditional government-controlled forestry model (Kanel and Dahal 2008). To ensure democratic decision-making, Forest User Groups (FUGs) are formed and registered at the Division Forest Office (DFO), with a Community Forest User Groups (CFUG) Constitution defining the rights of users to a specific forest (Pokharel and Nurse 2004). This participatory approach allows communities to manage their forests for their benefit, and the success of community forestry is being watched with great interest for the lessons it offers (Pokharel et al. 2012). Community forests have been found to provide benefits such as fuel wood, fodder, leaf litter, and water, which can help women save time in their daily activities (Roy and Pokharel 2000). However, to ensure the success of community forestry, policies and practices must be community-oriented, with communities in charge of decision-making and receiving most of the benefits (Baral 2014). While community forestry has been successful in restoring degraded lands and habitats, conserving biodiversity, and generating rural incomes, and it has limited success in improving rural livelihoods (Thoms 2008). Nevertheless, community forestry is regarded as a model for active people's participation, empowering women and disadvantaged groups, and developing human resources (Shrestha et al. 2010).

In conclusion, community forests provide opportunities for conservation, economic growth, and livelihood promotion. By involving communities in the management of their forest resources, community forestry can empower communities, conserve biodiversity, and generate rural incomes. However, to ensure its success, policies and practices must be community-oriented and benefit local communities.

2.2 Resource utilization

Community members have long been involved in forest conservation, distribution and utilization of forest products to meet their household requirement (Shrestha 2009). The rural people have largely been dependent on forest resource from ancient time for

firewood, timber, grass, agricultural tools and other domestic needs as well as medicinal herbs available from non-timber forest products (NTFPs) which are an integral part of rural livelihood (Paudel 2017). The impact on forest resources has been very positive, almost 75% of forest resources were deteriorating (Yadav et al. 2003). Sal forests (*Shorea robusta*) were particularly vulnerable to resource utilization, as they provide valuable timber for construction and agricultural implements (Yadav et al. 2003). Average daily 8.4 kg of fuel wood was consumed by household with mean annual consumption of 3,060 kg per household, fuel wood from CF contributes 23% and trees on private farmland contribute 12% (Kadel et al. 2016). Among various NTFPs Asparagus (*Asparagus officinalis*) was found to be used mostly from CF (Dhakal et al. 2016). Highest majority of herbaceous species followed by shrubs and trees were recorded from nearby CF (Pandey and Ghimire 2020). Sal forest has been found the predominant species in natural forest followed by Black scutch (*Acasia catechu*), Indian rosewood (*Dalbergia sissoo*), Red silk-cotton tree (*Bombax ceiba*), Indian blackberry (*Syzygium cumini*) and Yellow teak (*Adina cordifolia*) (Shrestha 2009). Women from larger households located closer to forests and markets were more likely to participate in forest resource utilization activities (Chhetri et al. 2013). A wide variety of foodstuffs, a number of non-food direct uses; various uses of wood for energy, construction materials and various implements; other non-wood resources such as leaf litter, livestock fodder and browsing; the use of grasses, canes, reeds etc. have been used as forest resources (Pandey 2009).

Medicinal plants followed by fodder, fruit, fuel wood were some of the major forest usage of the user group in terms of monetary value while fodder, grass and bedding materials were distributed free of cost (Paudel 2017). Different indigenous communities widely practice various angiospermic plants in traditional system of medicine for the treatment of different human ailments. Other uses include fuel wood, fodder, agricultural tools making, furniture making, timber, thatching, condiments and spices, shade, fencing and poles, tannins and dyes, ornamental purpose and soil stabilization (Sher et al. 2010). Unmonitored over-utilization of NTFPs may negatively influence forest biodiversity. The harvested NTFPs contributes to 6.35% of the community income with 68.55% of the household's dependency on NTFPs (Thammanu et al. 2020). Study reveals that the unmonitored utilization and over exploitation of NTFPs has negative impacts on mammals, amphibians and the reptiles

(Ukpong et al. 2012). However, the estimated species richness does not differ significantly between unlogged forest (15.5 ± 2.82 species), previously logged forest (14.5 ± 2.10), or recently logged sites (14.2 ± 1.45) sites (Wall et al. 2021).

2.3 Mammal species

Community Forests play a vital role in the conservation of flora and faunal species by providing suitable nutritional source and habitat. It has been found that highest number of mammal species followed by herpetofauna were recorded from various community forests. Over 93% of the respondents agreed on the wildlife has dramatically increased due to establishment of CF (Pokhrel and Shah 2008). Study have shown that among wild animals, birds were recorded as highest in number followed by mammals and reptiles (Yager et al. 2018). Study reveals that faunal species within the class mammals, aves, and reptiles were most abundant among various Community Forests (Yager et al. 2019). Thus the protection of CF from various resource exploitation its conservation and monitoring is very important to sustain biodiversity.

3. MATERIALS AND METHODS

3.1 Study Area

Ganesh Community Forest (28°59'07.13" to 29°01'09.39"N, 80°13'43.79" to 80°15'28.17"E), located in the Kanchanpur district of Sudurpachhim Province in western Nepal, covers an area of 434.37 hectares and was registered as a community forest in 2057/058. It is situated between Bachela Khola to the east and Chunepani Khola to the west, and stretches from Siddhasarowar dharmik ban to Musepani residential area from north to south. The forest is bordered by Kailali district to the east, Dadeldhura to the north, and India to the south and west. The forest plays a crucial role in providing livelihoods for local communities and in conserving biodiversity in the region. However, there are concerns regarding the sustainable use of forest resources and their impact on the flora and fauna in the area. Therefore, it is important to study the forest resources utilized by the local people and their impact on the mammal species occurrence in order to develop effective conservation and management strategies for the forest. The study area of Ganesh Community Forest has a total of 1,260 households involved in forest management, with a higher population of males (4,032) than females (3,927) (GCFOP 2023). The forest in the area is dominated by mixed Sal forest, and is well-known for its timber and non-timber forest products. The forest stands at a higher elevation of 809 feet along the Churia foot hill, which is a natural forest type. The region experiences a humid tropical climate with three distinct seasons, including monsoon, winter, and summer, with an average annual rainfall of 1575 mm (GCFOP 2023). During the summer season, the maximum temperature can go beyond 40°C, while during winter, the temperature can go below 10°C (GCFOP 2023). The climatic conditions of the area have a significant impact on the growth and distribution of vegetation and fauna within the forest ecosystem.

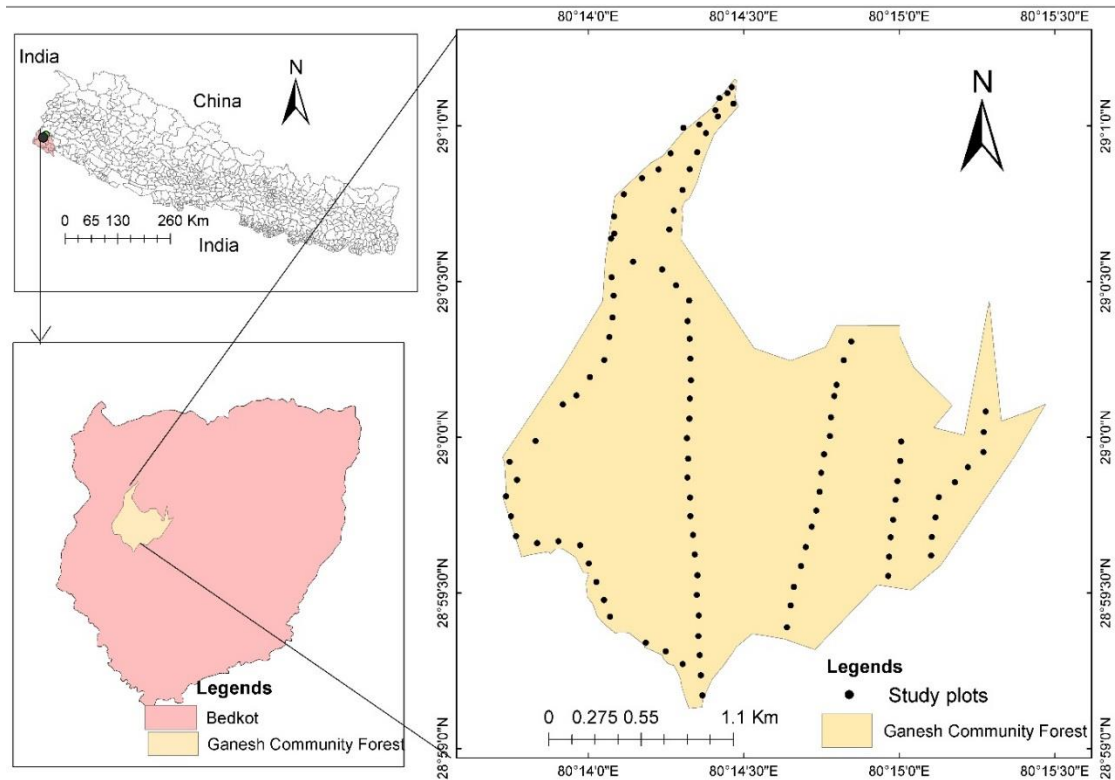


Figure 1. Ganesh Community Forest with study sampling area.

3.1.1 Flora and Fauna

Major vegetation's of Ganesh Community Forest are Sal tree, Black cutch, Yellow teak, Bedda nut tree (*Terminalia bellerica*), Kusum tree (*Schleichera oleosa*), Indian laburnum (*Cassia fistula*), Black murdah (*Terminalia elliptica*), Indian blackberry, Banyan (*Ficus benghalensis*), etc. Amphibians and reptiles includes Indian Bullfrog (*Hoplobatrachus tigerinus*), Nepal Paa Frog (*Nanora minica*), Snake species like Indian Python (*Python molurus*), Oriental Rat Snake (*Ptyas mucosa*), and Oriental Garden Lizard (*Calotes versicolor*). In the same way major mammals of GCF are, Indian Gray Wolf (*Canis lupus pallipes*), Indian Grey Mongoose, Wild Boar, Rhesus Macaque, Nilgai, Barasingha, Royal Bengal Tiger, and Asian Elephant. Bird species like Rose-Ringed Parakeet (*Psittacula krameri*), Large-Billed Crow (*Corvus macrorhynchos*), Black Eagle (*Ictinaetu malayensis*), Kalij (*Lophura leucomelanos*), Jungle Owlet (*Glaucidium radiatum*), and Western Spotted Dove (*Spilopelia suratensis*) are found in Ganesh CF.

The materials used during the field survey were:

- Measuring Tape
- GPS: Garmin Etrex 10
- Data sheets
- Paper/ pencils

3.2 Data collection

During the period of 13-21 August 2021, a preliminary survey was conducted at the Ganesh Community Forest to gather information about the forest condition, community forestry practices, and the involvement of local people in resource collection. Additionally, the survey collected information about the occurrence of mammal species in the area. The survey was conducted through interviews with local residents and forest users, as well as direct observations of the forest and its fauna. The collected information was used to design and implement further studies on the forest resources and biodiversity conservation at the Ganesh Community Forest. This preliminary survey has provided a basis for understanding the forest management practices and their impact on mammal species occurrence in the study area.

3.2.1 Questionnaire survey

The questionnaire survey was conducted between September and November 2021, and number of households for the questionnaire survey were identified using stratified random sampling, which was carried out based on known population size (N) using following Slovin's Formula at 10 % margin of the error (Compendio and Bande 2017, Wulandari and Kurniasih 2019).

$$N = N \sqrt{1 + Ne^2},$$

Where, n = sample size, N = population Size

Survey was conducted to only people >18 years old. During the survey no discrimination was done to the people based on education level, gender, ethnicity, or religion. Both demographic and social data of interviewee were collected during this survey. In addition, the information on the resource used by local people from the CF was also collected from questionnaire survey. It includes types of resources, quantity,

their access, etc. Data about different grades of wood (i.e. A, B, C), their annual demands (Per/Cu. Ft.) by local people, and their monetary values were also calculated.

3.2.2 Forest resources and mammal records

In order to investigate the mammal species and impact of forest resource extraction on mammal species at Ganesh Community Forest, a total of five line transects were established from South to North. The interval between the transects was approximately 400 meters, although this distance varied depending on the feasibility of the geographical area within the CF. Along each transect, a 10 m X 10 m plot was established at intervals of 100 meters. The total number of study plots among five line transects were 102. The length of first line transect was around four km and consists of 38 study plots. Second line transect consist 31 study plots with length around three km and two hundred meters, third line transect consist 16 plots with length around two km, fourth line transect consist eight plots with length around one km and fifth line transect consist nine study plots with length around one km and 200 meters.

To ensure accuracy in establishing the starting point, GPS was used in the field before walking straight lines along a constant northing direction, as much as possible based on the topography of the area. This approach allowed for a systematic assessment of the impact of forest resource extraction on mammal species within Ganesh Community Forest.

In each plot, direct observation of the mammal species, their foot prints, scats, burrows were recorded. Tree canopy was measured by using Densiometer from the center of each plot. In addition coordinates of each plot were recorded by using GPS. Furthermore, the distance to nearest water sources (m), nearest roads (m), nearest settlement (m) and nearest agricultural land from the Center of each plot were also recorded by using the measuring tape. If the distance for these variables were > 50 m, the distance was measured by using Google Earth Pro.

3.3 Data analysis

A generalized linear model was used to identify the impact of resource extraction on mammal species occurrence. Prior to analysis correlation test was performed to remove highly

Correlated variables. Among these, the nearest distance to settlement and agriculture land were highly correlated variables ($|r| > 0.7$) with distance to nearest road. All models used model averaging to estimate 95% confidence intervals for each variable and accepted statistical significance at $\alpha < 0.05$. All analyses were performed in R program (R Core Team 2019).

4. RESULTS

4.1 Forest resource utilization by locals

Altogether, a total of 92 households were surveyed for this study. Among the respondents, (79%; n = 73) were male and (21%; n = 19) were female. (60%; n = 55) of respondents were above age 50 and (40%; n = 37) were less than 50 years old. Among the respondents (88%; n = 81) were educated remaining (12%; n = 11) respondents were uneducated. Majority of respondents (83%; n = 76) were rich (having land above one katta) and (17%; n = 16) were poor (land less than one katta). Most of the respondents were farmer (67%; n = 62). Remaining respondents were students (10%; n = 9), housewife (8%; n = 7), business persons (5%; n = 4), government job holders (3%; n = 3) and (7%; n = 7) were unemployed. Among the respondents (80%; n = 15) women were involved in farming along with preparing bio formulations from the bedding materials collected from the CF and animals waste. Around (4%; n = 1) women was merchant and remaining (16%; n = 3) were works as labor. Among 92 household buffalos were reared by (97%; n = 90) household followed by ox/cow (92%; n = 85) household, goats (60%; n = 56) household, pigs were reared by (9%; n = 8) household and hens were reared by (23%; n = 22) household (Figure 2).

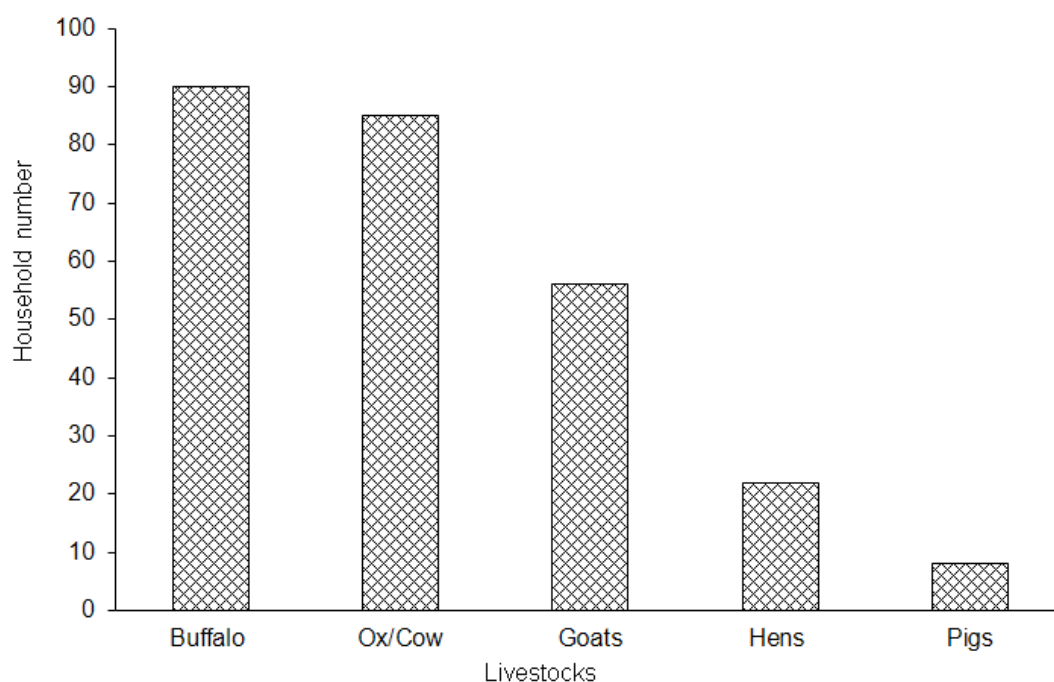


Figure 2. Types of livestock reared by local people.

In the study area it has been found that (67%; n = 62) people were dependent on forest resource for grass (87%; n = 80), leaf litter (87%; n = 80), wood (73%; n = 68), firewood (17.32%; n = 16), fodder (7.8 %; n = 8), and some medicinal herbs (1.42%; n = 2) (Figure 3).

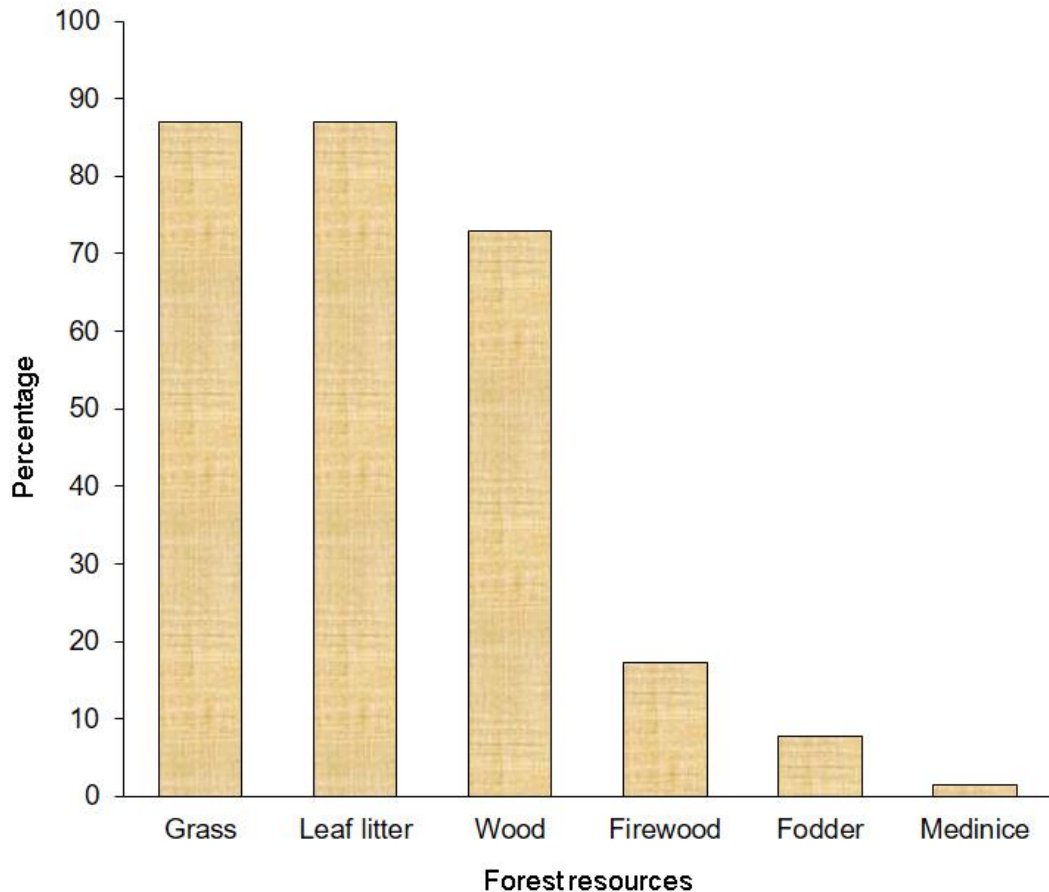


Figure 3. Types of forest resources used by local people.

Specific plants were not separated in grade. But according to the quality of wood its price was fixed. Wood was divided into three grades based on its quality i. e. grade A, B and C. A and B grade wood was used by local people for house construction purpose and includes mature and older plants whereas C grade wood was used for fire wood and other purposes. Sal tree, Yellow teak, Cutch tree (*Acacia catechu*), Indian blackberry, Indian rosewood, Indian lamburnum, Black murdah, Ceylon oak, Honey tree (*Madhuca longifolia*), Jungle cork tree (*Holoptelea integrifolia*), Banyan tree (*Ficus benghalensis*), Indian butter tree (*Diploknema butyracea*) etc. were mostly abundant on GCF. It was found that, user groups of Ganesh community forest charged

Rs. 600 for per cubic foot of A grade wood, Rs. 400 was set for B grade wood and Rs. 300 for C grade wood. The prices set by members of FUG for balla/balli was found to be Rs. 150 for per cubic foot and for fuel wood was Rs. 25 per bhari (1 bhari = 40 kg). The prices set by members of FUG for Fodder (syaula) was found to be Rs. 10 per bhari. Income generated by selling medicinal products from GCF per household was Rs. 20, 000 annully. Major medicines obtained from GCF includes Myrobalan (*Terminalia chebula*), Bedda nut tree (*Terminalia bellerica*), Indian gooseberry, Long pepper, Heart-leaved moonseed (*Tinospora cordifolia*), Indian bael (*Aegle marmelos*), Asparagus (*Asparagus officinalis*), Womens tongue tree (*Albizia lebbeck*), Lipstick tree (*Bixa orellana*), Asthma weed (*Euphorbia hirta*).

Table 1. Utilization of forest products in monetary value.

Types	Quantity Bhari (per Household/ year)	Monetary Value (NRS)	Percentage
Wood (Per/Cu.Ft)	A grade = 500	3,00,000	21.36
	B grade = 400	3,64,000	25.92
	C grade = 300	1,54,500	11
Balli (Per/Cu.Ft)	1,420	2,13,000	15.17
Fuel wood (Bhari)	9,730	2,43,250	17.32
Fooder (Bhari)	10,970	1,09,700	7.81
Medicinal Plant		20,000	1.42
Total		14,04,450	100.00

Of the total utilization of forest resources, nearly 26% was from B grade wood, 22% was from A grade wood, 17% was from fuel wood followed by 15% was from balli and 11% from C grade wood in the study area (Figure 4).

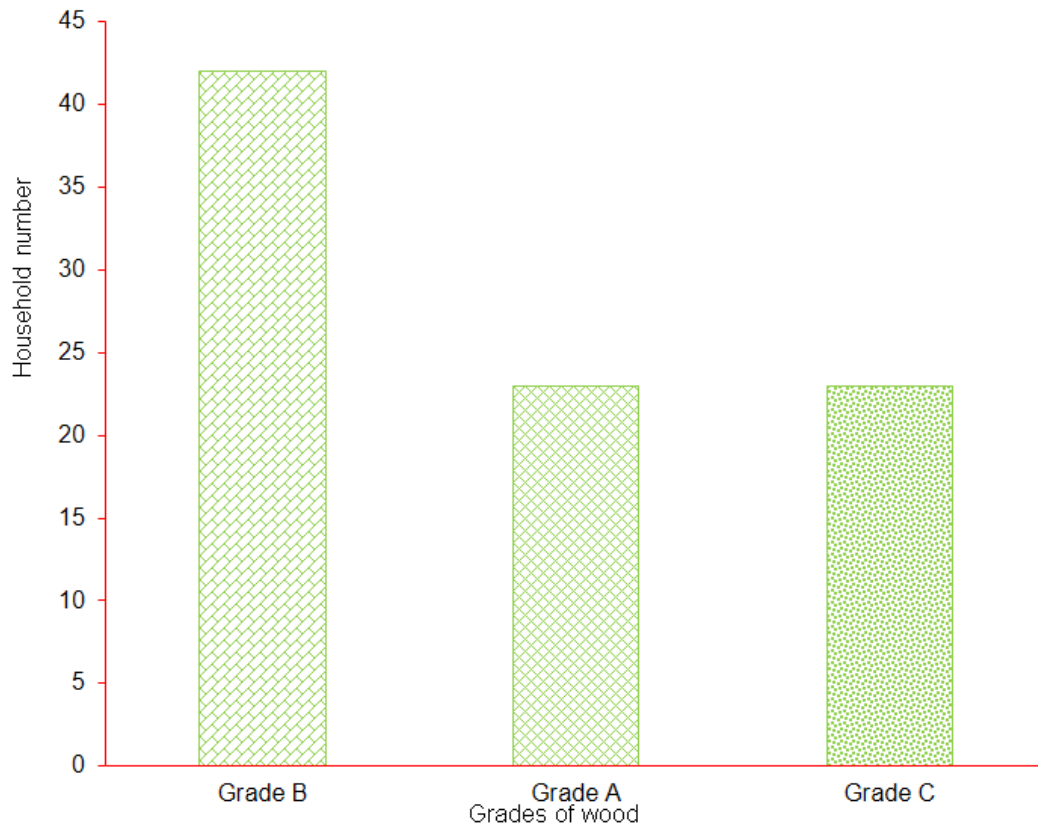


Figure 4. Grades of wood used by local people.

Some products such as grass and leaf litter were distributed free of cost to the users. However, the field survey revealed that the pricing of forest products and its distribution system were not well managed in the study area.

4.2 Impact of resource extraction on mammal species occurrence

The average tree canopy percentage was 61.9% (range: 50% to 70%). The nearest distance to road from the observation plot was 1035.89 ± 937.3464 m (range: 20 to 3292 m), household 924.64 ± 976.66 m (range: 40 to 3349 m), water source 329.29 ± 624.6792 m (range: 18 to 3280 m), elevation 269.0 ± 36.74 m (range: 233 to 383 m) and agricultural land 907.06 ± 920.6376 m (range: 33.55 to 3348 m). It was found that there is no any significance effect of each variables on mammal species occurrence. But it was found that mammal species occurrence was decreased with increasing canopy cover, distance to nearest road, distance to nearest water source, and distance to nearest agricultural land. However, the mammal species occurrence was increased with increasing distance to nearest settlement.

Table 2. Model- averaged variable estimates and 95% confidence limits (CL) describing the impact of resource extraction on mammal species occurrence in Bedkot Municipality, Kanchanpur, Nepal during 2022. Variables include Canopy coverage (%), distance to road, distance to water source, distance to settlement, distance to agricultural land.

Variables	Estimate	Standard Error	Z Value	P
(Intercept)	-0.21829	2.499906	-0.087	0.93
Canopy coverage	-0.02173	0.039542	-0.549	0.583
Distance to road	-0.00071	0.001525	-0.467	0.641
Distance to water source	-0.00025	0.00042	-0.6	0.549
Distance to settlement	0.002435	0.001635	1.489	0.136
Distance to agricultural land	-0.0009	0.000571	-1.581	0.114

The study plots were taken from four types of habitats i.e. unlogged forest, grassland, river bank and logged forest. First line transect consist 38 study plots and four species of mammals i.e. (46.6%; n = 7) Wild Boar, (33.33%; n = 5) Nilgai, (13.33%; n = 2) Rhesus Macaque, and (6.66%; n = 1) Asian Elephant (figure 5).

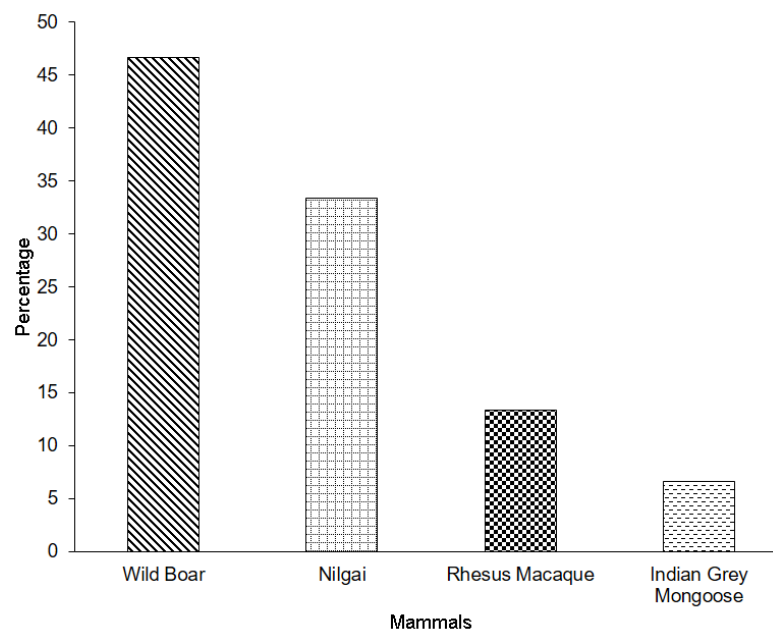


Figure 5. Mammal species of first line transect.

Second line transect consist 31 study plots and five species of mammals i.e. (50%; n = 6) Wild Boar, (8.33%; n = 1) Nilgai, (25%; n = 3) Rhesus Macaque, (8.33%; n = 1) Indian Grey Mongoose, and (8.33%; n = 1) Royal Bengal Tiger (figure 6).

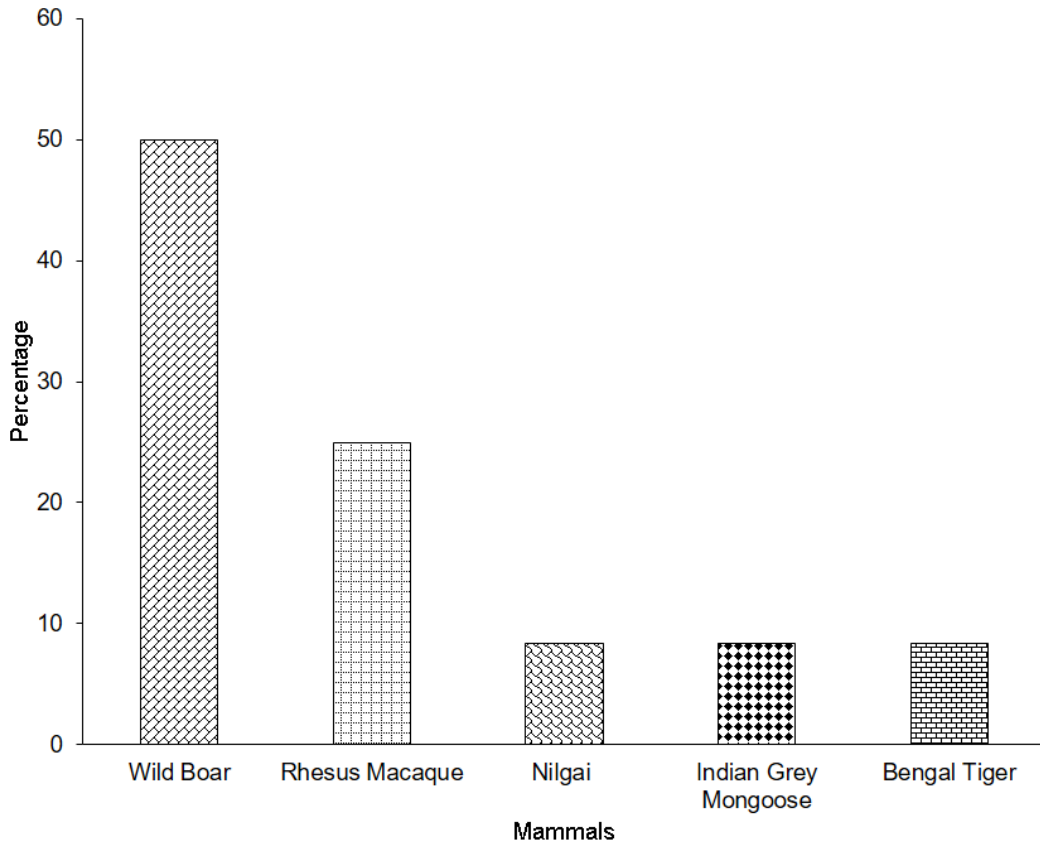


Figure 6. Mammal species of second line transect.

Third line transect consist 16 study plots and three species of mammals i.e. (66.67%; n = 4) Wild Boar, (16.67%; n = 1) Indian Grey Mongoose, (16.67%; n = 1) Barasingha (figure 7).

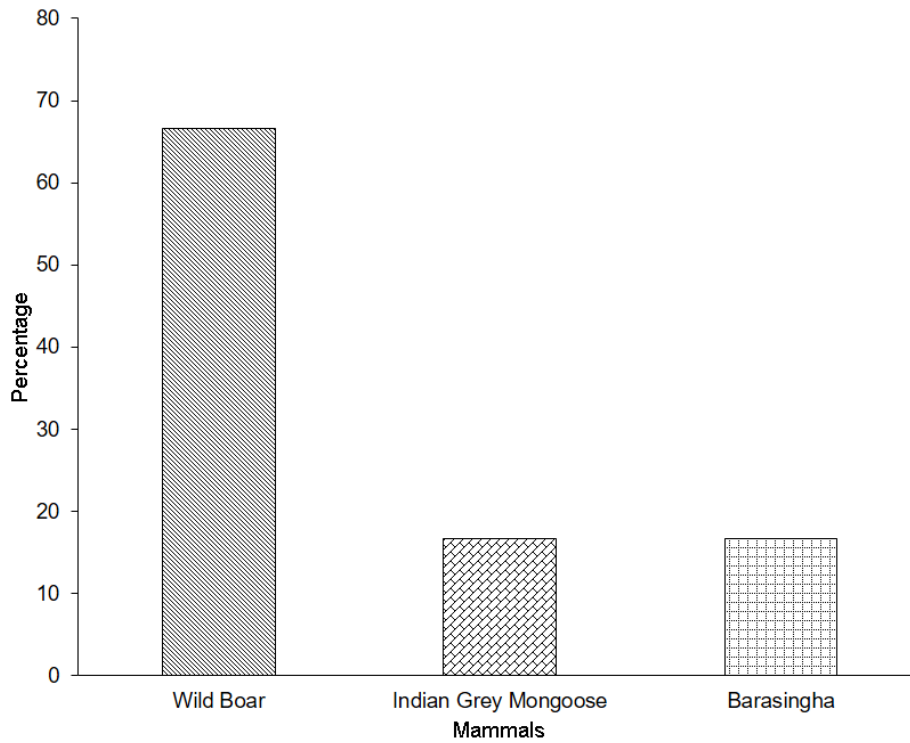


Figure 7. Mammal species of third line transect.

Fourth line transect consist eight study plots and two species of mammals i.e. (50%; n = 1) Wild Boar and (50%; n = 1) Nilgai (figure 8).

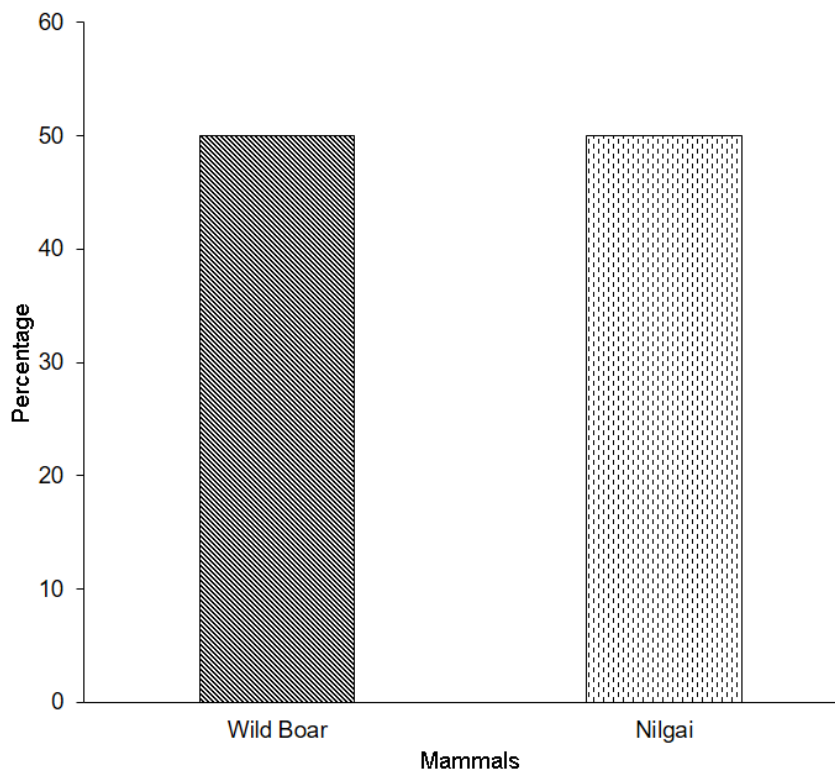


Figure 8. Mammal species of fourth line transect.

Fifth line transect consist only five study plots and two species of mammals i.e. (50%; n = 1) Wild Boar and (50%; n = 1) Nilgai (figure 9).

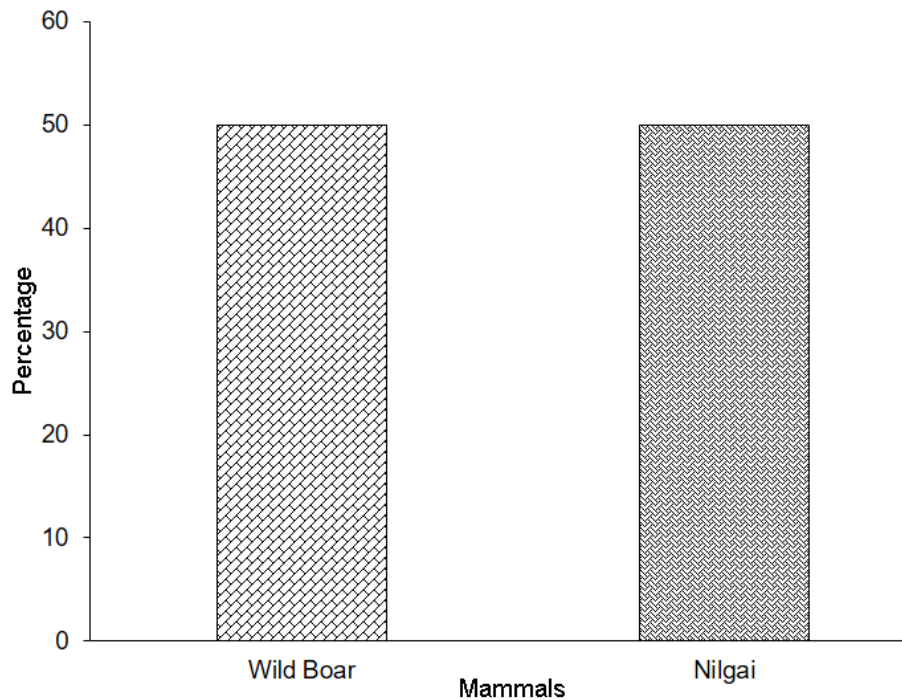


Figure 9. Mammal species of fifth line transect.

The total number of mammal species recorded from these all habitats were seven. Four species of mammals were identified through direct sighting from all transects i.e. (51%; n = 19) Wild Boar, (13.4%; n = 5) Rhesus Macaque, (5.5%; n = 2) Indian Grey Mongoose, (2.7%; n = 1) Barasingha. While (2.7%; n = 1) pugmark of Royal Bengal Tiger, (2.7%; n = 1) footprint of Elephant and (22%; n = 8) faecal matter of Nilgai were identified through their signs and activities (figure 10). Out of these Barasingha is globally listed as Vulnerable (VU), Royal Bengal Tiger is listed as Endangered (EN) in IUCN Red List and Asian Elephant is in Endangered category (EN) and all other were in least concern (LC) category in IUCN Red List.

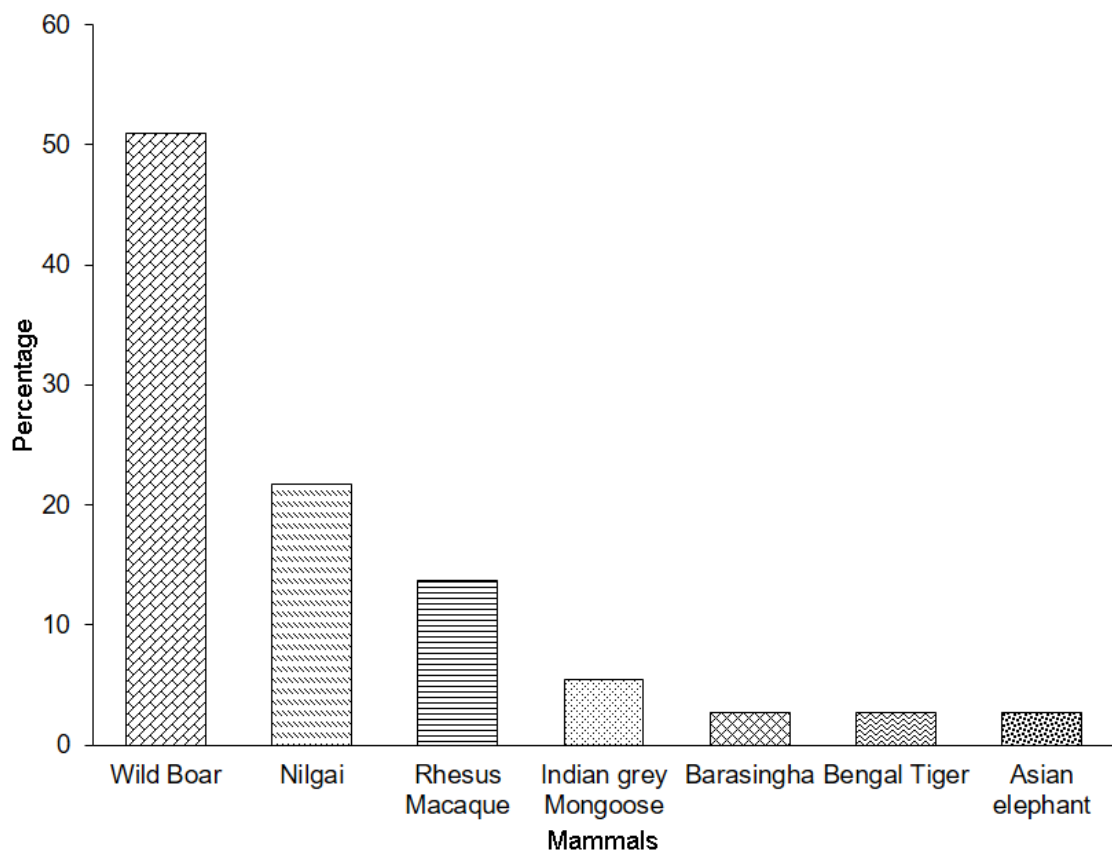


Figure 10. Mammal species found in Ganesh Community Forest.

5. DISCUSSION

This study identified Grass, Leaf litter, wood, firewood, fodder and medicine as major forest resources utilized by local people in Ganesh Community forest. Not only in Ganesh Community Forest these resources such as wood, timber, fuel wood, grass, fodder, leaf litter, medicines are also main forest resources, like other areas of Nepal (Maharjan 1998, Acharya et al. 2005, Dhakal and Masuda 2005, Pandey 2009, Parviainen 2012, Kadel et al. 2016, Paudel 2017). These forest resources are more useful for their livestock and sustainable livelihood for Rural people (Acharya et al. 2005) , therefore, people in this study area also uses these resources. In this study Gender showed a high degree of association with forest protection, men were more likely than women to participate in forest protection activities. In contrast woman were primarily responsible for resource utilization by gathering grass, leaf litter and fuel wood. Not only in this research similar findings were also recorded in earlier study (Chhetri et al. 2013). But it was observed that, males contribute more significantly to fuel wood collection (Amacher et al. 1993). Due to resource utilization facility to the local people almost all households had livestock including buffalo, cow, goat, chicken, pig etc. Probably due to the enough agricultural land and forest resources fodder, grass and bedding materials were found freely from CF local people were highly engaged on farming and animal husbandry. Another study also found that mostly reared livestock are cattle, buffalo and goat (Kadel et al. 2016). It was found that grass and fodder used as feeding materials for cattle whereas leaf litter was used for bedding materials for livestock and to make compost. In addition, because of lower prices of these forest products than those of the market locals use these materials for their domestic needs like construction purpose rather than selling them.

Buffalo was found to be reared in the area mostly for consumption and selling purpose of milk. Most of the respondents use fuel wood for cooking their daily food and to make farming equipment's and tools (Paudel 2017). More fuel wood was found to be used by households specially in winter season who had more family members and livestock units (Cooke 2000). Large amount of firewood was used to cook the food of Livestock known as khole, which is the mixture of water and barley, corn, grain and hay (Bajracharya 1983). It was also found that more firewood was consumed by households to prepare khole for cow and buffaloes. Various works with full effort were made by CF users to make forest resources usable and to enforce laws against

deforestation (Parviainen 2012). It was found that monetary value obtained from timber, firewood and fodder was high in comparison to medicinal products of GCF. Contradict to our research (Paudel 2017) found that out of the total utilization of forest, nearly 57% was from medicinal plant followed by 16% was from fodder and fuel wood comprises only 10%. User group prefer plant species, which produce quality timber, have medicinal or spiritual value (Acharya 2003) same result was also found in this research. Because of high diversity of mature and woody plants, local people were getting benefits from different grades of wood, balla balli, agricultural tools etc. which were used in house construction purpose rather than medicinal products. Grass and Leaf litter are cost free so it was insignificant for monetary purpose.

Very little efforts being made to protect the resources of the forest. Wild Boar, Nilgai, Rhesus Macaque, Indian Grey Mongoose, Barasingha, pugmark of Royal Bengal Tiger, footprint of Asian Elephant and faecal matter of Nilgai were observed mammal species in the study area, out of these Wild Boar (51%) was observed as most abundant mammal followed by Nilgai (22%), Rhesus Macaque (13.7%), Indian Grey Mongoose (5.5%), Barasingha (2.7%), pugmark of Royal Bengal Tiger (2.7%) and footprint of Asian Elephant (2.7%). Wild Boar was also the mostly observed mammal species in the study of (Pokhrel and Shah 2008) thus community forest play an important role to conserve biodiversity around it which results to increase in number of wild animals (K.C. 2017). Agriculture was the main activity of the households, due to it women were mostly involved in preparing compost from bedding materials collected from CF and used this manure in their agricultural field to improve their production rate. Similar to our research (Pandey 2009) also found agriculture as the main occupation and locals were involved in preparing bio-fertilizer and farming. Some part of GCF was found to be extracted, which found to be impact the occurrence of mammal species around it. There was no any significance effect of each variables on faunal species occurrence.

The relatively low status of mammal species in the Ganesh Community Forest might be due to high incidence of resource extraction, deforestation and poaching of some wildlife by local people for meat and traditional medicine. But study reported that deforestation rates were mostly higher in conserved, preserved and protected areas than in community forests, an analysis of human presence showed similar desertification, logging rates in inhabited protected areas and recently inhabited community forests (Bray et al. 2008). Mammal species were largely depleted due to the uncontrolled

resource extraction, utilization and reduction (Ukpong et al. 2012), wildlife habitat, breeding space and their shelter was going to be lost which reduced wildlife richness.

The mammal species occurrence was influenced by canopy cover. Lower number of mammal species was found in high canopy cover. Higher number of mammal in lower canopy cover might be due to ground surface of low canopy trees has denser grassland habitat which provides enough food for them. However, contradictory results were found which explained high canopy cover helps to increase number of animals including mammals, birds and amphibians. Canopies of trees were used by birds and mammal species for resting purposes while they used to forage and most of the time was used by them in foraging (Campos et al. 2017). Again, occurrence of mammal species was greater nearer to the road, water source, and near to the agricultural land. It was probably due to roads acting as corridors for mammals in between two habitats of the study area.

Studies have shown that vegetation zones present on either side of the road help to serve as favorable surroundings and provide microhabitats to the mammals rather than barriers and mortality factors (Bissonette and Rosa 2009). Occurrence of mammals was greater nearer to the water, it might be due to water helping to minimize the energy of mammal species to search for water. Another study has also shown that availability of water is a critical parameter in calculating the carrying capacity which helps to maximize the occurrence of mammals. It might be due to crops grown on agricultural lands, mammals were found nearer to it and crop raiding was also found nearer to the agricultural land. According to the respondents it was found that crop damage was mostly done by Rhesus Macaque (45%) followed by Wild Boar (25%), Nilgai (15%), and Asian Elephant (15%) at day and night time in agricultural land. Another study revealed that Wild Boar caused the highest crop damage followed by Elephant, Porcupine and others (Pokhrel and Shah 2008). However, the mammal species occurrence was increased with increasing distance to nearest settlement, it might be due to the disturbance occurring from human settlement. The condition of GCF is not much degraded. It is possible because of higher percentage of locals are educated, aware of the importance of forest resources, coordination with District Forest Office, GCF staffs, forest user groups and local people of study area. From establishment date to till now the condition of GCF is always in an improving state. Smooth improvement of GCF results in the increase in number of wild faunal species. To improve socio-economic and environmental

condition, wise and effective use of forest resources is required. The income of CF is directly or indirectly related with forest products like wood, timber, medicines, etc. so emphasis should be given on planting such plants.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

In conclusion, the community's dependence on forest resources is still strong despite facing various challenges. The mixed society's active participation and enrolled programs are crucial for conserving the community forest. The most commonly utilized resources include grass, leaf litter, wood, fuel wood, and fodder. The utilization of medicinal plants is limited due to inadequate knowledge and technology. Forest resource extraction has a minor impact on the occurrence of mammal species. The study finds that the occurrence of faunal species is decreased with increasing canopy cover, distance to nearest road, distance to nearest water source, and distance to nearest agricultural land. Overall, the study highlights the need for effective management strategies to promote sustainable resource use and protect biodiversity in community forest ecosystems.

6.2 Recommendations

Based on the study findings, some recommendations can be made to improve the conservation of the Ganesh Community Forest.

First, future studies should aim to collect baseline information on other animal species occurrence to provide a comprehensive understanding of the forest's biodiversity.

Secondly, the impact of resource extraction on mammal species should be monitored more closely to ensure the sustainable utilization of forest resources.

Thirdly, awareness programs on the importance of biodiversity should be conducted regularly to promote the active participation of local communities in forest conservation.

Additionally, it is important to address significant anthropogenic impacts, such as overgrazing, forest fires, and deforestation, which can have a negative effect on wildlife and their habitat.

Therefore, steps should be taken to manage these activities and minimize their impact on the community forest. Overall, these recommendations can help to promote sustainable resource use and biodiversity conservation in the Ganesh Community Forest.

REFERENCES

- Acharya, K. P., Goutam, K. R., Acharya, B. K. and Gautam, G. 2005. Participatory assessment of biodiversity conservation in community forestry in Nepal. *Banko Janakari* **16**(1): 46-56.
- Adhikari, B. 2005. Poverty, property rights and collective action: understanding the distributive aspects of common property resource management. *Environment and Development Economics* **10**(1): 7-31. <https://doi.org/10.1017/s1355770x04001755>.
- Adhikari, M. k. 2016. Revised checklist to the mycotaxa proposed from Nepal. Department of Plant Resources. Thapathali, Kathmandu, Nepal. *Bulletin of Department of Plant Resources* **38**: 1-11.
- Agrawal, A. and Ostrum, E. 2001. Collective action, Property rights and Decentralization in Resource use in India and Nepal. *Politics and Society* **29**(4): 485-514.
- Amacher, G. S., Hyde, W. F. and Joshee, B. R. 1993. Joint production and consumption in traditional households: Fuelwood and crop residues in two districts in Nepal. *Journal of Development Studies* **30**(1): 206-225. <https://doi.org/10.1080/00220389308422311>.
- Bajracharya, D. 1983. Fuel, Food or Forest? Dilemmas in a Nepali Village. *World Development* **11**(12): 1057-1074.
- Baniya, C. B. and Bhatta, P. 2021. Exploration of Lichen in Nepal. *Journal of Plant Resources* **19**(1): 18-54.
- Baral, B. S. 2014. Who Benefits? Decentralized Forest Governance through Community Forestry in Nepal. Ph.D. Dissertation. Program in Politics and International Relations, School of Social Science, University of Tasmania, Australia.
- Baral, S., Meilby, H., Khanal Chettri, B. B., Basnyat, B., Rayamajhi, S. and Awale, S. 2018. Politics of getting the numbers right: Community forest inventory of Nepal. *Forest Policy and Economics* **91**: 19-26. <https://doi.org/10.1016/j.forpol.2017.10.007>.

- Bissonette, J. A. and Rosa, S. A. 2009. Road zone effects in small-mammal communities. *Ecology and Society* **14**(1): 27.
- Bray, D. B., Duran, E., Ramos, V. H., Mas, J.-F., Velazquez, A., McNab, R. B., et al. 2008. Tropical deforestation, community forests, and protected areas in the Maya Forest. *Ecology and Society* **13**(2): 56.
- Brodie, J. F., Giordano, A. J., Zipkin, E. F., Bernard, H., Mohd-Azlan, J. and Ambu, L. 2015. Correlation and persistence of hunting and logging impacts on tropical rainforest mammals. *Conservation Biology* **29**(1): 110-121. <https://doi.org/10.1111/cobi.12389>.
- Campos, V. E., Fernández Maldonado, V., Balmaceda, P. and Giannoni, S. 2017. Richness of plants, birds and mammals under the canopy of *Ramorinoa girolae*, an endemic and vulnerable desert tree species. *Bosque* **38**(2): 307-316. <https://doi.org/10.4067/s0717-92002017000200008>.
- Caro, T. M. 2003. Umbrella species: critique and lessons from East Africa. *Animal Conservation* **6**(2): 171-181. <https://doi.org/10.1017/s1367943003003214>.
- Chhetri, B. B. K., Johnsen, F. H., Konoshima, M. and Yoshimoto, A. 2013. Community forestry in the hills of Nepal: Determinants of user participation in forest management. *Forest Policy and Economics* **30**: 6-13. <https://doi.org/10.1016/j.forpol.2013.01.010>.
- Chhetri, B. B. K., Larsen, H. O. and Smith-Hall, C. 2012b. Law Enforcement in Community Forestry: Consequences for the Poor. *Small-scale Forestry* **11**(4): 435-452. <https://doi.org/10.1007/s11842-011-9194-7>.
- Chhetri, B. B. K., Lund, J. F. and Nielsen, Ø. J. 2012a. The public finance potential of community forestry in Nepal. *Ecological Economics* **73**: 113-121. <https://doi.org/10.1016/j.ecolecon.2011.09.023>.
- Compendio, S. J. M. and Bande, M. M. 2017. Effectiveness of Community-based Forest Management Program as a Strategy on Forest Restoration in Cienda and San-Vicente, Baybay City, Leyte, Philippines. *Asian Journal of Agricultural Extension, Economics and Sociology* **15**(4): 1-20. <https://doi.org/10.9734/AJAEES/2017/16095>.

- Cooke, P. A. 2000. Changes in Intrahousehold Labor Allocation to Environmental Goods Collection: A Case Study from Rural Nepal, 1982 and 1997. *Agricultural and Applied Economics*.
- Dev, O. P., Springate-Baginski, O., Yadav, N. P. and Soussan, J. 2003. Hamlet-Based Microlevel Action Planning: A Tool for Improving FUGS' Planning, Decision-Making, and Implementation. *Journal of Forest and Livelihood* **3**(1): 51-63.
- DFRS 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal: 1-50.
- Dhakal, M. and Masuda, M. 2005. Generation and utilization of community fund in small-scale community forest management in the Terai region of Nepal. *Banko Janakari* **17**(2): 55-61.
- Dhakal, P., Dev R. Paudel, D. R. and Baral, D. R. 2016. Inventory of Non-timber forest products in western Nepal and strategies for sustainable management. *International Journal of Environment* **5**(3): 87-103.
- Gautam, A. P. and Shivakoti, G. P. 2005. Conditions for Successful Local Collective Action in Forestry: Some evidence from the Hills of Nepal. *Society and Natural Resources* **18**(2):153-171. <https://doi.org/10.1080/08941920590894534>.
- GCFUG. 2022. Ganesh Community Forest Operational Plan, Bedkot Municipality, Musepani, Kanchanpur, Nepal.
- Gilmour, D. 2003. Retrospective and Prospective View of Community Forestry in Nepal. *Journal of Forest and Livelihood* **2**(2): 5-7.
- Harbi, J., Erbaugh, J. T., Sidiq, M., Haasler, B. and Nurrochmat, D. R. 2018. Making a bridge between livelihoods and forest conservation: Lessons from non-timber forest products' utilization in South Sumatera, Indonesia. *Forest Policy and Economics* **94**: 1-10. <https://doi.org/10.1016/j.forpol.2018.05.011>.
- Jnawali, S.R., Baral, H.S., Lee, S., Acharya, K.P., Upadhyay, G.P., Pandey, M., Shrestha, R., Joshi, D., Laminchhane, B.R., Griffiths, J., Khatiwada, A. P., Subedi, N., and Amin, R. 2011. The Status of Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation Kathmandu, Nepal.

- Jorge, M.-G. and Diez, J. J. 2012. Sustainable Forest Management: An Introduction and Overview 2nd ed. University of Valladolid, Palencia, Spain, 463 p.
- Kadel, P., Chapagain, P. S., Sharma, L. N. and Vetaas, O. R. 2016. Consumption Patterns of Fuel wood in Rural Households of Dolakha District, Nepal: Reflections from Community Forest User Groups. *Small-scale Forestry* **15**(4): 481-495. <https://doi.org/10.1007/s11842-016-9335-0>.
- Kanel, K. R. and Dahal, G. R. 2008. Community forestry policy and its economic implications: An experience from Nepal. *International Journal of Social Forestry* **1**(1): 50-60.
- Kanel, K. R. and niraula, D. R. 2004. Can rural livelihood be improved in Nepal through community Forestry? *Banko Janakari* **14**(1): 19-26.
- K.C., A. 2017. Community Forestry Management and its Role in Biodiversity Conservation in Nepal. Global Exposition of Wildlife Management, Environment and Social Studies Department, Kharipati, Bhaktapur, Kathmandu, Nepal. <https://doi.org/10.5772/65926>.
- Kellert, S. R., Mehta, J. N., Ebbin, S. A. and Lichtenfeld, L. L. 2000. Community Natural Resource Management: Promise, Rhetoric, and Reality. *Society and Natural Resources* **13**(8): 705-715. <https://doi.org/10.1080/089419200750035575>.
- Lachapelle, P. R., Smith, P. D. and McCool, S. F. 2004. Access to Power or Genuine Empowerment? An Analysis of Three Community Forest Groups in Nepal. *Human Ecology* **11**(1): 1-12.
- Maharjan, M. R. 1998. The flow and distribution of costs and benefits in the Chuliban community forest, Dhankuta district, Nepal: 1-13.
- MoFSC 2009. Nepal Forestry outlook study. Ministry of Forests and Soil Conservation Singha Durbar, Kathmandu, Nepal: 1-83.
- MoFSC 2014. Nepal National Biodiversity Strategy and Action plan 2014-2020. Government of Nepal Ministry of Forests and Soil Conservation Singhadurbar, Kathmandu, Nepal: 1-226.

- Nagendra, H. and Gokhale, Y. 2008. Management regimes, property rights, and forest biodiversity in Nepal and India. *Environmental Management* **41**: 719-733. <https://doi.org/10.1007/s00267-008-9073-y>.
- Ng, W. P., van Manen, F. T., Sharp, S. P., Wong, S. T. and Ratnayeke, S. 2021. Mammal species composition and habitat associations in a commercial forest and mixed-plantation landscape. *Forest Ecology and Management* **491**: 119163. <https://doi.org/10.1016/j.foreco.2021.119163>.
- Norris, D., Peres, C. A., Michalski, F. and Hinchsliffe, K. 2008. Terrestrial mammal responses to edges in Amazonian forest patches: a study based on track stations. *mammalia* **72**(1): 15-30. <https://doi.org/10.1515/mamm.2008.002>.
- Ojha, H. R., Cameron, J. and Kumar, C. 2009. Deliberation or symbolic violence? The governance of community forestry in Nepal. *Forest Policy and Economics* **11**(2009): 365-374. <https://doi.org/10.1016/j.forpol.2008.11.003>.
- Pandey, R. 2009. Forest Resource Utilization by Tribal Community of Jaunsar. *The Indian Forester* **135**: 655-662.
- Pandey, N. and Ghimire, S. K. 2020. Floristic Diversity in a Community Managed Forest of Kanchanpur District, Western Nepal. *Journal of Plant Resources* **18**(1): 124-134.
- Parviainen, T. 2012. Role of Community Forestry in Rural Livelihood and Poverty Alleviation in Ohangwena and Caprivi Regions in Namibia. Academic Dissertation, University of Helsinki, Unioninkatu: 1-170.
- Paudel, D. P. 2017. Forest resource management and livelihood of local people in Panchase area of Western hilly region, Nepal. *Journal of Geography* **17**: 37-50.
- Pokharel, B. k. and Nurse, M. 2004. Forests and People's Livelihood: Benefiting the Poor from Community Forestry. *Journal of Forest and Livelihood* **4**(1): 19-29.
- Pokharel, R. K., Rayamajhi, S. and Tiwari, K. R. 2012. Nepal's Community Forestry: Need of Better Governance. *Global Perspectives on Sustainable Forest Management*, Dr. Clement A. Okia (Ed.). Institute of Forestry Tribhuvan University, Pokhara, Nepal, p. 44-58.

- Pokhrel, G. K. and Shah, K. B. 2008. Role of Community Forests in Faunal Diversity Conservation: A Case Study of Community Forests within Satbariya Range Post of Dang District. *Nepal Journal of Science and Technology* **9**(2008): 111-117.
- Poudel, K. L. 2007. Trade Potentility and Ecological Analysis of NTFPs in Himalayan Kingdom of Nepal. Department of Agricultural Economics and Business Management: 1-36.
- R Core Team. 2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.
- Rasaily, R. G. and Zuo, T. 2012. Effect of managing methods of the community forests on the expression of forest products extracted from them in Lalitpur and Dhading districts from Nepal. *African Journal of Agricultural Research* **7**(31): 4465-4473. <https://doi.org/10.5897/ajar12.1233>.
- Rasmussen, L. V., Watkins, C. and Agrawal, A. 2017. Forest contributions to livelihoods in changing agriculture-forest landscapes. *Forest Policy and Economics* **84**: 1-8. <https://doi.org/10.1016/j.forpol.2017.04.010>.
- Roy, R. and Pokharel, R. K. 2000. Impact of community forest on rural livelihood. *Banko Janakari* **10**(2): 53-56.
- Sher, H., Al-Yemini, M. and Sher, H. 2010. Forest resource utilization assessment for economic development of rural community in northern parts of Pakistan. *Journal of Medicinal Plants Research* **4**(17): 1786-1798. <https://doi.org/10.5897/JMPR10.206>.
- Shrestha, T. B., Pokhrel, S. K., and Khanialal, B. 2001. Nepal Country Report on Red Listing. In *Using the IUCN Red List Criteria at the National Level: A Regional Consultative Workshop for South and Southeast Asia*. IUCN Regional Biodiversity Programme, Asia, Colombo, Sri Lanka.
- Shrestha, B. 2009. Community forest management practices in far-western lowlands of Nepal. *Banko Janakari* **18**(2): 25-34. <https://doi.org/10.3126/banko.v18i2.2170>.

- Shrestha, K. K., Bhattarai, S. and Bhandari, P. 2018. Handbook of flowering plants of Nepal. Gymnosperms and Angiosperms, Jodhpur, India. Scientific publishers **1**: 1-576.
- Shrestha, U. B., Shrestha, B. B. and Shrestha, S. 2010. Biodiversity conservation in community forests of Nepal: Rhetoric and reality. *International Journal of Biodiversity and Conservation* **2**(5): 98-104.
- Smith, P. D., Khanal Chhetri, B. B. and Regmi, B. 2003. Meeting the Needs of Nepal's Poor: Creating Local Criteria and Indicators of Community Forestry. *Journal of Forestry* **101**(5): 24-30.
- Sodhi, N. S., Posa, M. R. C., Lee, T. M., Bickford, D., Koh, L. P. and Brook, B. W. 2010. The state and conservation of Southeast Asian biodiversity. *Biodiversity and Conservation* **19**(2): 317-328. <https://doi.org/10.1007/s10531-009-9607-5>.
- Struebig, M. J., Wilting, A., Gaveau, D. L. A., Meijaard, E., Smith, R. J., Borneo Mammal Distribution, C., et al. 2015. Targeted conservation to safeguard a biodiversity hotspot from climate and land-cover change. *Current Biology* **25**(3): 372-378. <https://doi.org/10.1016/j.cub.2014.11.067>.
- Tachibana, T. and Adhikari, S. 2009. Does Community-Based Management Improve Natural Resource Condition? Evidence from the Forests in Nepal. *Land economics* **81**(5): 107-131.
- Terborgh, J., Lopez, L., Nunez, P., Rao, M., Shahabuddin, G., Orihuela, G., et al. 2001. Ecological meltdown in predator-free forest fragments. *science* **294**(5548): 1923-1926. <https://doi.org/10.1126/science.1064397>.
- Thammanu, S., Han, H., Marod, D., Zang, L., Jung, Y., Soe, K. T., et al. 2020. Non-timber forest product utilization under community forest management in northern Thailand. *Forest Science and Technology* **17**(1): 1-15. <https://doi.org/10.1080/21580103.2020.1862712>.
- Thoms, C. A. 2008. Community control of resources and the challenge of improving local livelihoods: A critical examination of community forestry in Nepal. *Geoforum* **39**(3): 1452-1465. <https://doi.org/10.1016/j.geoforum.2008.01.006>.

- Ukpong, E. E., Jacob, D. E., Ufot, I. N. and Joseph, A. E. 2012. The Fauna Biodiversity of Ikot Ondo Community Forest in Essien Udim L. G. A. of Akwa Ibom State, South Eastern Nigeria. *Ethiopian Journal of Environmental Studies and Management* **5**(3): 276-280. <https://doi.org/10.4314/ejesm.v5i3.9>.
- Wall, J. L., Loken, B. and Brodie, J. F. 2021. Reconciling resource extraction and species conservation in a multi-use landscape: Immediate and long-term impacts of logging on rainforest mammal diversity. *Global Ecology and Conservation* **28**: 1-7. <https://doi.org/10.1016/j.gecco.2021.e01642>.
- Wilcove, D. S., Giam, X., Edwards, D. P., Fisher, B. and Koh, L. P. 2013. Navjot's nightmare revisited: logging, agriculture, and biodiversity in Southeast Asia. *Trends Ecology and Evolution* **28**(9): 531-540. <https://doi.org/10.1016/j.tree.2013.04.005>.
- Wulandari, C. and Kurniasih, H. 2019. Community preferences for social forestry facilitation programming in Lampung, Indonesia. *Forest and Society* **3**(1): 114. <https://doi.org/10.24259/fs.v3i1.6026>.
- Yadav, N. P., Dev, O. P., Springate-Baginski, O. and Soussan, J. 2003. Forest Management and Utilization under Community Forestry. *Journal of Forest and Livelihood* **3**(1): 37-50.
- Yager, G., Alarape, A. and Onuwa, O. 2018. Preliminary Assessment of Fauna Species Diversity in Ipinu Igede Community Range Forest in Oju Local Government of Benue State, Nigeria. *Asian Journal of Biology* **5**(4): 1-11. <https://doi.org/10.9734/ajob/2018/41060>.
- Yager, G. O., Abete, M. and Chenge, I. 2019. Evaluation of range flora and fauna composition of a Community Forest in North-Central Nigeria. *Sustainability, Agricultural, Food and Environmental Research* **7**(1): 21-36. <https://doi.org/10.7770/safer-V0N0-art1636>.
- Young, H. S., McCauley, D. J., Helgen, K. M., Goheen, J. R., Otarola-Castillo, E., Palmer, T. M., et al. 2013. Effects of mammalian herbivore declines on plant communities: observations and experiments in an African savanna. *J Ecol* **101**(4): 1030-1041. <https://doi.org/10.1111/1365-2745.12096>.

APPENDICES

Appendix 1: Questionnaires about Resource utilization.

Are you willing to give answer to the following questions? Yes/No, If Yes proceed to Question number 1-19.

1. Name of the Respondent: _____
2. Gender: i) male ii) Female iii) Other
3. Age _____ 4. Contact number _____
5. Family size: _____ (Male = _____, Female = _____) Total: _____
6. Address _____
7. Highest Educational qualification (Use Education code): _____ (0-Illiterate, 1-Literate)
8. Livelihood option: Job- gov service/teacher, Business- shop/hotel, Farming, Social worker,
Agriculture dependent/ forest resources dependent
9. Land: _____ (Kattha regd. land, Kattha Non regd. land)
10. Number of livestock reared: _____
11. Fuel source : _____
12. Livelihood option: Job- gov service/teacher, Business- shop/hotel, Farming, Social worker,
Forest resources dependent and if any others please specify:

13. How much Wood (cub. Ft.) You collect from CF? _____
14. How much wood you take from CF and what is cost of wood for (A grade/ cub.ft., B grade /cub.ft.,C grade /cub. Ft.) ?
15. How much balli you take from CF and what is cost of balla balli per cub.ft?

16. How much bhari of daura you take from CF and what is cost for per bhari?
17. What kinds and how much fodder you collect from CF for livestock annually:

18. How much bhari of grass you take from CF annually:
_____ (50, 100, 200, more)
19. Will you pay money for bhari of grass or not? _____

Appendix 2: Photo plates

PHOTOGRAPHS

Photographs 1: List of field observed mammal species and their signs



Rhesus Macaque inside GCF



Questionnaire with GCF guard



Scratch of the Wild Boar



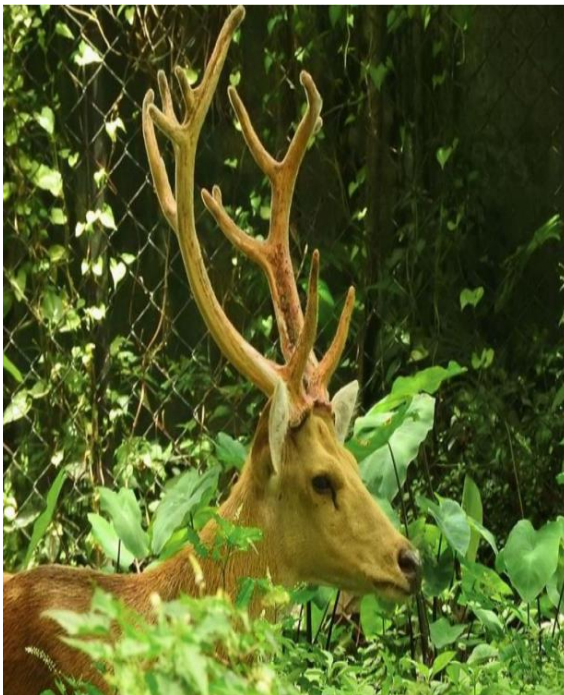
Wild Boar inside GCF



Footprint of Mongoose



Footprint of Asian Elephant



Barasingha inside GCF



Pugmark of Royal Bengal Tiger



Fresh Fecal Pellets of Nilgai

Photographs 2: Questionnaire survey with GCF users

