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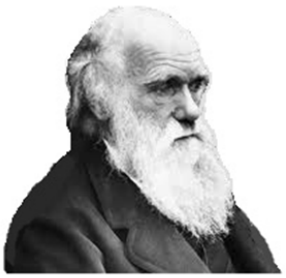

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Impact of Anthropogenic Activities on Vegetation Cover and Mammalian Herbivores in Afi Mountain Wildlife Sanctuary, Cross River State, Nigeria

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ABSTRACT

Despite the popular perception of protected areas, forest resources are still subject to many forms of anthropogenic activities such as logging, hunting and burning. This necessitates the study on the impact of anthropogenic activities on vegetation cover and mammalian herbivores in Afi mountain wildlife sanctuary. Four communities around the study area namely; Ebok, kakukob, Esekwe and Olum were selected based on proximity to the sanctuary. Data on socio-economic characteristic and anthropogenic activities of the communities were determined using questionnaire. A total of sixty (60) copies of questionnaire, 15 each were distributed to the four communities. Dynamics in vegetation cover for 1985, 2000 and 2021 was determined using landsat imagery. Data were analyzed using descriptive statistics, Normalized Difference Vegetation Index. The result revealed that, males (65.0%) were the dominant respondents. The study respondents were in the age bracket between 41-50 years (51.6%) and majority (51.7%) can at least read and write. The result also indicates a drastic decrease in the forest cover as from 1985-2021, owning to increase in activities such as settlement, logging and farming within the sanctuary. Major threats to the vegetation cover and mammalian herbivores survival were farming, logging and illegal hunting. Conservation of the remaining forest resources should be given top priority.

***Keywords*:** Anthropogenic activities, mammalian herbivores, Afi Mountain Wildlife Sanctuary

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1. INTRODUCTION

Wildlife sanctuary protect the integrity of the biodiversity and serves as ecotourism potential, it is notable amidst sites for strategic management and conservation (Thomas and Middleton, 2003; Yager *et al*. 2017). They harbor most of our remaining floristic and fauna species specially mammalian herbivore. However, wildlife sanctuaries are becoming increasingly degraded through anthropogenic activities. Anthropogenic activities such as game exploitation, logging, farming and urbanization around the protected areas have a major limitation to wildlife conservation especially in West African (Meduna *et al.*, 2001; Oladipo, 2001). As a result, many species are now rare and their number and range have been reduced greatly in the last century (Onadeku, 2004).

Anthropogenic activities can lead to extinction of fauna species especially mammalian herbivores, and loss of herbivores can alter the ecosystem mostly to the detriment of other species and ecosystem services (Ripple et *al*., 2015). Large and small mammalian population are threatened due to factors emanating from both the environment and anthropogenic effects. Human through its illegal activities altered the ecology of protected areas of different fauna species in most protected ecosystem (Western *et al*., 2009). This has increased the rapid rate of extinction of mammals more than a fifth of all global mammals (Milius, 2008). Despite their ecosystem services, fauna species are still put at risk by anthropogenic activities (Schipper, 2008). Habitat destruction and degradation are some of the biggest factors influencing extinction and decline of mammalian herbivores (Munguia *et al*., 2016).

Mammals can either benefit or suffer from how they respond to anthropogenic disturbance, they may take advantage to foraging on the fresh resource and some can change their behaviors by spending more time scanning and other staying vigilant instead of foraging (Cluti *et al.*, 2012). Other can avoid interaction with humans and domestication animals by shifting their temporal activities pattern (Tsunoda *et al*, 2018). This shift can influence individual fitness, reproductive success and ecosystem tropic level (Presser *et al*, 2005; Pattern, 2018). In the same vein mammals can also avoid human and domesticated animals on a spatial scale (Hilbert *et al*, 2010). This behavior can limit access to suitable feeding and breeding sites.

Mammalian herbivores are generally referred to mammals with small and large body mass (Sandom *et al*., 2014), that are adapted to feeding on plants materials and are key component of the rangeland dynamics (Arild, 2002). They are classified as grazer that feed primary on grasses and forbs and browsers which feed primary on woody vegetation (Holdo *et al*., 2009). They dwell in all major terrestrial ecosystems on earth (Ripple *et al*., 2015; Ogujemite *et al*., 2014).

Protected areas have ecological significance on large and small mammals and predict the degree of vegetation deterioration and improvement (Yager *et al.*, 2017). Human have impacted on the biosphere by removing original vegetation cover replacing it with either other flora on man-made structure. At the global scale, the ecologically most significant anthropogenic action of mammalian herbivores is loss of habitat. Herbivores are mostly used as indicator species mostly in land use cover dynamics.

Remote sensing is the science (and to some extent) of acquiring information about the earth surface without actually being in contact with it (Jensen, 2007). While a geographical information system (GIS) is a computerized system that combines spatial and descriptive data for mapping and analysis. One of the importance of ArcGIS is its ability to integrate different type of spatial data (Brooker *et al*., 20I2). These tools provide basic database, quantitatively

and spatial information for analysis and interpretation of land cover changes (Lambin *et al*., 2003). Understanding the current condition of wildlife habitat using GIS and remote sensing approaches is important in monitoring the impact of anthropogenic activities and management policies.

2. METHODOLOGY

2. 1. Study Area

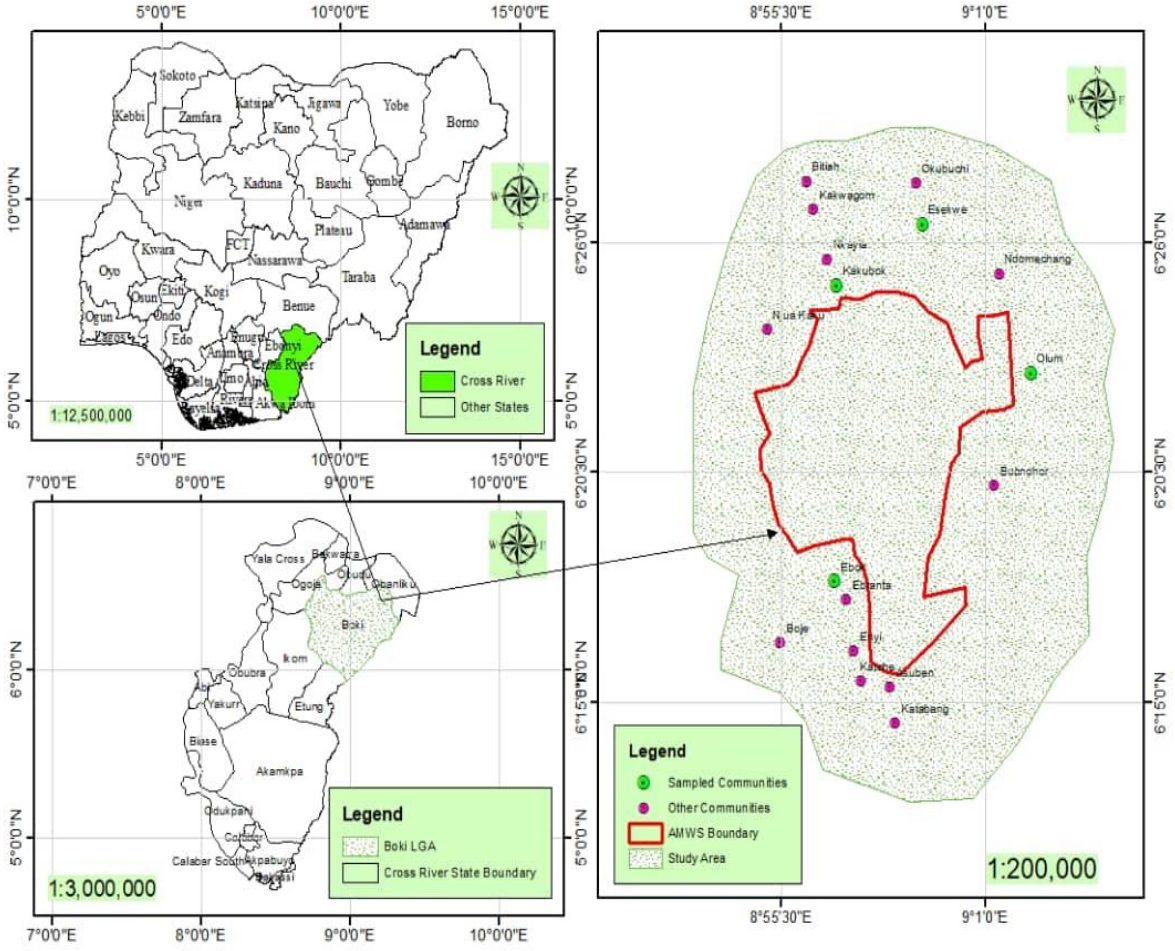

Figure 1. Map of Afi Mountain Wildlife Sanctuary

The Afi Mountain Wildlife Sanctuary (AMWS) is situated in Afi River Forest Reserve Boki Local Government Area of Cross River state, Nigeria, which lies between Latitude 6° 15′ North, longitude 8°55′ - 9°15′ East **(Figure 1)**. Established in May 2000 to provide improved protection to important population of several endangered species including the critically endangered Cross River Gorilla, the Nigeria – Cameroon Chimpanzee, the drill and the Grey-neck rockfowl (Ransom, 2004; Edet *et al*., 2012). It covers approximately 100 km^2 total land area. The climate is characterized by an extreme rainfall pattern of 3500-500 mm with the mean

temperature of 27 °C and relative humidity of about 65% during the afternoon throughout the year. It is the sole watershed of the sixteen surrounding communities (Bukie *et al.*, 2015). The Sanctuary falls within the tropical high forest vegetation zone. The rain forest occupies the foot of the mountain at about 700 m part of the forest structure, which changes gradually into sub-montane vegetation while the Eastern portion of the sanctuary is characterized by rock outcrop vegetation. Some common tree species on the study area include *Parkia bicolor, Pycnanthus angolensis, Albiza zygia, Monodora myristica* and *Irvingia gabonensis* (Edet *et al*., 2012).

3. METHODS OF DATA COLLECTION AND SAMPLING PROCEDURES

3. 1. Socio-economic Characteristic of the Household Heads Community

The research instruments used for obtaining primary data were the questionnaire. A total of sixty (60) copies of questionnaire- fifteen (15 each) was distributed among four communities (Kakubok Irruan, Olum Eastern, Esekwe Irruan and Eboki). The communities were chosen based on their proximity to the Sanctuary. Head of household who lived more than 35years were sampled. This was to determine their impact on the sanctuary in relation to fauna species especially mammalian herbivores.

3. 2. Examination of Vegetation Cover changes of the study area

Three (3) multi-date Landsat satellite imageries, Thematic Mapper (TM+) of 1985, Enhanced Thematic Mapper (ETM+) 2000 and Operational Land Imager (OLI) of 2021 and software were employed (**Table 1** and **2**). The study area was extracted from the scene, and a supervised classification method was carried out based on level 1 classification scheme of Anderson *et al.* (1976) was used to classify the identify vegetation cover categories of the study areas. Five land use and land cover features were used for the study (i.e., built up areas, forest, vegetation, agricultural land, and water body).

Table 1. Characteristics of Landsat images used for the study.

Year of Acquisition	Sensor	Path	Row	Multispectral Band	Thermal Band	Spectral Range (micrometers)	Spatial Resolution (pixel spacing)	Source
1985	TM	190	56	1 to5 and 7	6	10.45-12.45	30	
2000	ETM+	190	56	1 to5 and 7	6	10.45-12.45	30	USGS
2021	OLI and TIRS	189	56	1 to7 and 9	10 and 11	10.60-12.51	30	

Some of the basic pre – processing operations used include image reconstruction to extract area of interest (AOI) from the general satellite scene, image enhancement to improve

visual interpretation by increasing apparent contrast among various features in the image, radiometric correction to correct the sun elevation was perform on the raw data, a band combination of 2,3,4 was used for 2000 and 2010 images while 3,4,5 combination was used for the 2020 landsat 8 (OLI) because it produce superior results due to the sensitivity of band 4 and 3 to vegetation cover and sensitivity of band 4 to water contents.

Table 2. Software Components of the Research.

S/N	Software	Purpose
1	Idrisi & ArcGIS 10.3	GIS analysis & classification of the Landsat images
2	Microsoft Excel	Statistical analysis for the calculation of percentage
3	GPS & Google earth	For picking geographic co-ordinates

3. 3. Data Analysis

Data obtained for socio-economic characteristics of the study respondents and their impact was analyzed using descriptive statistics. Also, Histograms of the classified images were used to provide information of the total area coverage of each class theme from the different images. For land use/ land cover change (Vegetation cover).

Normalized difference vegetation index (NDVI)

The Normalized Difference Vegetation Index (NDVI) is a numerical indicator that uses the red and near-infrared spectral bands. High NDVI values correspond to areas that reflect more in the near-infrared spectrum. Higher reflectance in the near-infrared corresponds to denser and healthier vegetation. This was determined using the general equation for Normalized Difference Vegetation Index (NDVI) is expressed using the equation below

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

where: NDVI = Normalized Difference Vegetation Index
NIR = Near-Infrared reflectance value (spectral band 0.76 – 0.9 μm)
RED = Visible Red reflectance value (spectral band 0.6 – 0.7 μm)
where NIR is reflectance in the near-infrared band and RED is reflectance in the visible red band. The NDVI algorithm takes advantage of the fact that green vegetation reflects less visible light and more NIR, while sparse or less green vegetation reflects a greater portion of the visible and less near-IR.

The extent of the sanctuary degradation

The extent of land use change in the sanctuary was analyzed by subtracting the reference year (2021) from the base year. It is represented mathematically as:

$$E_T = B - A$$

A = the base year (1985)
B = the reference year (2021)
E_T = total extent of forest land

Change detection techniques

Change analysis was carried out to examine the change in vegetation coverage between 1985 – 2020 in order to determine the extent/impact of land use and land cover change.

Three main change detection methods which have been previously applied by (Ikusemoran *et al.,* 2013) were employed, they are:

Change detection by area calculation

There are three steps in calculating change detection by area calculation

a) The first step is the calculation of the magnitude of change, which is derived by subtracting observed change of each period of years from the previous period of years.
b) The second step was the calculation of the trends, that is, the percentage change of each of the land-use, by subtracting the percentage of the previous land-use from the recent land-use divided by the previous land-use and multiplied by 100 (B-A/Ax100).
c) The last is the calculation of the annual rate of change by dividing the percentage change by 100 and multiplied by the number of the study years, that is, thirty-six (36) years (2000-2020).

4. RESULTS

Socio-economic Characteristic of the Household Heads Community

The socio-economic characteristic of respondents is presented in **Table 3**. The result on sex distribution of the respondent shows that majority of the respondent were male, 65% while 35% of the respondent were female. The result of age distribution of the respondent showed that majority 51.6% of the respondent falls within the age range of 41-50. About 86.6% of the respondents were married, while 11.7% were divorced. The result also reviews that majority of the respondent 51.7% had attained secondary level of education.

Table 3. Socio-economic characteristics of respondents of the household heads communities (n = 60)

Variable	Ebok	Kakubok	Eswekwe	Olum	Mean
Gender					
Male	10 (25.6%)	8 (20.5%)	10 (25.6%)	11 (28.2%)	65.0
Female	5 (23.8%)	7 (33.3%)	5 (23.8%)	4 (19.0%)	35.0

Age (years)					
31-40	4 (26.7)	6 (40)	7 (46.7)	4 (26.7)	35.0
41-50	9 (60.0)	8 (53.3)	8 (53.3)	6 (40)	51.6
>51	2(13.3%)	1(6.7%)	0	5(33.3%)	13.33
Marital Status					
Married	12 (80.0)	15 (100)	14 (93.3)	11 (73.3)	86.6
Single	0	0	0	0	0
Divorced	3(20.0%)	0	1(0.08%)	4(26.7%)	11.7
Educational qualification					
Non formal	0	0	1 (6.7)	0	1.7
Primary	3 (20)	7 (46.7)	5 (33.3)	5 (33.3)	33.3
Secondary	11.73.3)	6 (40.0)	5 (33.3)	9 (60.0)	51.7
Tertiary	1 (6.7)	2 (13.3)	4 (26.7)	1 (6.7)	13.25

Analyses of Sanctuary land use/land cover (LULC) Classification

(a) Analysis of 1985 LULC classification for Afi Mountain Wildlife Sanctuary (AMWS)

The land use/ land cover map gives an account of the spatial distribution and areal extent of various categories of land use/land cover over the study area. **Figure 2**, presents the classified land use/land cover map of the study area for the year 1985. The map portrays five (5) categories of land use/land covers; built-ups, forest cover, farmland (Cultivated land), grassland and water bodies. The areal extent of these classes revealed that the dominant class is grassland which covers 276.18 km^2 (56.25%), this is followed by forest cover with 176.59 km^2 (35.97%), built up areas covers 23.81 km^2 (4.85%). This is seen more at the Centre and water bodies with 1.90 km^2 representing (0.39%) of the total area as the less dominant land use and land cover class.

(b) Analysis of 1985 LULC classification for Afi Mountain Wildlife Sanctuary (AMWS)

The land use and cover map of AFI for 2000 (**Figure 3**), reveals that there was a drastic increase in built up areas. Result shows that built up area increase from 23.81 km^2 (4.45%) in 1985 to 29.58 km^2 (6.02%) in 2000. Farmland (Cultivated land) also increases from 12.45 km^2 (2.54%) in 1985 to 19.39 km^2 (3.95%) in 2000. However, grassland areas decreased from 276.18 km^2 (56.25%) in 1985 to 273.03 km^2 (55.62%) in 2000. Similarly, forest cover also witnesses a decrease from 176.59 km^2 (35.97%) in 1985 to 166.92 km^2 (34.00%) in 2000. Furthermore, water body witness a slight increase to 1.99 km^2 (0.40%) respectively.

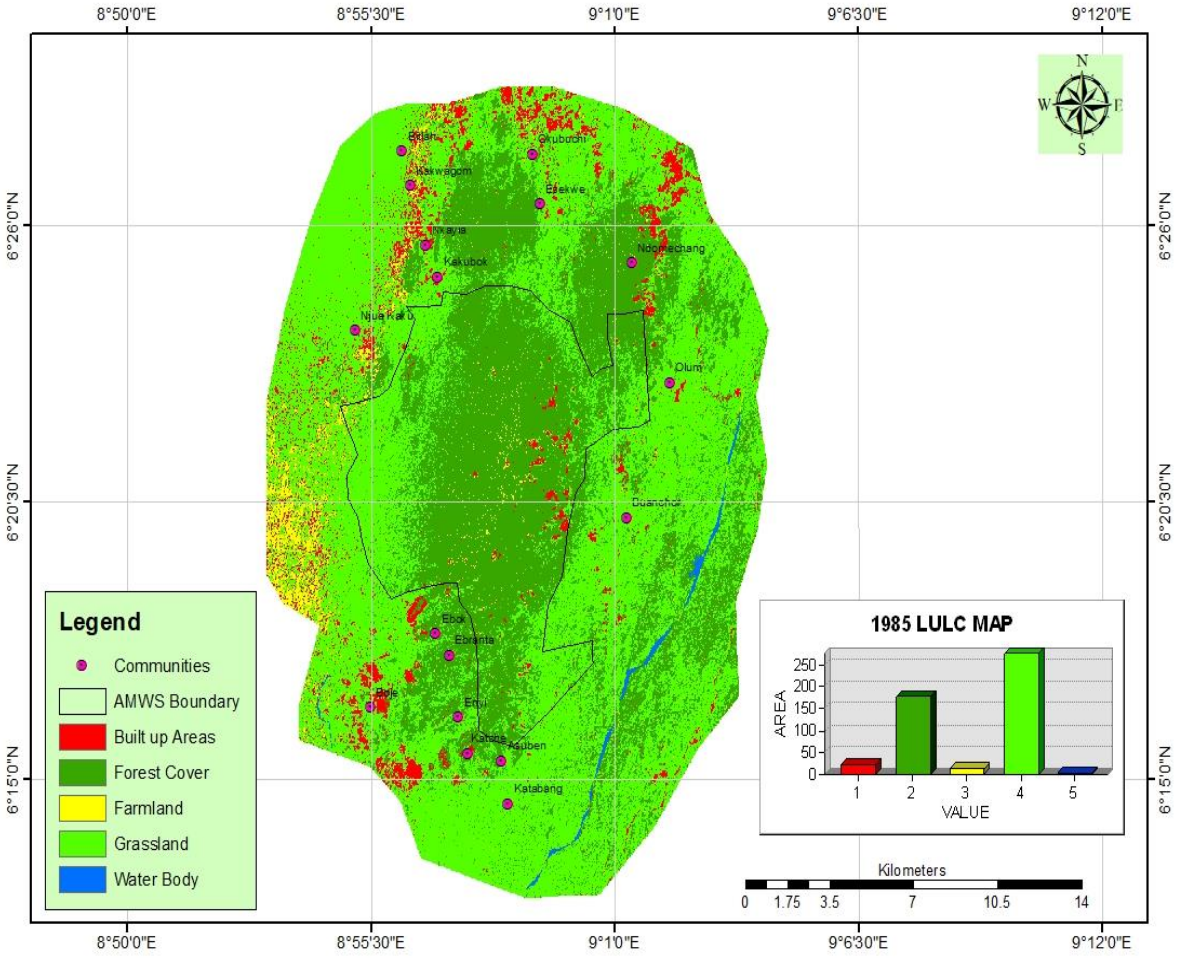

Figure 2. AFI 1985 Land use/Land cover distribution map generated from LandSat 4 TM
Source: Author's Analysis, 2020.

(c) Analysis of 1985 LULC classification for Afi Mountain Wildlife Sanctuary (AMWS)

From **Figure 4**, the land use and cover map of AWMS for 2021 is given. Result shows that built up area drastically increase from 29.58 km^2 (6.02%) in 2000 to 114.65 km^2 (24.59%) in 2021. Similarly, grassland areas decreased from 273.03 km (55.62%) in 2000 to 121.69 km^2 (24.78%) in 2021 and forest cover also witnesses a decrease from 166.92 km^2 (34.00%) in 2000 to 155.64 km^2 (30.46%) in 2021. In addition, water body also witnessed a slight increase to 1.48 km (0.30%) respectively. **Table 4** shows the summarized statistics of the various land use and land cover categories. More so, **Figure 5** shows the land use and land cover comparism chart, it revealed a fluctuation across the various land use and cover categories, it was obvious that the built-up areas and grassland indicates steadier rise than other land use categories.

Normalized Difference Vegetation Index (NDVI)

The **Figure 6**, shows that the Normalized Difference Vegetation Index (NDVI) with high value is regarded as vegetated land and low value regarded as non-vegetated land. The

classification represents the level of the sanctuary degradation. The value ranges from Low: – 0.0645161 - High: 0.388889, the negative values represent non-vegetated land while positive values represent vegetated land for the year 1985.The figure illustrates the image of NDVI results which display the distribution of NDVI values, and from their legends, the distribution of vegetated land and non-vegetated land are also shown.

In the same vein, **Figure 7** shows the NDVI map of the sanctuary for year 2000. The map indicates the vegetated and non- vegetated areas, the map further reveals that there is forest degradation in the sanctuary. The value ranges from Low: – 0.297297 - High: 2.98013, the results indicate higher level of degradation of vegetation across the study area, vegetation cover is found more around the north east and towards the center.

In addition, **Figure 8**, shows the NDVI map for the year 2021, the map indicates the vegetated and non- vegetated areas, the map further reveals that there is further increase in forest degradation in the reserve and the national park. The value ranges from Low: -0.0228861 -High: 0.485973, the increase in forest degradation is attributable to increase in population which has resulted in high lumbering activities and other forest resource exploitation in the area.

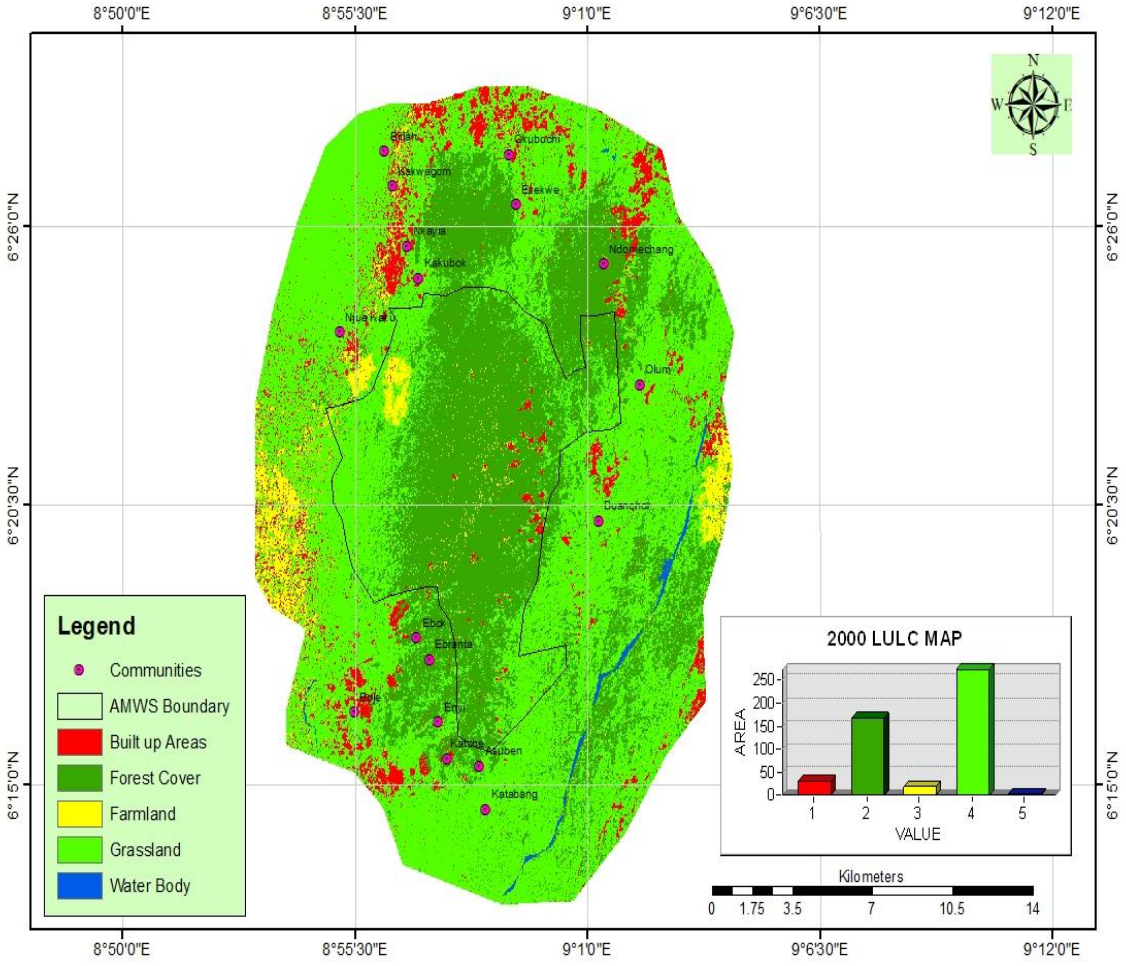

Figure 3. AFI 2000 Land use/Land cover distribution map generated from LandSat 4 TM
Source: Author's Analysis, 2020.

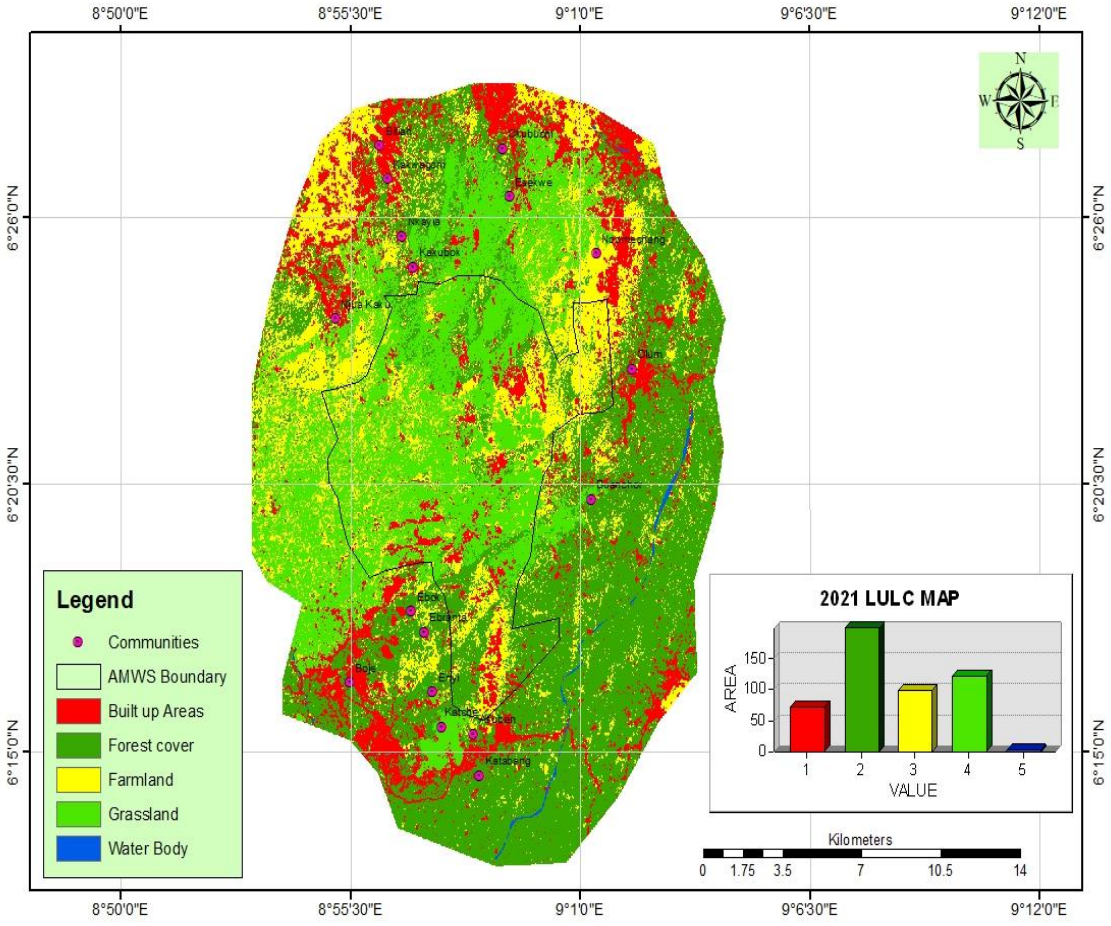

Figure 4. AFI 2021 Land use/Land cover distribution map generated from LandSat OLI
Source: Author's Analysis, 2021

Table 4. Land use and land cover Distribution of AFI (1985, 2010 and 2020).

Land Cover Category	1985 Area (Sqkm)	Area covered (%)	2020 Area (Sqkm)	Area covered (%)	2021 Area (Sqkm)	Area covered (%)
Build up	23.81	4.85	29.58	6.02	114.65	24.59
Forest cover	176.59	35.97	166.92	34.00	155.64	30.46
Farmland	12.45	2.54	19.39	3.95	97.56	19.87
Grassland	276.18	56.25	273.03	55.62	121.69	24.78
Water body	1.90	0.39	1.99	0.40	1.48	0.30
Total	490.94	100	490.91	100	491.02	100

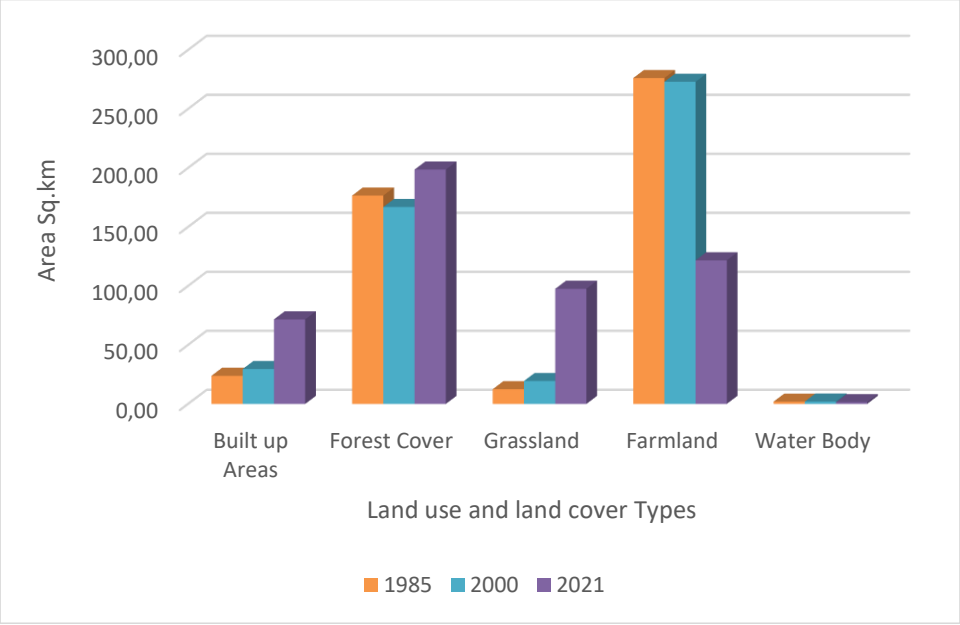

Figure 5. Land use and Land cover Compares Chart

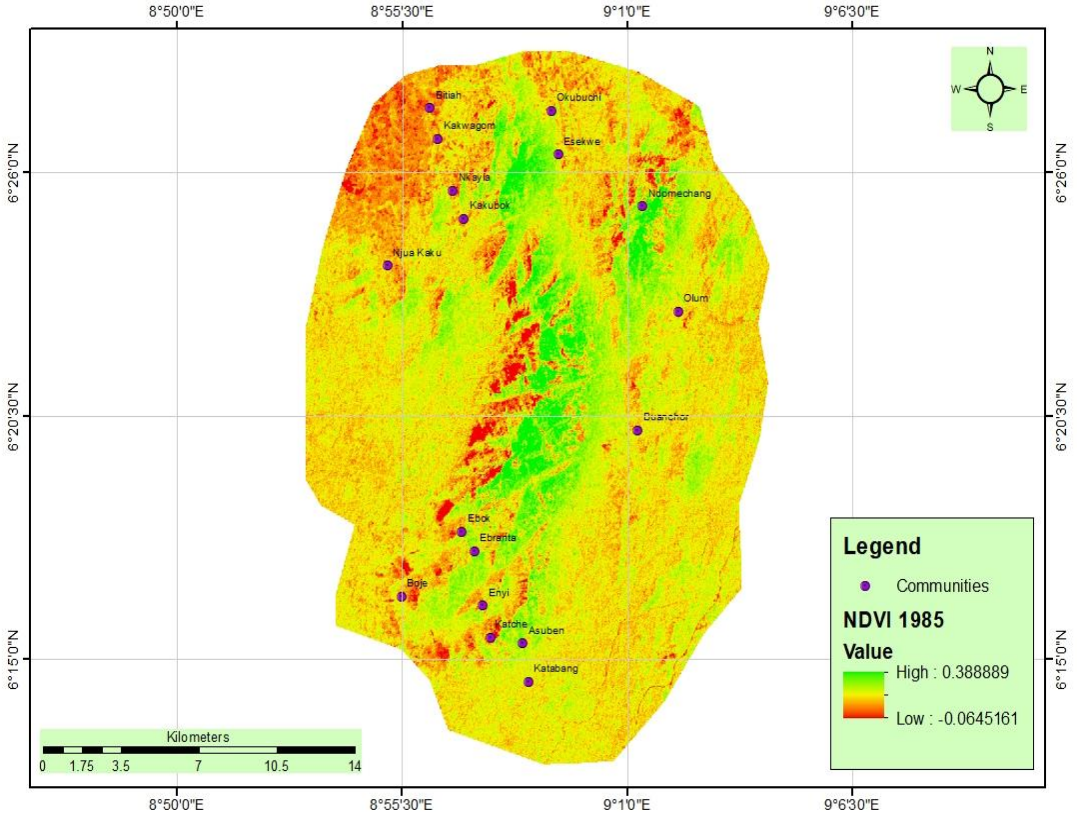

Figure 6. The 1985 NDVI Between Vegetated land and non-vegetated land

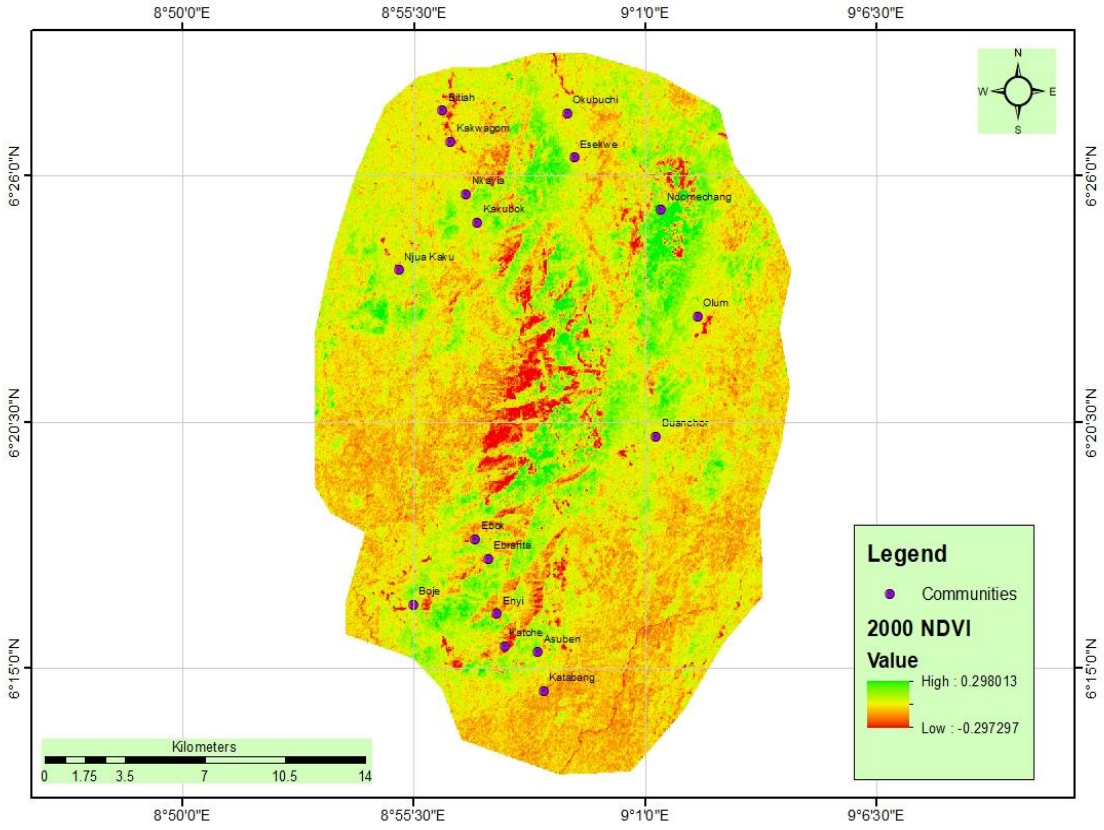

Figure 7. The 2000 NDVI between vegetated land and non-vegetated land

Magnitude and Percentage of Change in Land Use/Landover between 1985 and 2000

The magnitude of change of forest area for 15 years between 1985 to 2000 shows that, forest decreased by -9.67 Sq. km representing a change (-5.48%) of the total change for the period. Built up has an annual rate of change of 1.62%, while farming (cultivated land) has the highest annual rate of change of 3.7%. The period also witnessed a decrease in grassland area by -3.15 km representing -1.14% of the total change, while water body increased by 0.09 (4.74%) (**Table 5**).

Magnitude and Percentage of Change in Land Use/Landover between 2000 and 2021

The magnitude of change of forest area for 21 years between 2000 to 2021 shows that forest decreased by -31.72 Sq. km representing a change (-19%) of the total change for the period with an annual rate of change of 0.9%. Built up has an annual rate of change of 6.77%, while farming (cultivated land) has the highest annual rate of change of 19.20%. The period also witnessed a decrease in grassland area by -151. 34Sq.km representing -55.43% of the total change, while water body decreased by -0.51 (25.63%) (**Table 6**).

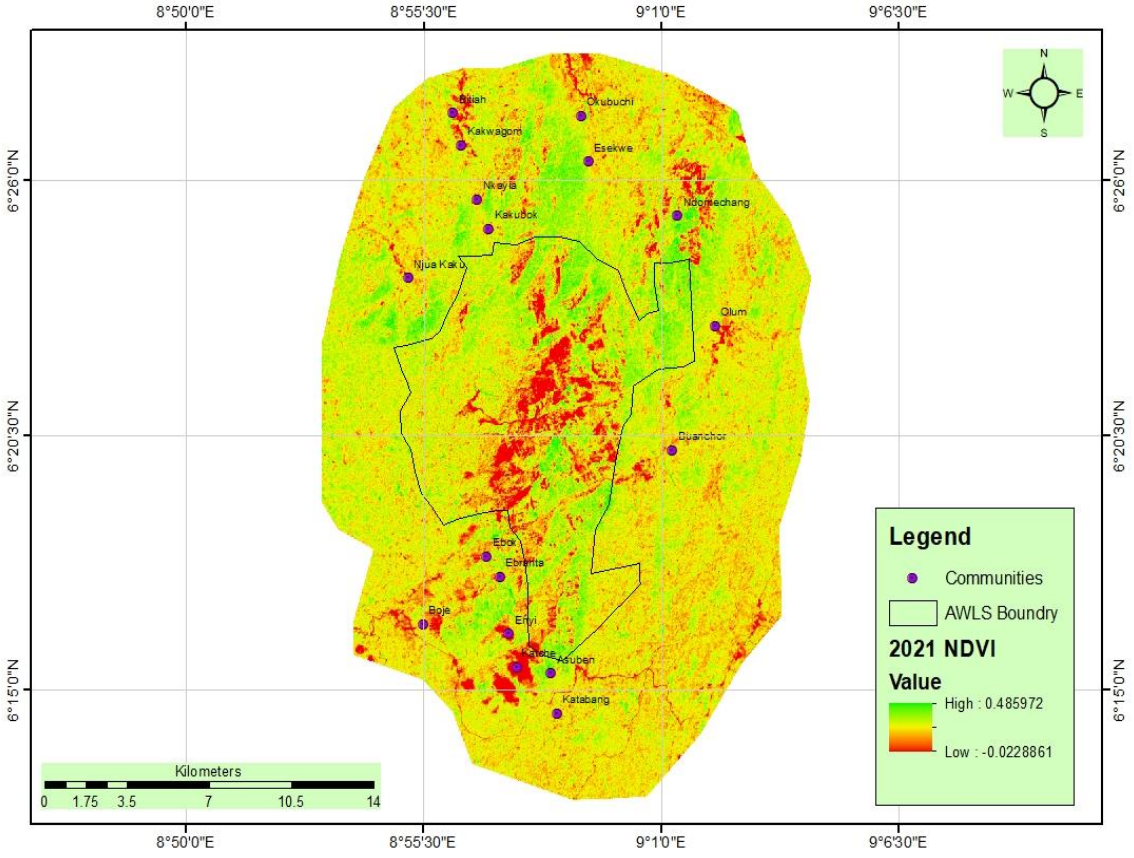

Figure 8. The 2021 NDVI between vegetated land and non-vegetated land

Magnitude and Percentage of Change in Land Use/Landover between 1985 and 2021

The magnitude of change of forest area for 36 years between 1985 to 2021shows that forest decreased by -22.05 Sq. km representing a change (-12.49%) of the total change for the period with an annual rate of change of 0.35%. This means that 12% of forest cover is been lost annually for the years under consideration Built up has an annual rate of change of 5.58% while cultivated land has the highest annual rate of change of 18.98%. The period also witnessed a decrease in grassland area by -154. 49 Sq.km representing -1.55% of the total change, while water body decreased by -0.42 (22.11%) (**Table 7**).

Table 5. Magnitude and Percentage of Change in Land Use/Landover between 1985 and 2000

LULC Class	1985 Extent (Sq. km)	2000 Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change	Annual Rate of Change %
Built up	23.81	29.58	5.77	24.23	1.62
Forest cover	176.59	166.92	-9.67	-5.48	0.37

Farming (Cultivated land)	12.45	19.39	6.91	55.50	3.7
Grassland	276.18	273.03	-3.15	1.14	0.08
Water body	1.90	1.99	0.09	4.74	0.32
Total	490.94	490.91	25.59	91.09	6.09

Table 6. Magnitude and Percentage of Change in Land Use/Landover between 2000 and 2021

LULC Class	2000 Extent (Sq. km)	2021 Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change	Annual Rate of Change %
Built up	29.58	71.65	42.07	142.22	6.77
Forest cover	166.92	198.64	-31.72	-19.00	0.90
Farming (Cultivated land)	19.39	97.56	78.17	403.15	19.20
Grassland	273.03	121.69	-151.34	-55.43	2.64
Water body	1.99	1.48	-0.51	25.63	1.22
Total	490.91	491.02	303.81	645.43	30.73

Table 7. Magnitude and Percentage of Change in Land Use/Landover between 1985 and 2021.

LULC Class	1985 Extent (Sq. km)	2021 Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change	Annual Rate of Change %
Built up	23.81	71.65	47.84	200.92	5.58
Forest cover	176.59	198.64	-22.05	-12.49	0.35
Farming (Cultivated land)	12.45	97.56	85.11	683.61	18.98
Grassland	276.18	121.69	-154.49	55.94	1.55
Water body	1.90	1.48	-0.42	22.11	0.61
Total	490.94	491.02	309.91	975.07	27.07

Major Anthropogenic Activities that Impacted on the Vegetation Cover and Mammalian Herbivores in the Study Area

The result identified hunting, farming and logging activities as the major effect impacting negatively to the loss of the Sanctuary vegetation cover and on fauna species habituation and survival especially the mammalian herbivores.

Hunting, Farming and Logging Activities and Involvement in the Study Area

The result shows that majority (78.3%) of the respondent indicated that they do not hunt while only 21.7% do hunt and usually in the sanctuary (78.3%), while others (21.7%) within the forest reserve, mostly done alone (95%). Hunting activities was higher (95%) in the dry season. The entire respondents indicated that traditional hunting areas do not exist. Major hunting equipment used were; iron traps and gun. The most favorites fauna species hunted were identified to be herbivores. Wild species hunted were basically for sales (56%), while for consumption (food) accounted for (43%). The entire respondent agreed that they are decline in fauna species. According to the respondent the decrease in fauna species was due to hunting (83%), farming (95%), logging (100%) and climate change (67%). Majority that hunts opted that if alternative source of income is provided to them hunting will stop **(Table 8)**.

The result on farming activities given in **Table 9** indicated that, Majority (76.5%) of the respondent within the study areas were farmers while 23.5% were not farmers. Most (87%) of the farmers inherited their land and indicated that their income come from faming. Traditional farming areas were not in place as revealed by the study respondents (66.3%) Majority (56.6%) of the respondent farmland is located in the community forest, while 37.5% is located in the sanctuary areas (a way of encroachment). majority 95.5% of the respondent attest that wild species raid they crops and they have killed some wild species on the farm before especially herbivores. They also attest to the decline in wild species population in the sanctuary.

The result shows that Majority (80%) of the respondent do not carry out logging activities within the sanctuary, while (20%) of them do. Those that log said, logging is their major source of income (78%). All (100%) of the respondent that log attest to the loss in the habitat owning to deforestation (logging of tree species), they link the decline in mammalian herbivores to farming (94%), logging (100%), hunting (75%) and bush burning (100%). Those that log also said if provided with alternative source of income they will stop logging activities **(Table 10)**.

Table 8. Hunting activities involvement in Afi Mountain Wildlife Sanctuary

Variable	Ebok	Kakubok	Esekwe	Olum	Percentage
Do you hunt					
Yes	5 (33.3)	3 (20.0)	2 (13.3)	3 (20)	21.7
No	10 (66.7)	12 (80)	13 (86.7)	12 (80)	78.3
If yes, where do you normally hunt					
Sanctuary	4 (80)	3 (100)	2 (100)	1 (33.3)	78.3

Forest reserve	1 (20)	0	0	2 (66.7)	21.7
Others	0	0	0	0	0
Does your community have traditional hunting areas					
Yes	0	0	0	0	0
No	5 (100)	3 (100)	2 (100)	3 (100)	100
Which season do you hunt the most					
Wet	1 (20)	0	0	0	5
Dry	4 (80)	3 (100)	2 (100)	3 (100)	95
Do you normally hunt alone					
Yes	4 (80)	3 (100)	2 (100)	3 (100)	95
No	1 (20)	0	0	0	5
What is your hunting equipment					
Iron traps	4 (80)	3 (100)	2 (100)	3 (100)	95
Wire snares	3 (60)	1 (33.3)	1 (50)	0	35.8
Cutlass	2 (40)	1 (33.3)	2 (100)	0	26.7
Gin traps	2 (40)	2(66.6)	0	0	
Gun	5 (100)	3 (100)	2 (100)	3 (100)	100
What Mega fauna species are your favorite to hunt					
Primate	1 (20)	0	0	0	5
Herbivores	4 (80)	2 (66.6)	2 (100)	3 (100)	86.6
Carnivores	0	1 (33.3)	0	0	8
How many of the fauna species have you killed for the last one year for					
Food	2 (40)	1 (33.3)	0	3 (100)	43
Sales	6 (60)	2 (66.7)	2 (100)	0	56.7
In your opinion are they increasing or decreasing					

Increasing	0	0	0	0	
Decreasing	5 (100)	3 (100)	2 (100)	3 (100)	100
If less, what is the cause(s)					
Hunting	5 (100)	1 (33.3)	2 (100)	3 (100)	83
Farming	4 (80.0)	3 (100)	2 (100)	3 (100)	95
Logging	5 (100)	3 (100)	2 (100)	3 (100)	100
Climate change	5 (100)	2 (66.7)	0	3 (100)	67
If provided with an alternative source of income, will you accept					
Yes	5 (100)	3 (100)	2 (100)	3 (100)	100
No	0	0	0	0	0

Table 9. Farming activities involvement in Afi Mountain Wildlife Sanctuary

Variable	Ebok	Kakubok	Esekwe	Olum	Percentage
Are you a farmer					
Yes	10 (66.7)	14 (93)	11 (73.3)	11 (73.0)	76.5
No	5 (33)	1 (7)	4 (27)	4 (27)	23.5
How did you acquire your farmland					
Rented	0	3 (21.4)	0	1 (9.1)	7.6
Inherited	10 (100)	11 (79)	11 (100)	8 (72.7)	87.9
Gift	0	0	0	2 (18.1)	4.5
Other	0	0	0	0	0
What portion of your income comes from farming					
Percentage	92	82	93	89	89
Does your village have traditional farming areas					

Yes	0	6 (42.8)	9 (81.1)	1 (9.0)	33.2
No	10 (100)	8 (57.1)	2 (18.1)	10 (90.9)	66.3
Where is your farmland located					
Sanctuary	0	7 (50)	8 (72.7)	3 (27.2)	37.5
Forest reserve	0	2 (14.2)	0	1 (9.1)	5.8
Community forest	10(100)	5 (35.7)	3 (27.3)	7 (63.7)	56.6
Does animal raid your crops					
Yes	10 (100)	14 (100)	11 (100)	9 (81.8)	95.4
No	0	0	0	2 (18.2)	4.5
Have you killed them in your farm before					
Yes	6 (60.0)	9 (64.3)	8 (73.0)	9 (81.8)	69.8
No	4 (40.0)	5 (35.7)	3 (27.2)	2 (18.18)	30.3
In your opinion are they increasing or decreasing					
Increasing	0	0	0	0	0
Decreasing	10 (100)	14 (100)	11 (100)	11 (100)	100
If less, what is the cause(s)					
Farming	9 (90)	13 (92.8)	11 (100)	11 (100)	95.7
Hunting	8 (80)	8 (57.1)	11 (100)	11 (100)	84.3
Logging	10 (100)	9 (64.3)	7 (63.6)	11 (100)	81.9
Climate change	6 (60)	5 (35.7)	4 (36.4)	3 (27)	39.7
Others	0	0	0	0	0

Table 10. Logging activities involvement in Afi Mountain Wildlife Sanctuary

Variable	Ebok	Kakukob	Esekwe	Olum	Percentage
Are you a logger					
Yes	2 (13.3)	2 (13.3)	4 (27)	4 (27)	20

No	13 (87.0)	13 (87)	11 (73)	11 (73)	80
What percentage of your household income comes from logging					
Percentage	2 (100)	2 (100)	4 (65)	4 (85)	78
Where do you normally log					
Sanctuary	0	2 (100)	2 (50)	3 (75.0)	56
Forest reserve	0	0	2 (50)	0	12.5
Community forest	2 (100)	0	0	1 (25.0)	31.2
In your opinion are the trees increasing or decreasing					
Increasing	0	0	0	0	0
Decreasing	2 (100)	2 (100)	2 (100)	4 (100)	100
If decreasing what is the likely cause(s)					
Farming	2 (100)	2 (100)	4 (100)	3 (75.0)	94
Logging	2 (100)	2 (100)	4 (100)	4 (100)	100
Hunting	1 (50)	2 (100)	4 (100)	2 (100)	75
Bush burning	2 (100)	2 (100)	4 (100)	4 (100)	100
Others	0	0	0	0	0
If provided an alternative source of income, will you stop logging					
Yes	2 (100)	2 (100)	4 (100)	4 (100)	100
No	0	0	0	0	0

5. DISCUSSION

The roles and effect of support Zone community towards wildlife conservation and management cannot be over expressed. However, overexploitations and illegal activities in and around wildlife pose a threat to their survival, productivity and continuity. The dominant in

male respondent in the study area signify a typical African community. This implies that male compacters participate more in anthropogenic activities in the study area. The level of their education determines the ability of the respondent to see the importance of protected areas.

Land satellite ecology application is still widely used for the purpose of research, its thus reveal the vegetation cover status and the impact on fauna species. Drastic decline in the forest cover was observed over the study period. This change is attributed to increase in activities such as built up, farmland due to continuous influx of people, creating wildlife-human co-habituation. This is in line with the findings of Hammed *et al*. (2017) who reported a continuous change in landuse/land cover due to major anthropogenic activities. Many compelling factors to meet the needs of human ranging from food and income in a way pave way to heavy exploitation of the remaining forest resources in the study area. This is in line with the report of Oyar *et al* (2016); Hammed *et al*, (2017) who observed a decreasing natural vegetated forest areas in most Nigeria protected areas in recent years due to high demand of forest resources.

The sanctuary experience higher level of degradation of vegetation annually for over 36 years. This increase in forest degradation is attributed to increase in population, lumbering activities and other forest resources exploitation, this indicated a loss in habitat and shrinking of forage resources for both grazer and browsers (herbivores). This magnitude of change was higher than the annual rate of change reported by Ogar *et al.* (2016) in Akwa-Ibom State, Nigeria and Jande and Amonjenu (2018) in Apa, Benue state, Nigeria

Encroachment into protected areas like the Afi Wildlife sanctuary causes significant decline in forest resources. Higher number of the support zone communities were involved in hunting, logging and farming activities. Majority of the respondents hunts favorite species like herbivores. This is line with the finding by Adetoro (2014); Sodhi and Ehrlich (2010), who reported negative impact of hunting activities on small to large herbivores in tropical rain forest. The agrarian lifestyle revealed in the study areas is typical of a rural setting in Africa and is in line with the findings by Emulue and Ukandu, (2014). Majority of the respondents acquired their land through inheritance, owning to rapid population increase and demand for more land has been. This of course create room for encroachment to the nearby sanctuary. Extinction of native species is cause by habitant loss in order to make way for crop land expansion within the protected areas. Logging, an act of tree extraction has led to habitat degradation over time, including the Afi sanctuary. This in line with Morgan *et al*. (2018) who link logging activities to decreasing and negative effect on the vegetation cover. The general decline in forest cover of the sanctuary is really threatening the remaining fauna species, especially the mammalian herbivores. If prompt actions are not taken the vegetation component of the sanctuary will be totally lost.

6. CONCLUSION AND RECOMMANDATIONS

This study also revealed method for evaluating the impact of anthropogenic activities on mammalian herbivores in Afi Mountain Wildlife Sanctuary. Protected areas management and conservation requires up to data information on the condition and trend of biodiversity including their distribution and population abundance. The study revealed that anthropogenic activities in the area is mostly caused by farming, hunting, logging and climate change which causes significant decline in forest resources and impacted negatively on wild species survival.

At present the flora and fauna species of this park are under threat due to anthropogenic activities.

The following recommendations are made;

1) Encroachment in the sanctuary in any form should discourage to conserve the remaining resources.
2) Continuous conservation education should be carried out.

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