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THE CORRELATION BETWEEN BUSHMEAT HARVESTING AND WILDLIFE ABUNDANCE IN THE TOFALA-MONE FOREST CORRIDOR, CAMEROON

Neba Bede CHE[1], Mbunya Francis NKEMNYI[2*], Efuetlancha Taleih ATEM[3], Richard GILIBA[4]

[1]University of Yaounde I, BP 337 Yaoundé, Central Region Cameroon
[2]Institute of Development Policy and Management (IOB), University of Antwerp, Lange St. Annastraat 7, 200 Antwerp Belgium
[3]Department of Forestry, University of Dschang, P.O. 96 Dschang, West Cameroon,
[4]Forestry Training Institute, Olmotonyi, P.O Box 943 Arusha Tanzania

Abstract

The use of sophisticated tools and unconventional methods in wildlife exploitation is a threat to wildlife conservation. This study analysed the influence of bushmeat harvesting on wildlife abundance in the Tofala-Mone Forest Corridor (TMFC), Cameroon. Data were collected across 8 villages using semi-structured questionnaires, in-depth interviews and transect survey. Descriptive and inferential statistical analyses were used for quantitative data while content analyses were used for qualitative data. The key finding revealed that the main reason for bushmeat harvesting was for income generation. Agriculture, large family sizes and motivation were some of the factors influencing harvesting. An average of 16.0 ± 2.0 animals was harvested weekly per harvester, giving an annual average of 272.8901tons per harvester. Annual bushmeat harvested stood at 2,665,156 Francs CFA (5,330 US Dollar) per harvester. Most harvesters (97.3 %) reported a decrease in wildlife abundance. Hunting time per catch was reported to be about 3.48 hours compared to lesser time in the past. A negative correlation was obtained between harvested wildlife species and scarce wildlife species. This suggested that bushmeat exploitation was a major threat to wildlife abundance in the study areas.

Keywords: *Bushmeat harvesting; Wildlife abundance; Biodiversity conservation; Wildlife management; Household income; Cameroon.*

Introduction

Forest income is the primary contributor to total environmental income, which account for 20% of global total household income [1]. Wildlife exploitation, especially through hunting has evolved into a large-scale commercial activity across the tropics and this is increasingly leading to biodiversity loss [2–5]. Despite the increase in conservation efforts in the tropics, the rate of biodiversity loss does not appear to be slowing down [2]. Local communities living adjacent forest areas continue to exploit forest resources for livelihood [6, 7]. Proximity to forest resources and limited alternative options have been argued to contribute to complete reliance of local people on forest resources for livelihood [8, 9].

* Corresponding author: nmbunyaf@gmail.com

In East, West and Central Africa, wildlife exploitation constitutes one of the greatest threat to biodiversity loss [2, 10, 11]. Wildlife is hunted for bushmeat. "Bushmeat is an African term that includes all wildlife species used for food, from cane rats to elephants"[2]. The bushmeat market in West and Central Africa contributes substantially to local people household income [10, 12]. This contribution is also motivating, and despite the forestry and environmental policies put in place by the local governments to regulate illegal wildlife hunting, biodiversity loss is still on the rise [13]. In Cameroon, the creation and management of protected areas, the 1994 Wildlife Law, and the 1996 Environmental Law are some of the local government efforts to fight biodiversity loss [14–17]. However, given that local people are highly dependent on forest resources to meet both development and livelihood needs, and that no viable alternatives to forest resources exist for most local people, they are bound to continue forest exploitation, even when prohibited by the law [6, 18].

The Tofala-Mone forest corridor (Lebialem Highlands) is considered to be among important biodiversity hotspots of global significance with high levels of species richness and endemism exhibited across a wide range of taxa [19]. Despite the rich biodiversity of this landscape, sustainable forest management practices are rare and this has posed a serious threat to biodiversity, most especially to great apes species (gorillas and chimpanzees) in this landscape [10, 20, 21]. Income needs of household is argued to be one of the major threats to wildlife conservation in the Lebialem highland [6, 18]. It is in line with this that this study sets out to evaluate the relationship between wildlife exploitation and biodiversity status in the Lebialem Highlands. Specifically the study identifies the various techniques employed in wildlife (bushmeat) exploitation, the factors influencing bushmeat exploitation, evaluates how bushmeat wildlife exploitation is affecting biodiversity conservation and finally discusses prospective solutions based on indigenous knowledge in order to improve wildlife conservation in the Lebialem Highlands and beyond.

Methods and data collection techniques

Study site

The study was conducted in the Tofala-Mone Forest Corridor (TMFC), located in the Lebialem Highlands, Southwest Region of Cameroon. The area is characterised by an undulated landscape from Bechati community (260 metre above sea level) in the lower altitudes to Fossimondi community (2400 meters above sea level) in the higher altitudes, with a chain of peaks notably the Tofala Hill (866 meters above sea level) [6]. The TMFC has a surface area of 65000 hectares (Fig. 1). It stretches from Lebialem Division in the east to Manyu (Upper Banyang) Division in the west. It lies between latitude 628000-644000 and longitude 560000-578000, UTM grid system [22]. The TMFC lies within the equatorial rainforest zone characterized by two major seasons: the dry season which runs from November-February and the wet season which runs from March-October [23]. The TMFC is very rich in wildlife species. It is home to 26 identified large mammals, including the critically endangered Cross River gorilla (*Gorilla gorilla diehli*) and the endangered Nigeria-Cameroon Chimpanzee (*Pan troglodytes ellioti*) [19]. There are about 28 villages within and around the TMFC. The livelihood of the local people revolves around hunting, farming, fishing, and small businesses and to a lesser extent other professional careers (mainly in the teaching sector) [6]. The main local cash crops are cocoa, oil palms and coffee. Agriculture is mainly for subsistence and the main method of farming is slash and burn [24].

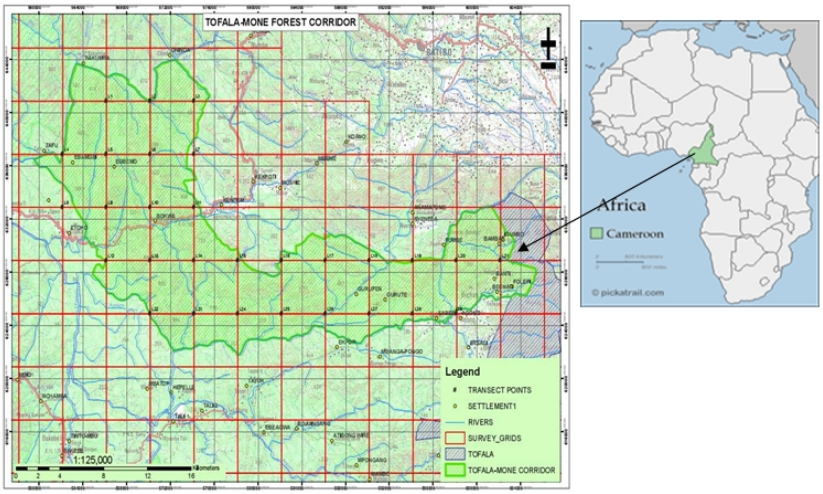

Fig. 1. Map of the study area (TMFC), zooming from Africa (Source: ERuDeF 2012)

Data collection techniques

Data collection techniques included questionnaires, in-depth interviews and transect survey. Questionnaires and interviews were designed to enable the evaluation of actors involved in wildlife exploitation/trade and their distribution. Specifically, questionnaires elicited information on wildlife harvesting, in relation to the periods, methods and tools. In-depth interviews elicited information on factors influencing bushmeat exploitation and how exploitation affects wildlife abundance. Transect survey enabled the evaluation of impact of bushmeat exploitation on wildlife population based on field observation.

Questionnaires were administered to eight villages in the TMFC. Sampled villages were selected purposely, based on their proximity to the TMFC and their spatial distribution across the studied area. This selection criteria was motivated by the argument that proximity to forest resources is associated with higher reliance [8]. Given that the study was interested in exploring bushmeat exploitation techniques and factors influencing them, the focus was on those persons who practice bushmeat harvesting. Bushmeat harvesters were classified as hunters (practice hunting only), trappers (practice trapping only) and hunter/trappers (practice both hunting and trapping). Three (Bokwa, Egbemoh and Ebangabi) out of the eight villages were located inside the forest corridor and five (Kendem, Etoko, Tafu, Bakumba and Chinda) were located adjacent the forest corridor. These villages are subsequently referred to as interior (villages located inside the forest corridor) and peripheral villages (villages located adjacent the forest corridor) respectively. Purposive sampling was the method used in questionnaire survey [25]. The targeted population was mainly hunters, trappers and hunters/trappers. Interviewees were identified with the help of a local field guide and the village quarter heads in most cases. A total of 73 valid questionnaires were administered: 23 hunters, 27 trappers and 23 hunter/trappers. In addition to questionnaires, interviews were also conducted with seven bushmeat traders, one bio-monitoring staff (working for a local non-profit organization promoting conservation in the study area) and one member of the village forest management committee (VFMC).

The use of transect survey enabled the assessment of the field situation and also contributed to the validation of data gathered during questionnaire survey. Transect survey also enabled the assessment of anthropogenic activities in the forest linked and how it reflected wildlife harvesting. Seven 2×2 square kilometers predetermined quadrants were used for transects data collection. Anthropogenic data collected through transect survey included the number of gun shots heard, number of gun shells and numbers/nature of snare (traps) and other sign indicating human disturbance in the field. Biological data collected during the transect

survey included sleeping nests for large mammals, feeding signs, tracks (trails), dung pile, vocalisation and direct observation. Anthropogenic and biological data were used to estimate relative abundance of human activity and wildlife respectively and most importantly to inform the relationship between human activities and wildlife conservation. Each 2×2 square kilometer transect was walked using guided recce walk in a pre-determined compass bearing. Transect bearings were chosen to cut diagonally across transects. Transects were sampled following paths of less resistance, hunting tracks, large mammals trails, village paths and river courses. However, the recce walks were guided not to deviate significantly from the pre-determined bearing. All data collected were recorded on a data sheet.

Data analysis

SPSS version 20 was used for analysis. Case summaries statistics were used to determine measurements of central tendencies and dispersions, notably the mean, standard deviation, standard error of mean, the median and the percentile values for continuous variables such as 'time taken to trek to the forest' 'income' or 'quantity of bushmeat consumed per year'. Continuous variables were then screened for normality and homogeneity of variance using Kolmogorov-Smirnov and Shapiro-Wilk tests. Non-parametric tests were used to compare groups for the significant difference. The Kruskal Wallis test was used to compare the significant difference between three or more independent groups. The Wilcoxon Signed Rank test was used to compare two related samples for significant difference while the Mann-Whitney U test was used to compare two independent samples for significant difference.

Correlation between indicators was carried out using Spearman's row. For taste ranks, a score was assigned to each species listed by each respondent in order of preference (1-5: 1 being the most preferred and 5 being the least preferred). The total score for each species was then calculated. Mean income generated yearly was extrapolated using mean quantity caught per trip, number of trips per week, mean price and number of weeks in a year while the volume of bushmeat harvested was gotten by extrapolating weekly quantities of bushmeat harvested multiplied by the body mass of each species.

For categorical variables, descriptive statistics was used to present the distribution of subjects between and within subsets. Multiple response analysis was used for multiple-responses question. Measures of association between variables were carried out using Chi-Square test of independence or of equality of proportions. All statistics were discussed at the 0.05 significant level. Results were then presented using plates, graphs, tables and maps.

Results

Bushmeat Harvesting and practice

Bushmeat harvesters (n = 73) were exclusively males and none had a valid hunting permit. Six hunters declared that they once owned hunting permits but never renewed them again because they did not see any relevance in renewing them. However, women play a key role in promoting bushmeat harvesting as marketers (wholesalers and retailers).

Table 1. Harvester distribution in relation to age and location

Variable	Distribution	Percentage (%)	Sample (n)
Bushmeat harvesters	Hunters	31.5	23
	Trappers	37	27
	Hunters/trappers	31.5	23
Age distribution of harvesters	15-34	27.4	20
	35-54	42.5	31
	>55	30.1	22
Location of harvesters	Interior villages	20.5	15
	Periphery villages	76.7	56

There was a variation between age and category of harvesters (χ^2 = 16.423; df = 8; P = 0.04). Harvesters between the age of 35-54 were recorded to practice more of hunting (56.5%, n = 41). Trappers were almost equally distributed across the three age groups. Hunters/trappers were more represented in age group 15-34 (43.8%, n = 32). More harvesters were recorded in peripheral villages compared to the interior villages. However, 2.7% (n = 2) of the harvesters were unwilling to disclose their village of origin. Majority of harvesters (80.8%, n = 59) were natives while the rest were migrants from nearby villages. Bushmeat harvesting was mainly individual effort (82.2%, n = 60). However, some few individuals (17.8%, n = 13) practiced group hunting in group sizes of 3 to 4 individuals. Bushmeat harvesting was practiced throughout the year. However, harvesting was more intense in some months compared to others. Hunters harvested more between October-February and trappers harvested more between June-September.

Bushmeat harvesting techniques

Bushmeat harvesting techniques (Fig. 2) were identified including the following methods: tracking (hunting following wildlife trails), active searching of animals, waiting (at feeding/drinking sites, tracks and sleeping spots of wildlife), calling, baiting, remote hunting, hunting with dogs and trapping (line trapping and pitfall trapping).

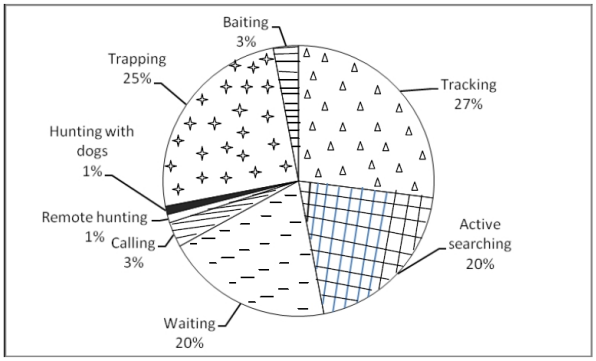

Fig. 2. Distribution of harvester across harvesting method

Harvesting tools included wire snares, metal traps, short guns (den guns and double barrels most of which were locally made), flashlights (which ranged from normal torch lights to miners' light), cutlasses, stones and sticks (Fig. 3). Choice for a particular tools were highly determined by affordability or cost (Table 1), availability, efficiency, ability to use the tool and efficiency of tool for self-defence or protection.

Table 2. Mean cost of bushmeat harvesting tools.

Tools	Wire snares	Short guns	Metal traps	Torch	Cutlass
Mean cost of tool ±SE in XAF	2651±127 (n = 42)	*31275±2509 (n = 40)	2750±553 (n = 7)	*12291±2022 (n = 36)	3044±714 (n = 53)

*Cost of gun elevated by one double barrel bought for 200,000 XAF (about $400 - US dollars)
*Usually, most torches cost 2,500 XAF (about $5), except Miners' light which ranges from 19,000 to 25,000 XAF ($38-$50).
*XAF – Central Africa Franc

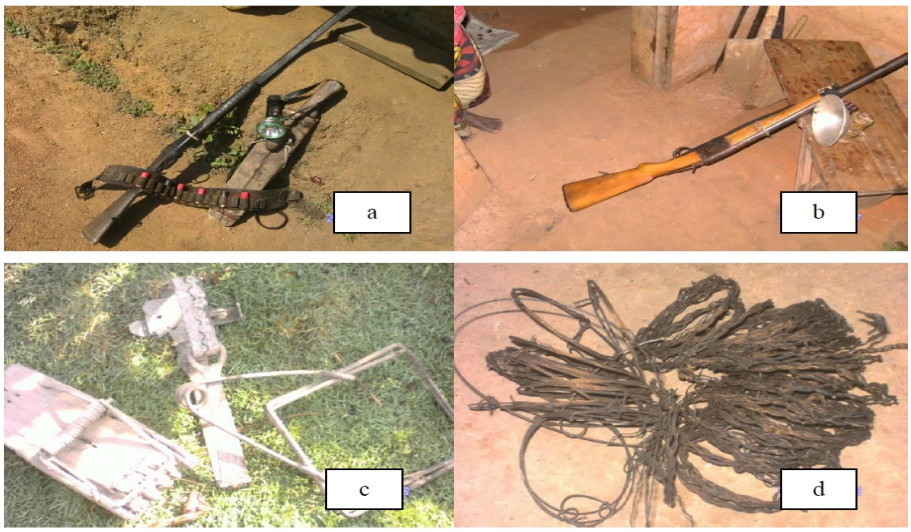

Fig. 3. Bushmeat harvesting tool used in the TMFC
*a. Locally made gun, cartridge belt, cutlass and torch; *b. Hunting gun and flashlight (miner light); *c. Metal and mouse traps; *d. Wire snares prepared for setting in the field

Bushmeat harvested in the TMFC

Bushmeat harvested included mammals, reptiles and birds. Fifteen out of the 34 recorded harvested species were listed in descending order of frequency (Table 2).

Table 3. Harvest composition and mean quantity per trip of species harvested.

	Species	Common name	Vernacular name
1	*Atherurus africanus*	African brush-tailed porcupine	Chucku-chucku beef
2	*Cephalophus monticola*	Blue duiker	Frutambo
3	*Cephalophus dorsalis, C. ogilbyi*	Bay duiker, Ogilby's duiker	*Red deer
4	*Potamochoerus porcus*	Red river hog	Bush pig
5	*Cricetomys emini*	Giant pouched rat	Rat mole
6	*Phataginus tricuspis*	Tree pangolin	Catter beef
7	*Thryonomys swinderianus*	Cane rat	Cutting grass
8	*Cercopithecus spp.*	Guenons	*Monkey
9	*Iguana iguana*	Iguana	
10	*Varanus niloticus*	Alligator/Nile monitor	
11	*Hyemoschus aquaticus*	Water chevrotain	Water beef
12	*Naja spp.*	Cobra	Black snake
13	*Mandrillus leucophaeus*	Drill	Shumbo
14	*Protoxerus stangeri, Anomalurus beecrofti*	Giant forest squirrel, Beecroft-flying squirrel	*Squirrel
15	*Python sebae*	Python	Mboma

The most harvested species was the African brush-tailed porcupine as reported by 97.3% of interviewees. The least harvested species was reported to be the chimpanzee. Just one hunter admitted to have hunted a chimpanzee and none admitted to have hunted a gorilla. The average number of animals caught per week was 16.0±2.0 per harvester. There was no significant difference amongst the average number of animals caught per week amongst hunters (16.0±3.0), trappers (15.0±3.0) and hunters/trappers (16.0±3.0); Kruskal Wallis Test: $P > 0.775$. Equally, there was no significant difference between the average number of animals caught per week per harvesters in the interior and periphery of the study area (Mann-Whitney U: $P > 0.838$). This indicates that both categories had equal impact on wildlife harvesting.

Factors influencing bushmeat exploitation

Bushmeat harvesting for income generation (67.1%, n = 49) was the most stated reason for harvesting wildlife. *…it is my only source of livelihood, money and it is a profitable business...* stated one of the hunters. Most of the harvesters (76.7%, n = 56) sold about 80 % of their harvest per trip. The rest was left for relatives and household consumption. This was followed by harvesting for food or protein (for the household 57.5%, n = 42), and harvesting to protect animals from destroying crops (9.6%, n = 7) was stated as the third reason. Averagely, 53.4% (n = 39) of harvesters make 30,000 XAF ($60) monthly from bushmeat wildlife, 34.3% (n=25) make 65,000 XAF ($130) and 12.9 % make 100,500 XAF ($201) and more. The mean income generated per week from bushmeat sales was 51,253±7,914 XAF per harvester. There was no significant variation of income between harvesters in the interior and periphery of the study area (Mann Whitney U: $P > 0.133$). When harvest success was correlated with generated income, it was positive and the relationship was very strong and significant (Spearman's rho; $r = 0.669$; $P = 0.000$). Other reasons for hunting included the protection of wildlife from harming local inhabitant (8.2%, n = 6), unemployment (6.8%, n = 5), inheritance/tradition (4.1%, n = 3) and hobby (2.7%, n = 2). In addition, low cost of harvesting tools (Table 1), availability and vulnerability of species to fall prey to traps were also noted as contributing factors to bushmeat harvesting.

In addition to the above factors, accessibility to the forest area was also attested by 72.6 % (n = 53) of interviews as a major contributing factor to bushmeat harvesting. Transect survey revealed that harvesting pressure was higher in the lower altitude forest area compared to the higher altitude. This observation also corresponds with interviewees views that 58.9% (n=43) harvested mainly in the lower altitude and 32.9% (n = 24) also harvested in high altitude. There was no significant variation amongst categories of harvesters ($\chi^2 = 3.713$; $df = 4$; $P = 0.446$) on preferred altitude. Agricultural activities also revealed to promote wildlife exploitation. Farmers claimed that wildlife is a threat to their crops, thus they are forced to set traps and hunt to protect their crops from wildlife destruction. Transect survey recorded seven farmlands deep in the forest habitat. Bushmeat harvesting signs (traps, gun shell and hunting hurts) were recorded in all farms surveyed.

Effects of bushmeat harvesting on species/biodiversity

Increase in the number of harvesters, demand for bushmeat, profit margins, population increase, harvesting experience and extension of farmlands were considered by harvesters as major causes for reduction in wildlife population. Majority of the interviewees (86.3%; n = 63) admitted that there has been a drastic reduction in bushmeat harvested per hunting trip. On the other hand 97.3% (n = 71) admitted that some of the wildlife are very scarce to find. Hunters attested that it take averagely 3.48 hours to hunt their first prey. Similarly, trappers also attested that traps stay much longer in the forest compared to five years back.

Discussions

The results of this study showed that bushmeat harvesting is exclusively a male affair with women only joining the chain later as marketers. This is in conformity with findings that in Lebialem division, women constitute a significant labour force in the bushmeat trade industry [10]. This implies efforts to reduce hunting should not only be focused on the harvesters but also should take into consideration the efforts that will address the market and the consumption challenges. Efforts to address bushmeat harvesting should also consider that it is a potential and in some cases the main source of food and income for most household living adjacent to forest areas [26]. In some cases the bushmeat market is a chain that emanates from the urban setting as a result of increasing demand from urban consumers mostly characterized by people of the upper class [27]. The results of this study revealed bushmeat harvesting to be all year round with peak period between certain months. This conforms to the findings that vulnerability of wildlife to fall prey increases when there is high availability of fruits (June to September) and when water and food availability shift to the low altitude area [28]. This study argues that bushmeat exploitation in the TMFC exerted pressure on wildlife abundance and on biodiversity conservation. This is supported by the results that majority of the interviewees (86.3%, n = 63) admitted that there has been a drastic reduction in bushmeat harvested per hunting trip. On the other hand 97.3% (n = 71) admitted that some of the wildlife are very scarce to find. This

finding is in line with the findings of a study conducted in the Ebensuk-Mambo and Tali-Bara Communal Forest Area in Cameroon situated some 40 km from this study area [29].

There is an increasing use of modern tools in hunting [10,12]. No bushmeat harvesters were observed to practice strictly traditional hunting (sticks and stones). The use of modern arms in bushmeat harvesting was observed to increase catch and eventually affected the wildlife abundance in the TMFC. We argue here that subsistence hunting is rapidly giving way to commercial hunting and majors need to be taken if biodiversity must be preserved. Income generation was the main reason for harvesting bushmeat. This result is in contrast with a study in Serengeti, Tanzania which shows that bushmeat harvesting is mainly for food [30].

Bushmeat exploitation was also a severe threat to biodiversity and wildlife abundance given that species vary in their ability to withstand hunting pressure. Slow-reproducers such as large carnivores and primates are particularly vulnerable and are seriously threatened by hunting [31]. In addition, this study revealed that the tools and methods used in harvesting promoted indiscriminate hunting. This exposed all wildlife in the forest landscape to hunting risk. Furthermore, the quest for hunters and trappers to meet up with their daily income need was also a driving force that pushed them to go to extreme during hunting. Adding to the fact that harvesting of bushmeat in the TMFC was practiced all year round with peak seasons in June to September and October to February, hunting was revealed as a severe threat to biodiversity and wildlife conservation in the study area if mechanisms are not urgently put in place to address the challenges.

Based on the above findings, this study argues that wildlife abundance in study area was threatened by bushmeat harvesting. This calls for timely and effective policy actions that could develop strategies to mitigate the high reliance of local community on bushmeat for income. At same time sensitizing the local population on the important of wildlife conservation and sustainable hunting could also contribute to addressing the threat posed by bushmeat harvesting.

Conclusions

In the proposed TMFC, traditional or subsistent wildlife harvesting has given way to commercial exploitation of wildlife. This was carried out all year round by harvesters who are exclusively males. Bushmeat harvesting was generally individual efforts and made use of unconventional methods which were observed to be highly detrimental to wildlife. Bushmeat was principally harvested to generate income and to be added to existing dietary components of households and to a lesser extent, to control pests around farms. Bushmeat harvesting was observed to cut across a wide range of social groups and professions and involved mostly less educated individuals. Accessibility to forest area, altitude, income motivation, agricultural activities and available markets were recorded as factors facilitating bushmeat harvesting in the study area. The high number/species animal harvested weekly and the high number of harvesters were evident of bushmeat threats to wildlife abundance and biodiversity conservation. The results of this study also suggested that there was over exploitation of wildlife in the study area and this has led to reduction in the population of mammals and consequently to biodiversity lost.

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