



PRIMATE CROP RAIDING IN KAINJI LAKE NATIONAL PARK, NIGERIA: AN ANALYSIS OF VULNERABILITY INDICATORS AND FARMERS PERSPECTIVES FOR EFFECTIVE CONSERVATION

¹Modu, M., ²Yager, G. O., ¹Modu, M. B and ³Adedoyin, S. O.

¹Department of Forestry and Wildlife, University of Maiduguri, Nigeria

²Department of Wildlife and Range Management, Joseph Sarwuan Tarka University

³Department of Forestry and Wildlife, Prince Abubakar Audu University, Anyigba, Nigeria

ABSTRACT

Human-primate conflict is a persistent challenge in conservation efforts. The study investigates vulnerability indicators of crop damage by primates and farmers attitudes towards conservation in Kanji Lake National Park, aiming to inform effective conflict mitigation strategies. Direct method and structured questionnaire were used to obtain information on crop damage severity, farmer perceptions and conservation attitudes. The Completely Randomised Design (CRD) was used in comparing vulnerability indicators that predisposed primates to conflict and the relationship between vulnerability indicators to crop damage intensity was determined using Karl Pearson's product moment coefficient of correlation. Descriptive statistics and Chi-square test analyses were adopted to reveal the opinions of respondents for significant differences on farmer's attitudes and perceptions for effective conservation. The results show a significant correlation between crop damage and vulnerability indicators thus, highlighting the need for effective conflict mitigation strategies. The results revealed that the identified key vulnerability indicator, numbers of standing crops (0.015) differed significantly among the ranges of the park ($P < 0.05$). Nevertheless, farm sizes (0.068) were not significantly different among ranges ($P > 0.05$). Farm distance to park has positive correlation with farm size ($r = 0.203$) and number of standing crops ($r = 0.310$). Similarly, there were strong correlations between farm size and number of crops damaged ($r = 0.680$). In respect to conservation attitudes 74% of the respondents were in support of primate conservation, 38% wished that primates should be exterminated to stop crop damage and economic losses. 40% of the respondents supported the use of lethal methods for preventing primates from raiding crops while 53.1% were of the opinion that zone dwellers should be allowed to hunt. The findings highlighted the need for conservation efforts, emphasizing the importance of

¹ Corresponding Author: malamodu50@unimaid.edu.ng +2347036018560

addressing human-primate conflict through collaborative approaches that consider both human livelihoods and wildlife conservation.

Keywords: human-primate conflict, crop damage, farmers attitudes, vulnerability indicators, conservation, Kanji Lake National Park.

INTRODUCTION

The delicate balance between human livelihoods and wildlife conservation is a pressing concern in many parts of the world. In Kanji Lake National Park, a protected area renowned for its rich biodiversity, the conflict between humans and primates is a long standing issue. Crop raiding by primates, particularly Baboon (*papio anubis*), has resulted in significant economic losses for local farmers, leading to tensions and retaliatory actions against the primates (Modu *et al.*, 2023). Conservation efforts aim to protect the primates and their habitats is crucial to sustainable management of the protected area. To effectively manage human-primate conflict, it is essential to understand the vulnerability indicators of crop damage by primates and the attitudes of farmers towards primate conservation.

Crop-raiding was experienced close to forest; however, highest damage values were experienced at a distance more than 700 m. This pattern may be explained by the fact that more households are situated away from the forest edge and there were more farms surveyed at this distance. Aharikundira and Tweheyo (2011), stated that the determining factor for these human-primate conflicts is proximity to the habitat. In the Ngangao area, many people living further away from the forest mentioned their furthest locations serve as a preventive factor for primate crop-raiding.

Primates engender a range of different, and often conflicting, perceptions among people. It is important to investigate the opinions held towards these animals in attempting to alleviate human-primate conflict (Simons and Meyers, 2011). An important component of wildlife conservation, and the management of human-wildlife conflict, is therefore the examination of people's behaviour and perceptions regarding wildlife and the factors that influence these perceptions (Riley and Priston, 2010). Hence, conservation can no longer be considered in isolation from the economic and social interests of people, and more so human-wildlife conflict. Perceptions influence attitudes towards wildlife and attitudes can be useful indicators of behaviour. When local people attach a negative value to wildlife, they will not support its continued existence in the region. This indicates that conservation depends on local community support (Hill, 2014).

People's attitudes towards wildlife are complicated and as such conflict scenarios are rarely simple. Attitudes are certainly more complex and nuanced than simply being positive or negative. It is often difficult for people involved in conflict to say whether they like or dislike the wildlife involved (Goldman *et al.*, 2010). Perceptions also vary within and between communities (Gifford and Nilsson, 2014). A number of studies have revealed that age, gender, ethnicity, level of education, political attitude, landholding size, period of residency and religion all influence attitudes towards wildlife (Gifford and Nilsson, 2014), but the same patterns are not always revealed. Attitudes also exhibit regional differences. It is often the distance a person resides from a wildlife area that most strongly influences attitudes. This is true because most people living closer to wild areas hold more negative views towards wildlife (Nijman and Nekaris, 2010). The study compares these vulnerability indicators, providing

insights for sustainable coexistence and informed conservation strategies in Kanji Lake National Park.

METHODS AND MATERIALS

Study Area

Kainji Lake National Park (KLNP) is geographically located between Latitudes 9° 40' and 10° 20' N, and Longitude 3° 40' and 5°10'E. The study area (KLNP) which has a savannah climate has a total land area of 5,340.82 sq km and is located in the North West central part of Nigeria between Niger and Kwara States (Marguba, 2002). The area has two distinctive sectors known as the Borgu and Zugurma Sectors (Marguba, 2002). Kainji Lake National Park was established as Premier Park in Nigeria on 29th July 1979 by the amalgamation of the two existing Game Reserves, Borgu and Zugurma sectors under decree 46 of 1976 replaced by decree 36 of 1991. Zugurma Sector covers an area of 1370.89km² and it is situated in Mashegu Local Government Area of Niger State while Borgu sector is located in Borgu Local Government Area of Niger State in Kaiama and Barutten Local Government Areas of Kwara state. It covers an area of 3970.02sqkm. Both sectors (Zugurma and Borgu) are separated by the Kainji Lake, a lake impounded on the river Niger for hydroelectric power generation (Eleazor, 2002) as shown in Figure 1.

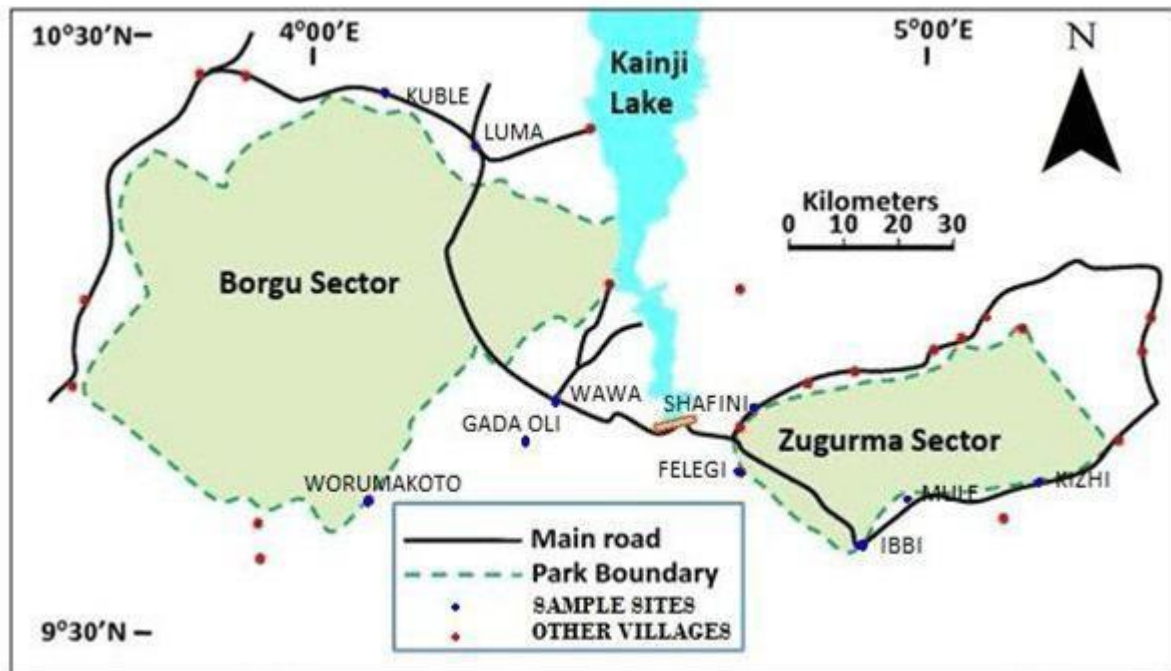


Figure 1: Map of Kainji Lake National Park, Nigeria

Source: Digitized from Google Earth Pro (May, 2018): GIS Laboratory, Dpt. of Geography, UNIMAID

Sampling technique and data collection

Purposive sampling technique was used in data collection. This involved the selection of communities with serious presence of human-primate conflict in the study area. Ten (10) communities with human-primate conflict were selected. The communities included Mazakuaka, Felegi, Patiko, Woko, Worumakoto, Kemanji, Luma, Kulho, Ibbi and Dekara. Simple random sampling was used to select respondents from each community. The respondents included farmers, civil servants, traders, students, pastoralists and hunters. The number of respondents selected in each community shown in (Table 1) was determined using the probability proportional formula as adopted by Amaja *et al.* (2016). The formula is stated as follows;

$$n = \frac{Z^2 PQ / d^2}{1 + \frac{1}{N} \left[\frac{Z^2 PQ}{d^2} - 1 \right]}$$

Where: n = desired sample size when population is less than 10000
 Z = standard normal deviation (1.96 for 95% confidence level)

P = 0.1 (proportion of population to be included in sample, that is, 10%)

Q = is 1-P, that is, (0.9)

N = is total number of population and d

= is degree of accuracy desired (0.05)

Distances and size of farmlands (maximum of 16) at 8 (ranges) of the park, locations closest to the park boundary at both sectors of the park were measured and the number of crop damage and number of standing crop were enumerated and their relationship to crop damage intensity was determined.

Table 1: Number of Respondents randomly selected from each community

Community	Population	Number of respondents sampled
Mazakuka	150	15
Feleji	200	20
Patiko	149	15
Woko	150	15
Worumakoto	200	20
Kemanji	499	50
Luma	500	50
Kulho	350	35
Ibbi	530	53
Dekara	300	30
Total	3028	303

Data Analysis

Questionnaires data were analyzed using SPSS version 20 software and MS Excel. Accordingly, descriptive statistics in form of frequency analysis, cross tabulation and percentages were used for the analysis of the vulnerable factors that increase conflict and crop losses associated with primate crop damage. Chi-square test analysis was adopted to reveal the opinions of respondents for significant differences. The one way classification analysis or Completely Randomised Design (CRD) was adopted to compare the variation in crop damage intensity among some indicators of vulnerability of primate to crop damages. The relationship between vulnerability factors to crop damage intensity such as farmland distances to the cutline of the park, sizes of the farmland, number of crops damaged and number of standing crops was determined using Karl Pearson's product moment coefficient of correlation. The statistical model for the designs is given as follows:

$$\chi^2 = \sum \frac{(o_{ij} - e_{ij})^2}{e_{ij}}$$

Where:

χ^2 =Chi-square value

o_{ij} = Observed values (respondents opinions)

e_{ij} = Expected values

$Y_{ij} = u + T_j + e_{ij}$ Where:

Y_{ij} = Crop damage intensity of each primate species (i.e. individual observations). u

= general mean

T_j = Effect of the primate species. e_{ij} = Experimental error containing all uncontrolled sources of variations.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Where:

r = Correlation coefficient n =

Number of pairs of values

x = Crop damage intensity on the different farmlands

y = distances from farmlands to the cutline of the park, or sizes of the farmland, or number of crops damage, or number of standing crops

RESULTS

Comparing vulnerability indicators of primates to crop damage among the ranges in KLNP

Table 2 presents the result of analysis of variance for comparing some indicators of vulnerability of primates to crop damage and conflicts with farmers among the ranges of the park. The results revealed that distance of park to farmlands, numbers of crops damaged and numbers of standing crops differed significantly among the ranges ($P < 0.05$). Nevertheless, farm sizes were not significantly different among the ranges ($P > 0.05$).

Table 2: ANOVA Results for Vulnerability Indicators among the Ranges

Variables	SV	df	SS	MS	F	P
Farm distance to park (km)	Range	6	65812526	10968754	115.50	0.000
	Error	14	1329536	94967		
	Total	20	67142061			
Farm size (acre)	Range	6	31.57	5.26	2.57	0.068
	Error	14	28.67	2.05		
	Total	20	60.24			
Crops damaged	Range	6	36122502	6020417	20.06	0.000
	Error	14	4202613	300187		
	Total	20	40325114			
Standing crops	Range	6	389000000	448270952	4.00	0.015
	Error	14	226800000	162021548		
	Total	20	615800000			

The relationship among vulnerability indicators to crop damage in the study area

The result of correlations among vulnerability indicators are presented in Table 3. All the four variables have direct relationships. For instance, farm distance to park has positive but weak correlation with farm size ($r = 0.203$) and number of standing crops ($r = 0.310$). Nevertheless, there was a strong correlation between farm distance and the number of crop damaged ($r = 0.637$). Similarly, there were strong correlations between farm size and number of crops damaged ($r = 0.680$) as well as the number of standing crops ($r = 0.846$). Number of crops damaged also strongly correlated with the number of standing crops, which implied that the more crops were on the farmland, the more the damages by the primate species in the area.

Table 3: Product Moment Correlation Coefficients for Vulnerability Variables

	FDP	FS	NCD	NSC
FDP	1			
FS	0.203	1		
NCD	0.637	0.680	1	
NSC	0.310	0.846	0.762	1

N.B.: $\alpha = 0.05$; FDP = farm distance to parks; FS = farm size; NCD = number of crop damaged; NSC = number of standing crops

Perceptions and attitude of Respondents towards Conservation and Management of Primates around KLNP

Table 4 presents the perception and opinions of respondents towards conservation and management of the primate species in the study area. About 74% of the respondents were in support of primate conservation in the area while 26.1% were not. With regard to the continued existence of the park in the region, 75.8% were in support while 24.2% wished that the park did not exist in the area. Only 38% of the respondents wished that the primates should be exterminated to stop crop damage, and prevent further economic losses. However, 66% of the respondents were of the view that primates are resources to be exploited while 34% did not see primate in that manner. Nevertheless, 43.2% of the respondents were of the opinion that primate population should increase while 56.8% prayed against that. In respect of primates conservation and continued existence of the park, respondents were unequally divided in their opinions, but skewed towards the continued existence of the park and primate conservation ($P < 0.05$).

Table 4: Attitude and Perceptions of Respondents towards Primates Conservation in the Study Area

Variables	Frequency	Percentage	P
Attitude on primate conservation Supported	224	73.9	0.00
Not supported	79	26.1	
Total	303	100	
Opinion on continuing existence of the park in the region Yes	229	75.8	0.00
No	73	24.2	
Total	302	100	
Opinion on whether primate should be exterminated Yes	115	38.0	0.00
No	188	62.0	
Total	303	100	
Belief that primate are resources for exploitation Yes	200	66.0	0.00
No	103	34.0	
Total	303	100	
Opinion that primate population should increase Yes	131	43.2	0.00
No	172	56.8	
Total	303	100	

$\alpha = 0.05$

Perspectives on the use of lethal method for prevention and Access to Hunting in KLNP

The Perspectives on the use of lethal method for prevention and Access to hunting are presented in Table 5. About 40% of the respondents supported the use of lethal methods for preventing

primates from raiding crops while 60.1% did not. On the other hand, 53.1% of the respondents were of the opinion that zone dwellers should be allowed to hunt while 46.9% did not support the idea (Table 5). However, with respect to access to hunting, there were equal distributions of opinions among respondents indicating a win-win situation as $P > 0.05$ (Table 5). **Table 5:**

Perspectives on the Use of Lethal Method for Prevention and Access to Hunting

<u>Variables</u>	<u>Frequency</u>	<u>%</u>	<u>P</u>
Perspectives on use of lethal method			
Supported	121	39.9	0.00
Not supported	182	60.1	
Total	303	100	
Access to Hunt			
Supported	161	53.1	0.30
Not supported	142	46.9	
Total	303	100	

$\alpha = 005$

DISCUSSION

The study revealed vulnerability indicators that influence primates to conflicts and crop damage in the study area. Vulnerability indicators like crop type, proximity to primate habitats, and lack of effective deterrents may lead to higher crop damage and loss. Repeated crop raids by primates can result in reduced yields, impacting farmers' livelihoods and food security. Crop damage can lead to significant economic losses for farmers, affecting their ability to invest in sustainable agricultural practices. Proximity of the farmlands to the protected area is a major indicator for crop raiding by primate. This is in line with Datiko and Bekele (2013) report that people who live close or near park area generally faced many problems of human-primate conflict than those living far from the park. In addition, Wallace and Hill (2012) reported that the distance of farmland from forest edge is directly related to human wildlife conflict. Other vulnerability indicators that predisposed crop raiding are the farm location, size and number of standing crops. In this respect Nijman and Nekaris (2010) reported that farm location and size and number of standing crops, affect the frequency, duration and type of crop raids, and therefore the extent of damage sustained.

The vulnerability indicators contribute equally to crop loss during crop raid. The statistical analysis confirmed that farm distance and number of standing crops irrespective of farms sizes were the major vulnerability indicators. This agrees with the report of Hansen (2013) and Priston *et al.*, (2012) that primates predominantly raided crops within 10 meters of farm-forest edges.

Association between vulnerability indicators to crop damage by primate on studied farms indicated positive relationships. Damage on standing number of crops had significantly reduce as distance travelled onto farm from park increases ($r = 0.637$). Number of crops damaged correlated positively with size of farms ($r = 0.680$) and standing crops ($r = 0.846$) with implication suggesting that more crop were loss in larger farm size with greater number of standing crops. The correlation model for all number of crops damaged by primate estimates shows that there is a significant increase in crop damage as all three parameters of damage, that is, farm distance to park, farm size and number of crops involved were related. However, Number of crops damaged involved in raiding is clearly the best predictor of damage, strongly

correlated with farm distance and standing crops respectively. Such a high correlation does indicate however that closeness of farm distance to park and taking into account the number of crop in field is the most vulnerability indicator that allows for raid and subsequent damage to crops. Although the key parameters determining crop loss were farm distance to forest and number of standing crop loss were farm distance to forest and number of standing, previous studies reported by Wallace and Hill (2012), indicated that travelling progressively further from forest was often necessary to access more stems during raids. Distances were tied to crop location and preference when baboons or chimpanzees targeted mangos, papaya, or jackfruit, usually grown relatively far from forest.

Understanding the perception and attitude of local communities is essential, especially where their livelihood depends on agriculture and forest resources. Such information is crucial for the success of biodiversity conservation programmes, since the role of the local people is primary to sustainability of biodiversity. The findings of this study in this regard indicated that majority of the respondents supported primate's conservation and continuing existence of the park in the area. Findings of separate studies by Newmark and Leonard (2013), Infield (2008) and Harcourt *et al.* (2016) conducted around conservation areas on human-wildlife conflicts are in consonance with the results of this study. Evidence of the attitudinal support in the current study is shown by the existence of primate populations with potential for growth in the park. The result further implies that the control measures mainly non supportive to lethal method to decimate the populations of primate species in the park. The positive attitude and perception of the respondents towards primate's conservation and existence of the park as revealed in this study, may not be unconnected with some benefits derivable from the park, which overrides the cost of losses being sustained from crop damage. Such benefits as observed were provision of feeder roads, portable water, health center, schools and payment of compensation for crop damage. The attitudinal assessment of the local communities in the study area provided insight into how the local people comply with wildlife protection regulations, their response to economic losses through crop damage and their willingness to coexist with wildlife. This is in agreement with Zafferet *al.* (2015) observations in a separate study in which they stated that efforts must be made by the management of conservation areas to ensure that wildlife conservation policies and programmes are sensitive to the local people's socio-economic and cultural conditions. This implies that the positive attitude of the support zone dwellers to the park and its resources should not be taken for granted. The park must articulate and execute policies and programmes that can prevent human-wildlife conflict in order to ensure total support of the local dwellers for the park.

Lethal methods are considered to be those techniques that cause or are closely associated with the death of animals. The Perspectives on the use of lethal method for prevention, 40% of the respondents supported the use of lethal methods for preventing primates from raiding crops. The main justification for lethal control, and removal in all its forms, is conflict prevention and the underlying assumption is that conflict declines when wild animals are removed. Despite the devastating history of many lethal control programmes, removal may have a legitimate role in wildlife conservation. Well managed lethal control has the potential to reduce threats to human lives and livelihoods without entailing serious extinction risks (Treves, 2005).

However, with respect to access to hunting, there were equal distributions of opinions among respondents indicating 53.1% of the respondents were of the opinion that zone dwellers should be allowed to hunt. Hunting is often considered as a major contributor to livelihoods, sources of food and as income, particularly for rural communities, (Mikolo and Ito 2015), and food

security, sociocultural customs and obligations and leisure (Noumbissi, 2013). In this study households in the sample population respondent were mostly farmers, and thus they relied more on agricultural products. Hunting of animals represent the least important source of income and food for the rural households when compared to agricultural sources of income and food. This agreed with the findings of Levang *et al.* (2015) that the current contribution of hunting in to rural households' income is relatively small.

CONCLUSION AND RECOMMENDATIONS

This study investigated primate crop raiding in Kainji Lake National Park, Nigeria, analyzed vulnerability indicators and farmers attitudes to inform effective conservation strategies. The results highlight the complex interplay between human livelihoods and primate conservation, emphasizing the need for collaborative approaches. Farm distance to park, farm size and standing crops significantly influence crop raiding frequency and severity. The support zones dwellers showed positive attitude and were in support of primates such as Olive baboon (*Papio anubis*), Patas (*Erythrocebus patas*), Tantalus (*Chlorocebus tantalus*), Mona (*Cercopithecus mona*), Green (*Cercopithecus aethiops*) conservation and continuing existence of the park. Such attitude is crucial for the success of biodiversity conservation programmes in the park.

The following recommendations were made based on the findings of this study:

1. Organize workshops and training programs for farmers to raise awareness about primate conservation and the importance of coexistence.
2. Introduce crop protection methods, such as fencing and guarding, to minimize crop damage.
3. Establish a conflict resolution mechanism to address farmer-primate conflicts.
4. Provide alternative livelihood options for farmers, like ecotourism and sustainable agriculture.
5. Strengthen conservation efforts, including habitat protection and primate population monitoring.
6. Advocate for policies and laws that support primate conservation and human-primate coexistence.

These recommendations aim to address the complex issues surrounding primate crop raiding in Kainji Lake National Park, promoting a harmonious coexistence between humans and primates.

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