



Science Forum (Journal of Pure and Applied Sciences)

Journal Homepage: <https://atbu.edu.ng/science-forum/>



Increasing urbanization around the Amurum Forest Reserve: is conservation efforts threatened more by duration of residency or distance of settlement to reserve?

A.A. Chaskda^{1,2}, W.V. Emmanuel², L.G. Turshak³, L.A. Bako¹

¹A.P. Leventis Ornithological Research Institute, University of Jos, P.O. Box 13404, Laminga, Jos-east LGA, Plateau State, Nigeria.

²Department of Zoology, University of Jos, P.M.B. 2084, Jos, Plateau State, Nigeria.

³Department of Science Laboratory Technology, University of Jos, P.M.B. 2084, Jos, Plateau State, Nigeria.

Human population size has surged significantly within the Jos metropolis over the past years consequently, this has led to rapid urban expansion across the landscape. One of the few remaining natural habitats on the Jos-Plateau witnessing such extensive urban drift towards its boundary is the Amurum Forest Reserve (AFR). Thus, of greater concern in relation to the sustainability of the conservation efforts at the AFR is the behavioural and attitudinal changes occurring gradually in the area. Thus, how this differs between old (> 10 years) and new settlers (≤ 10 years) and with proximity of a settlement from the reserve are the major questions this study sort to answer. This was carried out through questionnaire survey of 52-households in each of 4 communities surrounding the AFR namely Kerker (0.76 km from AFR), Laminga (0.99 km), Zarazon (1.85 km) and Kwanga (3.39 km). Due to the count nature of data obtained Chi-square test was used for analysis. Results revealed that old settlers and communities closest to the reserve were more appreciative of the conservation efforts in the area and are more knowledgeable about the presence of the reserve than new settlers. Also, in terms of negative environmental behaviours such as appetite for wildlife (bushmeat) consumption and source of energy for cooking old settlers and communities closest to the reserve ranked highest compared to new settlers and communities furthest from the reserve. However potential for carbon emission through vehicular ownership was higher among new settlers. The negative behaviours observed were viewed to have adverse future consequences on the biodiversity in the reserve. However, if the appropriate livelihood alternatives and enlightenment of the populace is carried out, conservation of the AFR could be sustainable.

ARTICLE INFO

Received 12 November 2023

Received in Revised Form

14 November 2023

Accepted 15 November 2023

Published 15 January 2024

Available online 15 January 2024

KEYWORDS

Urbanisation,
Amurum Forest Reserve,
Duration of residency,
Communities,
Conservation

1. Introduction

Urbanization is one of the major threats to wildlife conservation. This is as a result of its potential to convert natural habitats for human usage by activities such as building and road construction, agriculture, mining and intensive deforestation which distorts natural habitats (Czech *et al.*, 2000; McKinney, 2002; Makane, 2007; Destiartono and Hartono, 2022). Consequently, urbanization is the leading cause of species extinction, deforestation and global warming this is because habitat alteration by urbanization is both drastic and increasingly widespread resulting in de-vegetation of a large portion of land going beyond habitat changes that occurs naturally or due to other land uses (Destiartono and Hartono, 2022).

Human population has surged significantly on the Jos Plateau based on the 2006 national census figures; Plateau State has a population size of 3,206,531 people (National Population Commission, 2023). As a result, urban developments in form of buildings have also increased significantly thereby putting pressure on natural habitats. For example, in a study by Ndace and Danladi (2012) using time series analysis of Landsat MSS Satellite image of an area of the Jos Plateau covering 1,574.13 km² between 1975 to 2005, urban areas were reported to have increased by 18.51 % while natural habitats (forests) contracted by 35.18 % within the same period. One of the few natural habitats still existing on the Jos Plateau and which is currently under conservation is the Amurum Forest Reserve which is a small 300 km² conservatory. The reserve is known for its rich bird diversity. To-date, more than 300 bird species have been recorded in the Reserve including some bird species restricted to the Sudan-Guinea Savanna biome. The Reserve also holds two endemic bird species; The Rock Firefinch *Lagonosticta sanguinodorsalis* and its brood parasite the Jos Plateau Indigobird *Vidua marya* on this basis, the Amurum Forest Reserve is regarded as an Important Bird Area (IBA) (Ezealor, 2002).

Recent relocation of two government agencies, the Jos University Teaching Hospital and the Centre for Remote sensing with a large workforce size of more than one thousand people in both organisations and the rapidly expanding Jos metropolis may have resulted in the observed rapid increase of human settlements around the reserve. This increasing urbanization around the Amurum Forest Reserve raises a lot of questions on the future success of the conservation efforts taking place within and around the area particularly, if the new settlers into the area are coming with negative environmental attitudes. This is important as successful conservation efforts depends largely on the behaviours, attitude, and perceptions of people towards the environment (Nilsson, Fielding and Dean, 2020; Ihemezie et al., 2021).

Therefore, an assessment of the behaviours, attitude and perceptions of people living around protected areas could help expose any such threat to successful conservation and will guide conservation advocates/managers on the best conservation strategies to be adopted (Ihemezie et al., 2021). Thus, this study examined the knowledge and behaviour of old and new settlers around the Amurum Forest Reserve, Nigeria and whether such knowledge and behaviour changes with increasing distance of human settlement to the reserve. This was with a view to understanding any current and future threats to the conservation efforts around the reserve and provide Conservation Managers with information to guide their management strategies.

2. Materials and Methods

2.1. Study area

The study was carried out in Jos East Local Government Area (LGA) of Plateau state, north central Nigeria with the coordinates 9°55'N 9°06'E. In terms of population size, Plateau state is ranked the twelfth largest state in Nigeria. The State has an area of 26,899 Km² with an estimated population size of 3,206,531 people based on the 2006 national census (National

Population Commission, 2014). Average temperature on the Jos Plateau ranges between 18 and 22 °C. The mean annual rainfall varies from 131.75 cm in the southern area of the state to 146 cm in the northern part.

Jos east LGA where data collection took place is located north-east of Plateau state. The LGA has an area of 1,020 km² and a population of 85,602 people as at 2006 National Census (National

Population Commission, 2014). Data was collected in four communities surrounding the Amurum Forest Reserve based on their proximity to the reserve and the perception by the researcher that activities in the communities could harm conservation efforts in the reserve or wide-ranging animals from the reserve. These communities and their various distances from the reserve are shown in Fig. 1 below:

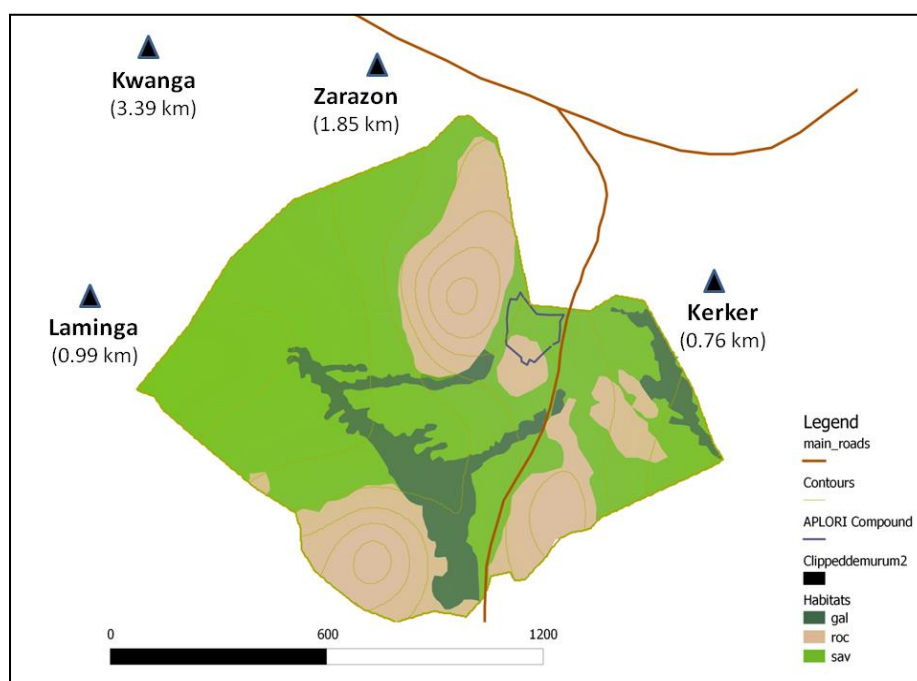


Figure 1. Map of Amurum Forest Reserve with study communities and their various distances from the reserve.

2.2. Study period

The study was carried out at the peak of the rainy season and towards its end precisely from 3rd May to 30th September, 2013. There were intense agricultural activities at the time of the survey with often cloudy and rainy days.

2.3. Data collection

Data collection was done using questionnaire. The questionnaire had two sections; Section A

and Section B. the former where mainly personal questions tailored to collect demographic data such as age, occupation and community of the respondent while the latter section had questions that evaluated the knowledge and behaviour of the respondents towards nature conservation. This focused on the following:

- i. Their knowledge about the existence and purpose of the Amurum Forest Reserve.
- ii. Appetite for wildlife consumption.

- iii. Source of energy for cooking.
- iv. Potential for increased carbon emissions in the area.
- v. Appreciation of the importance of wildlife conservation.

At each of the four communities surveyed, 52 individuals in separate households were randomly sampled giving a total sample size of 208 respondents. Before administering the questionnaire, the researcher introduced himself and explained the purpose for the research. After obtaining respondent's permission, a copy of the questionnaire was given to be filled by the respondent. However, the researcher assisted to fill in the responses of respondents that do not know how to read and write.

2.4. Data analysis

The SPSS Statistical Package (version 17.0) was used for data analysis. The Chi-square test was used to compare respondent's views or attitude as was in the questionnaire. This was because the data obtained was of a count nature; similar responses were counted and compared with those that negate a particular view or attitude.

3.1. Data description

A total of 208 respondents per household were examined using questionnaire during the study; this translated to 52 respondents in each of the four communities surveyed namely Laminga, Kerker, Zarazon and Kwanga. Respondents age ranged from 20 to 91 years old (with an average age of 40 years). The age bracket for most respondents was 20-30 years (36 %) followed by the age bracket 41-50 years (23 %). The occupation of respondents from the largest to the least include civil servants (28.4 %), farmers (27.4 %), business owners (16.8 %), students (16.3 %) and others (11.1 %).

3.2. Knowledge about Amurum Forest Reserve

Based on the duration of residency, old settlers (> 10 years of residency) knew more about the existence of the reserve as compared to new settlers (< 10 years of residency) ($\chi^2 = 32.453$, $df = 1$, $P < 0.001$; Table 1). Also, knowledge about the existence of the reserve decreased the further away a settlement was from the reserve such that residents of Kwanga located 3.39 km away knew less about the reserve in comparison to closely located residents of Kerker (0.76 km) and Laminga (0.99 km) ($\chi^2 = 60.513$, $df = 3$, $P < 0.001$; Table 2)

3. Results

Table 1. knowledge about Amurum Forest Reserve based on duration of residency.

Duration of residency	Yes know the reserve	Percentage of total	Don't know the reserve	Percentage of total	Total
	Number		Number		
Old settlers (> 10 years)	129	97.7	3	2.3	132
New settlers ($\leq$ 10 years)	54	71.1	22	28.9	76

Table 2. knowledge about Amurum Forest Reserve based on distance of surrounding settlements to reserve.

Settlement	Distance (km)	Yes know the reserve Number	Percentage of total (%)	Don't know the reserve Number	Percentage of total (%)	Total
Kerker	0.76	51	98.1	1	1.9	52
Laminga	0.99	52	100.0	0	0.0	52
Zarazon	1.85	50	96.2	2	3.8	52
Kwanga	3.39	30	57.7	22	42.3	52

3.3. Appetite for wildlife consumption by residents around the Amurum Forest Reserve

The various animal species reported to be consumed as bush meat in the area by respondents are shown in Table 3 with rabbit ranking the highest on the list followed by monkey and squirrel respectively. In terms of duration of residency, old settlers had the highest

percentage of households that consumed bush meat (i.e. 93.18 %) compared to the new settlers (85.53 %) ($\chi^2 = 3.252$, $df = 1$, $P = 0.07$; Table 4). Closest settlements to the reserve namely; Laminga, Zarazon and Kerker communities had the highest percentage of households that consume bush meat in relation to Kwanga which is the distant settlement ($\chi^2=19.915$, $df=3$, $p<0.001$; Table 5).

Table 3. Animal species consumed as bush meat by residents around the Amurum Forest Reserve.

S/n	Animal type	Number of respondents	Percentage of total (%)
1	Rabbit	120	65.57
2	Antelope	5	2.73
3	Rat	2	1.09
4	Crocodile	1	0.55
5	Porcupine	7	3.83
6	Monkey	14	7.65
7	Bush buck	1	0.55
8	Squirrel	11	6.01
9	Grass cutter	10	5.46
10	Baboon	1	0.55
11	Bufallo	3	1.64
12	Birds (Bird, Dove, Stone Patridge)	5	2.73
13	Mouse	1	0.55
14	Agama lizard	1	0.55
15	Grasshopper	1	0.55
	Total	183	≈100

Table 4. Differences between old and new settlers in terms of bush meat consumption

Settlement	Number eating bush meat	Percentage of total (%)	Number not eating bush meat	Percentage of total (%)
Old settlers	123	93.18	9	6.82
New settlers	65	85.53	11	14.47

Table 5. Differences in number of households consuming bush meat per community surrounding the Amurum Forest Reserve

Settlement	Distance to Reserve (km)	Number eating bush meat	Percentage of 52 households sampled per community (%)	Number not eating bush meat	Percentage of 52 households sampled per community (%)
Kerker	0.76	50	96.15	2	3.85
Laminga	0.99	51	98.08	1	1.92
Zarazon	1.85	48	92.31	4	7.69
Kwanga	3.39	39	75.00	13	25

3.4. Source of energy for cooking

Choice of energy used for cooking ranges widely across the 208 households examined. The energy types include Fuel wood, Charcoal, Kerosene and Gas cooker among which fuel wood had the highest number of users (Table 6).

Firewood and charcoal usage were significantly used daily than occasionally by residents around

the reserve ($\chi^2 = 468.827$, $df = 4$, $P < 0.001$; Table 7). Old settlers were also observed to use firewood and charcoal more often than new settlers ($\chi^2 = 55.027$, $df = 4$, $P < 0.001$; Table 8). Similarly, usage was also observed to be more regular by all three settlements that were closest to the reserve than the farthest settlement ($\chi^2 = 55.027$, $df = 4$, $P < 0.001$; Table 9).

Table 6. Energy types used by households around the Amurum Forest Reserve.

Energy type	Number of respondents	Percentage of total
Fuel wood	138	66.35
Charcoal	2	0.96
Kerosene	13	6.25
Gas cooker	14	6.73
Kerosene + Fire wood	23	11.06
Kerosene + Charcoal	3	1.44
Kerosene + Gas cooker	3	1.44
Gas cooker + Fire wood	3	1.44
Kerosene + Gas cooker + Charcoal	2	0.96
Kerosene + Gas cooker + Fire wood	2	0.96
Kerosene + Fire wood + Charcoal	5	2.40
Total	208	≈100

Table 7. How often firewood or charcoal is used by residents around the Amurum Forest Reserve.

Frequency	Number of respondents	Percentage of total
Daily	165	79.3
Once a week	5	2.4
More than once a week but not daily	8	3.8
Once in two months	1	0.5
Never	29	13.9
Total	208	≈100

Table 8. Frequency of usage of firewood/charcoal based on duration of residency

Duration of residency	Frequency					Total
	Daily	Once a week	More than once a week but not daily	Once in two months	Never	
	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	
Old settler	123 (93.2)	1 (0.8)	6 (4.5)	0 (0)	2 (1.5)	132
New settler	42 (55.3)	4 (5.3)	2 (2.6)	1 (1.3)	27 (35.5)	76
Total	165	5	8	1	29	208

Table 9. Frequency of usage of firewood/charcoal based on distance of settlement to reserve

Occupation	Distance (km)	Frequency					Total
		Daily	Once a week	More than once a week but not daily	Once in two months	Never	
		Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	
Kerker	0.76	49 (94.2)	1 (1.9)	1 (1.9)	0 (0)	1 (1.9)	52
Laminga	0.99	52 (100)	0 (0)	0 (0)	0 (0)	0 (0)	52
Zarazon	1.85	43 (82.7)	3 (5.8)	3 (5.8)	0 (0)	3 (5.8)	52
Kwanga	3.39	21 (40.4)	1 (1.9)	4 (7.7)	1 (1.9)	25 (48.1)	52
Total		165	5	8	1	29	208

3.6. Potential for carbon emission around the Amurum Forest Reserve

Carbon emission as determined by numbers of cars owned by residents was significantly higher

among new settlers than old settlers ($\chi^2 = 16.678$, $df = 1$, $P < 0.001$; Table 10). Also, carbon dioxide emission was highest in communities furthest away from the reserve namely Zarazon and Kwanga ($\chi^2 = 47.33$, $df = 3$, $P < 0.001$; Table 11).

Table 10. Potential of carbon dioxide emission based on duration of residency around the Amurum Forest Reserve.

Duration of residency	Number owning a car	Number Not owning a car	Mean number of cars per household $\pm$ S.E.	Total
	Number (%)	Number (%)		
Old settler (> 10 years)	40 (30.3)	92 (69.7)	0.45 $\pm$ 0.06	132
New settler ($\leq$ 10 years)	45 (59.2)	31 (40.8)	0.78 $\pm$ 0.08	76

Table 11. Potential of carbon dioxide emission based on settlements around the Amurum Forest Reserve.

Settlement (Distance to Amurum Forest Reserve)	Number owning a car	Number Not owning a car	Mean number of cars per household $\pm$ S.E.	Total
	Number (%)	Number (%)		
Kerker (0.76 km)	16 (30.8)	36 (69.2)	0.44 $\pm$ 0.10	52
Laminga (0.99 km)	5 (9.6)	47 (90.4)	0.13 $\pm$ 0.06	52
Zarazon (1.85 km)	26 (50.0)	26 (50.0)	0.73 $\pm$ 0.12	52
Kwanga (3.39 km)	38 (73.1)	14 (26.9)	0.96 $\pm$ 0.09	52

3.7. Appreciation of wildlife conservation among residents surrounding the Amurum Forest Reserve.

Appreciation of wildlife conservation was high among both old and new settlers in comparison to those within each group that do not appreciate

it ($\chi^2 = 1.194$, $df = 1$, $P = 0.274$; Table 12). Also, residents of Laminga and Kwanga (the farthest) also showed the highest appreciation for wildlife conservation among the settlements sampled ($\chi^2 = 4.92$, $df = 3$, $P = 0.177$; Table 13) although these were not significant.

Table 12. appreciation of wildlife conservation based on duration of residency

Duration of residency	Yes important to conserve	it's to	Percentage of total (%)	Not important to conserve	Percentage of total (%)	Total
	Number			Number (%)		
Old settler (> 10 years)	99		75.0	33	25.0	132
New settler ($\leq$ 10 years)	62		81.6	14	18.4	76

Table 13. Appreciation of wildlife conservation based on distance of settlement to reserve

Settlement (distance from Amurum Forest Reserve)	Yes important conserve	it's to	Percentage of total	Not important to conserve	Percentage of total	Total
	Number			Number		
Kerker (0.76 km)	36		69.2	16	30.8	52
Laminga (0.99 km)	44		84.6	8	15.4	52
Zarazon (1.85 km)	38		73.1	14	26.9	52
Kwanga (3.39 km)	43		82.7	9	17.3	52

4. Discussion

This study examined the effect of increasing urbanisation towards the boundary of the Amurum Forest Reserve (AFR) an important bird and biodiversity area. The study focused on knowledge and behaviours of old and new settlers coming into the community and how these behaviours differ across the various communities that surround the reserve considering the proximity of the communities to the reserve.

In terms of knowledge about the existence of the reserve and appreciation of the conservation efforts in the area, majority of old settlers showed such higher knowledge and appreciation in comparison with new settlers. Also, knowledge about the reserve and appreciation of wildlife conservation in the area appears to decrease with increasing distance of a settlement away from the reserve. This is expected as old settlers constitute mostly the natives of the area that are very conversant with the general environment and institutions around them compared to new residents. Similarly, communities residing closest to the reserve and the old settlers are the most positively impacted in terms of employment at the AFR as majority of the workforce of the reserve are drawn from the adjoining communities and natives of the area based on the Memorandum of Understanding among the partners establishing the protected area.

However, behaviours such as appetite for wildlife (bushmeat) consumption, source of energy for cooking were more common among old settlers

and communities closest to the reserve as compared to those farthest away from it.

Its alarming that communities closest to the reserve have high appetite for wildlife consumption and the fact that this spreads across various animal species. The fact that this is common among old settlers than new ones suggest long standing traditions. However, it is gladdening to know that majority of respondents have higher appetite for rabbits (65 %). This animal has been widely domesticated in the country; thus, it is viewed that by encouraging members of the community to take up rabbit farming, long term benefits in terms of reduced hunting pressure on fauna in the area could be achieved. Previous studies have shown that when communities are provided with alternatives/benefits for conserving biodiversity, conservation goals could be achieved (Kadigi et al., 2022; Gidebo, 2023; Samal and Dash, 2023).

It's also not encouraging that the major source of cooking energy among communities closest to the reserve and among old settlers is fuelwood and charcoal. Fuelwood utilisation in rural communities in the country is attributed often to high poverty levels and weak purchasing power of the rural populace as observed in our study communities (Isaac et al., 2020). Most of the fuelwood extraction occurring at the study site at the moment appears to be coming from trees and shrubs within the community due to the presence of enforcement personnel in the reserve and mainly because the area is still largely rural with communal bushes which provides the space for the extraction of such fuelwood plants.

However, it is feared that as the general area becomes more urbanised with increased human population as it is currently happening, this natural vegetation in the community may become more rapidly decimated and inadequate to meet the needs of the growing population in the long term. This may in the end exert more pressure on the plant resources in the reserve if alternatives such as community fuel wood lots and fuel-efficient stoves are not provided. A major shift towards other sources of cooking energy such as liquefied petroleum gas (LPG) and kerosene stoves as seen among new settlers could also mitigate against the potential problem. Studies that have shown rapid decline in amount of vegetation surrounding communities in the presence of increased urbanisation are quite common (Ndace and Danladi, 2012; Maina et al., 2020; Destiartono and Hartono 2022). Thus, if conservation of the Amurum Forest Reserve is to be sustainable its imperative that these alternatives are considered.

Conversely, the potential for increased carbon emission in terms of the number of cars owned was more widespread among new settlers and communities farthest from the reserve. Although use of fuel wood and charcoal are also major sources of carbon emission however increased vehicular presence in the communities around the reserve adds to this negative environmental problem. New settlers coming into the community are more of civil servants renting or building their houses closer to their workplace. These members of the community are more affluent and have higher purchasing power and more enlightened as can be seen in their use of better cooking energy in their homes.

Generally, our findings reveal that with the expansion of the Jos metropolis towards the Amurum Forest Reserve with new settlers coming into its adjoining communities more pressure could be exerted on the biodiversity of the area. Thus, to ensure the sustainability of the conservation efforts of the AFR, a change in behaviour of both old and new settlers is required. This can be achieved by encouraging the use of alternative sources of livelihoods and environmental education.

References

- Czech B, Krausman PR, Devers PK. Economic association among causes of species endangerment in the United States. *Bioscience* 2000; 50:593-601
- Destiartono M, Hartono D. (2022). Does Rapid Urbanization Drive Deforestation? Evidence From Southeast Asia. *Economics Development Analysis Journal* 2022; 11(4):442-453.
- Ezealor, A.U. ed. Critical sites for biodiversity conservation in Nigeria. Nigerian Conservation Foundation: Lagos, Nigeria 2002; pp 110.
- Gidebo HB. (2023). Linking livelihood and biodiversity conservation in protected areas: Community based tourism development perspective from developing country. *Tourism and Hospitality Research* 2023; 23(3):361-375. <https://doi.org/10.1177/14673584221102699>
- Ihemezie EJ, Nawrath M, Strauß L, Stringer LC, Dallimer M. The influence of human values on attitudes and behaviours towards forest conservation. *Journal of Environmental Management* 2021; 292:article 112857
- Isaac I, Habila J, Salami H, Ibrahim Y, Danlami G, Ogwu RO, Yakatun MM. Socioeconomic determinants of wood fuel energy consumption in Minna, Nigeria. *International Journal of Scientific Research in Multidisciplinary Studies* 2020; 6(2): 40-46.
- Kadigi WR, Ngaga YM, Kadigi RMJ. Perceptions of smallholder farmers on nature-based income generating activities as potential livelihood and biodiversity conservation strategies in Uluguru Mountains, Tanzania. *Journal of Development and*

- Agricultural Economics 2022; 13(2): 174-191.
- Makane, OM. (2007). Adoption of improved stoves and deforestation in Zanzibar. *Management of Environmental Quality* 2007; 18(3): 353-365.
- Maina YB, Umar NK, Egbedimame AB. An Empirical Analysis of the Impact of Household Fuel Wood Consumption on the Environment in Nigeria. *FUTY Journal of the Environment* 2020; 14(3): 35-46.
- McKinney ML. Urbanization, biodiversity and conservation. *Bioscience* 2002; 52:883-890
- National Population Commission (2023). Publications <http://www.population.gov.ng/publications>. Accessed 27/10/2023.
- Ndace JS, Danladi MH. Impacts of derived tin mining activities on landuse/landcover in bukuru, Plateau state, Nigeria. *Journal of Sustainable Development* 2012; 5(5): 90-100.
- Nilsson D, Fielding K, Dean AJ. Achieving conservation impact by shifting focus from human attitudes to behaviors. *Conservation Biology* 2020; 34(1):93-102.
- Samal R, Dash M. Ecotourism, biodiversity conservation and livelihoods: Understanding the convergence and divergence. *International Journal of Geoheritage and Parks* 2023; 11(1): 1-20.