






ORIGINAL RESEARCH ARTICLE

Effects of Human-Wildlife Conflict on Households' Food Security and Income in Communities around Kainji Lake National Park, Niger State, Nigeria: Implications on Wildlife Conservation

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ABSTRACT

Human–Wildlife Conflict (HWC) has become a fundamental aspect of wildlife management, but it threatens both wildlife and human welfare. Agriculture is an important sector for achieving food security, creating employment, and driving economic growth, as well as supplying raw materials for agro-based industries. However, households (HH) around Kainji Lake National Park (KLNP) experienced challenges, such as Human-Wildlife Conflict, which could undermine wildlife conservation efforts and agricultural productivity. Data were collected using a semi-structured questionnaire and focus group discussions. Multi stage sampling procedure was employed in this study. In the first stage, all the communities adjacent to KLNP were stratified by distance into three groups: A (≤ 3 km), B (3–6 km), and C (> 6 km). In the second stage, 23 out of 36 communities were purposely selected based on accessibility. In the third stage, 322 households (out of 1,060) were selected proportionate to size. Results of this study revealed that the majority (62.3%) had 21–30 livestock per HH and experienced a loss of 11–20 animals per annum. The number of farms affected by HWC varied significantly across communities: A (5 ± 1.13), B (3 ± 1.02), and C (2 ± 0.03). These conflicts, often involving livestock depredation and crop damage, negatively affect the economic and social well-being of local communities. Annual financial losses due to crop raiding and livestock depredation per household were ₦60,987.40k and ₦50,891.80k; ₦45,807.47k and ₦40,689.12k; ₦30,692.63k and ₦20,463.32k, in the A, B, and C communities, respectively. This implies that HWC reduced with increasing distance from the park's boundary. A positive association exist between annual financial loss due to crop raiding and household annual income $\chi^2(2, N=322) = 47.07, p < 0.05$, financial loss due to livestock depredation and household annual income $\chi^2(2, N=322) = 24.89, p < 0.05$, number of livestock loss per annum and households' total Livestock holding $\chi^2(2, N=322) = 12.43, p < 0.05$. This study established that HWC can undermine wildlife conservation efforts in KLNP as people retaliate against wildlife for perceived losses, sometimes through illegal hunting and habitat destruction.

INTRODUCTION

Human-Wildlife Conflict (HWC) and food security have emerged as critical issues for humanity with potentially profound implications for biodiversity conservation. These interconnected challenges not only threaten human well-being and socio-economic stability but also significantly impact biodiversity, including species of conservation concern (Carenton *et al.*, 2024). The impacts of HWC are far-reaching and affect several aspects of community life. Crop destruction is perhaps the most

pervasive issue, threatening food security and undermining local economies (Baudron *et al.*, 2022; Bond *et al.*, 2018). Human–Wildlife Conflict (HWC) is often viewed as a threat to the rural populace worldwide, as crop losses to wildlife remove the household's food supply and constitute an economic drain on the homestead (Wangchuk *et al.*, 2023). Nigeria is Africa's largest and most populous country, home to about 200 million people and growing at a rate of about 2.4% per year. As indicated

ARTICLE HISTORY

Received June 25, 2025

Accepted September 12, 2025

Published September 30, 2025

KEYWORDS

human-wildlife interactions, financial loss, crop raiding, livelihood, food security



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How to cite: Bunza, M. S., Alarape, A. A., Adewale, R. O., Abubakar, B. B. & Dododawa, Z. (2025). Effects of Human-Wildlife Conflict on Households' Food Security and Income in Communities around Kainji Lake National Park, Niger State, Nigeria: Implications on Wildlife Conservation. *UMYU Scientifica*, 4(3), 274 – 282. <https://doi.org/10.56919/usci.2543.028>

by the data of the Nigeria Bureau of Statistics (2022), Nigeria's agricultural sector remains the dominant economic sector, contributing 22.36% to the overall GDP in real terms, with an estimated value of ₦17.35 trillion in the first quarter of 2022 (NBS, 2022). Cattle and their byproducts are also crucial for enhancing both the local and national economies. Millions of households in Nigeria rely on these services to guarantee sustainable livelihoods and food security. Despite these benefits, farmers face challenges, including the effects of HWC, which could undermine agricultural productivity and production. Some examples of causes of HWC include livestock predation, crop raids, destruction of stored grains, physical and psychological harm or death of humans and wildlife, damage to infrastructure (Baral *et al.*, 2021; Long *et al.*, 2020; Bond *et al.*, 2018), and disease transmission to humans and Livestock (Matseketsa *et al.*, 2019).

Access to food is a serious problem in some African countries, as they rely exclusively on the outcome of a single harvest or the sale of Livestock. Though at the national level, the loss of two or four hectares of field crops to wild animals may have little impact, at the household level it can have a significant impact on their food supply for the whole year, which could be the difference between a secure life for all and destitution. Baboons and elephants are examples of species that can threaten the well-being of the whole family by raiding their farm produce. In communities where people farm to feed their families (subsistence), damage to crops such as millet, maize, sorghum, fruits, and vegetables by baboons is capable of significantly decreasing the yield of the major crops (Mwakatobe *et al.*, 2014; Eniang *et al.*, 2011; Adeola *et al.*, 2017; Odebiyi and Alarape, 2017). The work of defending crops from wild animals such as elephants, warthogs, bush pigs, and so on at night, and during the day from primates and wild birds, is an additional economic cost associated with HWC (Lamarque *et al.*, 2009; Nyhus, 2016). For rural households, especially those headed by females, Livestock is a vital source of income and a valuable asset (Pica-Ciamarra *et al.*, 2011). Additionally, in most arid rural regions, livestock production is more resilient to climate shocks than crop production, emphasizing its potential contribution to food security (Thomson *et al.*, 2013). Unfortunately, households in the surrounding communities of KLNP experienced serious attacks on Livestock and crop raiding by wildlife.

A household's vulnerability to the negative effects of HWC may differ from one household to another (Smit and Wandel, 2006), and the damage from wild animals may affect households' livelihoods differently depending on how secure their livelihoods were prior to the incident. Human-Wildlife Conflict can push poor households even deeper into poverty. Combined with other factors like drought and economic hardship, HWC becomes more problematic. The majority of rural households in Sub-Saharan Africa, such as those in Nigeria, depend on crop production for their livelihoods, making it the most significant activity. Reports show that most households in

developing countries rely significantly on cash income from the sale of farm produce, and many households consider it a secondary or tertiary source of cash income (Mulonga *et al.*, 2003). Given households' dependence on agriculture, reduced yields may have detrimental effects on livelihoods and food security. These problems will be more severe for households that mainly relied on crop production with little or no Livestock and had no household member engaged in any serious paid work.

National parks and game reserves offer both direct and indirect benefits to the people around them. The direct benefits are jobs, ecotourism, and leisure. The indirect benefits include the provision of ecological services, such as clean water, climate stabilization, carbon sequestration, soil stabilization, and erosion control, as well as protection of watersheds. These protected areas are vital reservoirs of biodiversity, hosting complex ecosystems with significant tree species diversity, as documented in similar environments in Nigeria (Paul & Alfred, 2024). The majority of academics contend that conservation areas ought to support the socioeconomic advancement of the host communities (Worku, 2019). However, the establishment of protected areas poses a greater threat to the living standards of the rural populace in Africa, because agriculture is their primary source of income (Amin *et al.*, 2015; Ahmed, 2017) and is mostly the driver of HWC. One area of research has been the effects of conservation areas on rural livelihoods (West *et al.*, 2006; Roe, 2008). The consequences of protected areas established around rural communities can affect their attitudes towards wildlife (Clements *et al.*, 2014; Ahmed, 2017). However, understanding the elements that affect the relationship between locals and protected areas is necessary to achieve conservation and livelihood goals (Kideghesho *et al.*, 2007). Although Human-Wildlife Conflict occurs globally, it is more prevalent in tropical regions and in Africa, such as Tanzania, Ethiopia, Kenya, India, and Nigeria, where agriculture and livestock raising play major roles in rural livelihoods, income, and food security. There are significant differences in the relative effects of wildlife damage on household income and farm productivity depending on the amount of land owned and the degree of economic reliance on rural activities (Messmer, 2000).

Crop damage caused by wild animals can affect farming households in a number of ways. These include a significant investment in guarding, a higher risk of injury and contracting diseases from wildlife, disruption of children's education because they must help guard croplands, fatalities, threats to economic security, and reduced food security and livelihood opportunities (Hill, 2004; Habtamu, 2016). Studies conducted in Kainji Lake National Park prior to this study revealed that species such as Olive baboons (*Papio anubis*) and Warthog (*Phacochoerus aethiopicus*) are responsible for most of the destruction of croplands (Alarape *et al.*, 2015; Adeola *et al.*, 2018; Odebiyi and Alarape, 2017). Additionally, a study carried out in southeast Ethiopia by Dejene and Demeke (2018) confirmed that the spotted hyena (*Crocuta crocuta*), Leopard (*Panthera pardus*), Olive Baboon (*Papio anubis*), and

Common Jackal (*Canis mesomelas*) are the main predators of domestic animals. This indicates that wild animals deprive households of their food and income sources (Wangchuk *et al.*, 2023). Previous studies have not assessed HWC in relation to income loss in surrounding communities and its implications for wildlife conservation efforts in Kainji Lake National Park; hence, the need for this study.

MATERIALS AND METHODS

Description of the study area

Kainji Lake National Park (KLNP) was the first National Park established among the seven currently found in Nigeria. The establishment of KLNP in 1975 marked the first attempt at managing wildlife for recreation in Nigeria. The park is located in Niger and Kwara States in Nigeria's North Central region. The Park lies between latitudes 10°22' 06"N and longitudes 4° 33' 17"E. It covers a total land area of 5,340.82 square kilometers and comprises two sectors: Borgu and Zugerma. Common tree species around the park include *Burkea africana*, *Deterium macrocarpum*, *Azizelia africana*, *Isobertina tomentosa*, and *Acacia species* (Ezealor, 2002). The dominant animal species in the park include Buffalo (*Syncerus cafer*), Olive baboon (*Papio anubis*), Roan antelope (*Hippotragus equinus*), Senegal kob (*Kobus kob*), Western hartebeest (*Alcelaphus buselaphus*), Bush buck (*Tragelaphus scriptus*), Hippopotamus (*Hippopotamus amphibius*), among others (Adeola *et al.*, 2022).

Sampling procedure

Communities around Kainji Lake National Park (KLNP) were stratified into three groups based on distances from the park's boundary: A (<3 km), B (3-6 km), and C (>6 km). In the first stage, 23 communities (A=7, B=8, and C=8) were selected based on their accessibility and severity of HWC. In the second stage, three hundred and twenty-two (322) households (out of 1,060) were selected using a sampling intensity of 30%, proportionate to size across the three (3) locations: [118 (A), 104 (B), and 100 (C)]. The semi-structured questionnaire was used to obtain information on the types of HWC experienced, the quantity and value of the items destroyed, and the number of farms and Livestock affected. Data were analysed using descriptive statistics, chi-square tests, and ANOVA at $\alpha = 0.05$.

RESULTS

Causes of Human-Wildlife Conflict around Kainji Lake National Park

Results presented in Table 1 revealed that wildlife attacks on humans, destruction of stored food, crop raiding, and

livestock depredation are the main factors that fueled HWC around Kainji Lake National Park.

Table 1: Causes of Human-Wildlife Conflict around Kainji Lake National Park (n=322)

Type of conflict	Frequency	(%)
Attack on humans	37	11.5
Destruction of stored product	59	18.3
Crop raiding	126	39.1
Livestock depredation	69	21.5
All forms of Conflict	31	9.6
Total	322	100%

Table 2: Percentage Distribution of Field Crops damaged and average Financial Value of Crop loss as reported by Sampled Households around Kainji Lake National Park (n=126)

Variables	Freq.	(%)
Crops		
Millet	23	18.3
Cowpea	14	11.1
Rice	20	15.9
Groundnut	11	8.7
Sorghum	5	4.0
Maize	42	33.3
Cassava	7	5.5
Yam	4	3.2
Animals responsible for the damage		
Primates	62	49.2
Birds	34	27.0
Other mammals (excluding primates, birds and rodents)	21	16.7
Rodents	9	7.1
Percentage of crop fields loss		
<10%	23	18.3
10-20%	69	54.8
21-30%	26	20.6
31-40%	6	4.8
>50%	2	1.5
Total yield/household/annum		
<5 bags	22	17.5
6-10 bags	79	62.7
11-20 bags	18	14.3
Above 20 bags	7	5.5
Average value of crop loss		
< ₦20,000	6	4.8
₦21,000 to ₦40000.00	46	36.5
₦41,000 to ₦60000.00	71	56.3
> ₦60000.00	3	2.4

Percentage Distribution of Field crops damaged and average Financial Value of Crop loss as reported by Sampled Households around Kainji Lake National Park

Results presented in Table 2 indicated maize was the most raided crop (n=42, 33.3%), followed by millet (n=23, 18.3%). Rice had 15.9% (n=20), Cowpea had 11.1% (n=5), while groundnut had 8.7% and Cassava had 5.5% (n=7). The crops that animals raided the least were yams and sorghum (3.2%, n=4, and 2.6%, n=5, respectively).

Primates were implicated in crop raiding by the majority of the sampled households (n=62, 49.2%), followed by birds (n=34, 27%). Other animals and rodents had (n=21, 16.7%) and (n=9, 7.1%), respectively. This was further confirmed by 60% of focus group discussants, who also said *Papio annubis* is the most disturbing species in this study. This study further recorded that most of the sampled households (54.8%) loss 10-20% of their crop fields to wildlife damage.

Percentage distribution of Livestock holdings and Financial Loss Incurred by the Sampled Households due to Human-Wildlife Conflict.

Results displayed in Table 3 indicate that many respondents had 21-30 livestock per household (n=43, 62.3%), while those with 40 or more livestock per household had the lowest representation (n=2, 2.9%). The study also found that households' annual livestock losses are alarming, with the majority (n=39, 56.5%) reporting losses of 11-20 animals per household, amounting to ₦41000-₦60000 (40.6%) per household. This was further reaffirmed by the majority (70%) of the group discussants, who reported that, if commensurate measures to address the problem of livestock depredation are not put in place, it can affect their livelihood assets. Poultry were the most affected domestic animals, and reptiles were implicated in the attacks (n=37, 53.6%), followed by sheep and goats (n=17, 24.5%) attacked by mammals. Cattle are the least affected domestic animals attacked by mammals (n=2, 2.9%)

Table 3: Percentage distribution of Livestock holdings and Financial loss Incurred by the Sampled Households due to Human-Wildlife Conflict (n=69)

Variables	Freq. (%)	
Total number of livestock holdings		
<10	13	18.8
10-20	7	10.2
21-30	43	62.3
30-40	4	5.8
>40	2	2.9
Number of Livestock loss/ annum		
< 10	16	23.2
11-20	39	56.5
21-30	4	5.8
31-40	8	11.6
>40	2	2.9
Estimate of financial loss (₦)		
<₦20000	12	17.4
₦21000-₦40000	20	29.0
₦41000-₦60000	28	40.6
Above ₦60000	9	13.0
Species involved		
Reptiles and Cattle	3	4.3
Reptiles and Poultry	37	53.6
Mammals and Cattle	2	2.9
Mammals, Goat and Sheep	17	24.6
Primates and Poultry	8	11.6
Reptiles, Sheep, and Goats	4	5.8

Association between financial (₦) loss as a result of Human-Wildlife Conflict and livelihood assets of the sampled households in the study area

Table 4 shows that annual financial loss (₦) due to crop damage ($\chi^2=32.61a, \alpha=0.05$) was significantly related to the annual income of the sampled households. At Wuromakuto (a community in category A), a 50-year-old man expressed fear over the financial and economic losses they incurred as a result of wildlife-caused crop and livestock destruction, stating it has affected their livelihood assets and income. Also, the percentage of crop field loss (₦) per annum per household was significant and statistically associated with yield per annum ($\chi^2=47.069a, \alpha=0.05$). Also, positive association exist between number of livestock loss per annum and total livestock holdings per household ($\chi^2=12.43a, \alpha=0.05$). Additionally, financial loss due to livestock depredation and households' annual income showed a significant association ($\chi^2=24.89a, \alpha=0.05$), as did crop damage and households' annual income ($\chi^2=32.61a, \alpha=0.05$). Although the association between annual financial loss due to destruction of stored foods and households' annual income, as well as the quantity of stored food loss per annum and total yield, was not statistically significant, they can still be important factors in shaping people's perception and attitude towards conservation in the study area. Over fifty-five percent (55%) of the participants in the in-depth interview claimed that economic and financial losses could likely exacerbate most of the household food crises experienced by locals, resulting from damage to food crops, livestock depredation, and destruction of stored foods by wild animals in the study area.

Households' Annual Financial Loss (₦) due to Human-Wildlife Conflict as influenced by the Distance of communities to the Park Boundary

Households' economic and financial losses were statistically different across the three communities (A, B, and C). The highest mean annual household financial loss was found in communities located within the first three kilometers of the park's boundary (group A), followed by communities within the radius of 3-6 km from the boundary (group B) of the park and the lowest was recorded in group C (Table 5), perhaps due to perhaps due to proximity and wildlife density.. This indicates that the proximity of communities to the boundary of KLNPN is an important factor in fueling conflict in the study area. This further revealed that as you move away from the park's boundary, incidences of HWC decrease, except for the financial losses incurred from the destruction of stored food products. This was also the perception of the majority (80%) of the group discussants.

Mean number of Farms and Livestock damaged by Wild Animals in the Study Area

The average number of farms and animals in category A (0-3km) impacted by human-wildlife conflict was the

highest, with 4.86 ± 1.13 and 10.21 ± 2.07 , followed by communities in category B (2.15 ± 1.02 and 7.59 ± 1.17), while the least mean of 1.61 ± 0.28 and 2.31 ± 0.14 was recorded in category C (Table 6).

Results presented in Table 7 revealed that sighted wild animals around residential areas once in a month (45.7%), followed by sighting twice a month (20.8%) while weekly sightings was the least. This shows a high level of human-wildlife interaction in the study area.

Table 4: Association between financial (₦) loss as a result of Human-Wildlife Conflict and livelihood assets of the sampled households in the study area

Variables	χ^2 value	$\alpha=0.05$
Percentage of crop field loss per annum* Yield per annum	47.069a	0.002*
Annual financial loss due to crop damage*Annual income	32.61a	0.000*
Number of livestock loss per annum*Total livestock holdings	12.43a	0.003*
Financial loss due to livestock depredation*Annual income	24.89a	0.001*
Annual financial loss due to destruction of stored foods*Annual income	29.07a	0.341ns
Quantity of stored food loss per annum*Total yield per annum	18.50a	0.061ns

*indicates significant difference at $p \leq 0.05$, ns=not significant

Table 5: Households' annual financial loss (₦) as influenced by the distance of settlements to the park boundary

Communities	Crop raiding	Livestock depredation	Destruction of stored foods
Category A (<3km)	$60,987.40 \pm 34.06^a$	$50,891.80 \pm 65.12^a$	$25,691.13 \pm 70.71^a$
Category B (3-6km)	$45,807.47 \pm 51.12^b$	$40,689.12 \pm 49.35^b$	$15,615.51 \pm 83.81^b$
Category C (>6km)	$30,692.63 \pm 76.21^c$	$20,463.32 \pm 38.14^c$	$12,576.52 \pm 115.27^b$

Means within the same column with different superscripts were significantly different at $p \leq 0.05$

Table 6 Mean number of farms and Livestock damaged by Wild Animals across the three locations (Category A, B and C)

Communities	No. of farms affected	No. of livestock loss	Total
Category A	5 ± 1.13	10.21 ± 2.07	15.07 ± 3.2
Category B	3 ± 1.02	7.59 ± 1.17	9.74 ± 2.19
Category C	2 ± 0.28	2.31 ± 0.14	3.92 ± 0.42
SEM	0.019	0.077	
Mean \pm SD total	3.3 ± 0.81	6.70 ± 1.13	
p-value	0.001	0.716	

Table 7. Frequency of sighting Wild animals around residential areas

	Frequency	Percentage (%)
Duration	Weekly	45
	Twice a month	67
	Once in a month	147
	Quarterly	63
	Total	322
Time of the day sighted	Morning	135
	Afternoon	47
	Evening	96
	Night	44
	Total	322
Activity	Feeding	102
	Resting	77
	Roaming	143
	Total	322

Results presented in Table 8 show that very few victims of HWC were compensated. Furthermore, the conflicts can undermine wildlife conservation efforts as people retaliate against wildlife for perceived losses, sometimes through illegal hunting and habitat destruction.

Table 8: Compensation for the losses incurred from Crop raiding and Livestock depredation

Variables	Freq.	(%)
Compensation for crop damage		
Compensated	41	32.5

Not compensated	85	67.5
Total	126	100.0
Compensation for loss of Livestock		
Compensated	21	21.6
Not compensated	58	73.4
Total	79	100.0

DISCUSSION

Effects of Human-Wildlife Conflict on the Livelihoods, Income, and Food Security of Households in Communities around Kainji Lake National Park

Human-Wildlife Conflict (HWC) and food security have emerged as critical issues for humanity with potentially profound implications for biodiversity conservation. These interconnected challenges not only threaten human well-being and socio-economic stability but also have significant impacts on biodiversity, including species of conservation concern (Carenton *et al.*, 2024). The effects of damage caused by wild animals on the livelihoods and food security of people living around Kainji Lake National Park vary with distance from the park boundary (Tables 5 and 6). The interface can be more severe for low-income households than for moderate- to high-income households. It is particularly problematic when paired with other elements, such as Nigeria's current economic circumstances. More than half of the focus group discussants reported that Human-Wildlife Conflict has severely affected their livelihoods, limiting their access to good food, water, and health care services. They claimed that they could not sell surplus grain for the past two years. The impact is observed in two folds: fewer harvests imply reduced food supplies and fewer opportunities to make money (with the sale of excess food crops serving as the main source).

The study examined the major factors that influence HWC (crop raiding, livestock depredation, and destruction of stored foods) and their effects on the livelihoods and income of the surrounding communities of the park (Tables 5 and 6). For a better understanding of the implications of HWC on the livelihoods of the study participants, it is important to explain the type of respondents in this study. It's pertinent to note that subsistence farmers make up the majority of study participants, and most of these farmers have croplands averaging only 3 hectares per household, making them vulnerable individuals. When wild animals trespass and destroy a farm and consume almost all of the household's field crops, it can be the end of that year's source of food and income for the affected households. The situation may even be worse when the head of the household is a woman. This is because, in the sampled communities, women are not as exposed to other outdoor activities, such as farming and trading goods, which would enable them to source food and income from other sources. Agriculture- and livestock-based livelihoods in the neighboring communities of Kainji Lake National Park incurred both economic and financial losses ranging from ₦41,000 to ₦ 60,000 per household per season. More than half of the people who experienced crop raiding in

the 12 months before this study lost about one quarter of their field crops (Table 2). Considering households' dependence on crop and livestock production, lower yields can negatively affect their ability to make ends meet and cope with shocks such as drought and other external factors. These problems were most severe for households that only produced crops, had no cattle, and had no household member employed in a meaningful and steady job. One of the consequences of not producing adequate food is the migration of the working-age population, which translates to a farm labor shortage and, ultimately, an increase in fallow lands, reduced farm production and increase in pressure on limited wildlife resources (Wangchuk *et al.*, 2023; Bhawana *et al.*, 2020; Yan *et al.*, 2016).

The annual monetary value of products destroyed by wild animals per household was a significant share of household income. A possible explanation for this scenario could be the proximity of communities to the park's boundary. This could worsen food security in communities and, by extension, the entire country. The problem of food scarcity in the neighboring communities hit by Human-Wildlife Conflict may be triggered by the destruction of staple crops such as millet, maize, rice, and sorghum, as well as livelihood assets such as poultry, sheep, cattle, and goats (Tables 2 and 3). This is in line with the opinions of Mashap *et al.* (2018), Kahuni *et al.* (2014), and Mhuriro-Mashapa *et al.* (2017). This was also in tandem with Barua *et al.*, 2013, who stated that one potential consequence of HWC is an increased in the scarcity of food as a result of the destruction of stored foods and the crop raiding activities of wild animals

Human-Wildlife Conflict may have other consequences for affected households, including injuries and loss of human life (Mashapa *et al.*, 2018). It is worth noting that losses to Livestock and agricultural crops recorded in this study go beyond a mere financial drain on affected households. These losses can result in and worsen other socioeconomic costs for people, such as an increase in the need to safeguard crops, changes in livestock husbandry techniques, and increased school dropout, particularly among children, because children and middle-aged people are needed to help guard farms. This further increases the risk of contracting diseases, particularly when guarding crops or herding cattle at night (Mashap *et al.*, 2018). The affected households must invest substantial time and financial resources in crop protection measures against wildlife damage (Barua *et al.*, 2013). After wildlife damage, available funds are diverted from other household needs to cover food costs. This ultimately affects their health, nutrition, education, and general community development. However, the importance of wildlife for bushmeat in the sampled communities adds another layer of complexity in this study. In such areas, reliance on wildlife for sustenance often increases, leading to overexploitation of wildlife resources. Bushmeat serves as a crucial source of protein and livelihoods in many parts of the world, particularly Africa (Nyamwamu, 2016).

Considering its significant role in local economies and food security, this dynamic not only threatens biodiversity but also exacerbates the challenges of food security and Human-Wildlife Conflict. Understanding the interplay among humans and wildlife, food security, and biodiversity conservation is essential for developing sustainable solutions that address these complex issues holistically.

This study estimates the combined financial losses to crops, Livestock, and the destruction of stored foods encountered by the sampled households across the three locations (A, B, and C) in the study area. The results show that communities within the first 3 km of the park boundary (category A) experienced greater financial losses than communities in categories B and C (Table 6). This implies that economic and financial losses due to HWC are a function of the distance of communities from the park's boundary. This is in tandem with Wangchuk *et al.* (2023), who reported that communities closer to the park sustained greater economic and financial losses (Wangchuk *et al.*, 2023). The amount of land owned and the extent to which people rely on rural activities for their livelihood both influence the extent to which wildlife damage affects farm output and household income (Meyer and Borner, 2022). Most people in the surrounding communities of Kainji Lake National Park had few farms (3 per household), cultivated their own food crops to feed their household members, sold surplus where necessary, and kept livestock as an investment. Unfortunately, a significant relationship was recorded between the quantity of crop loss and yield per annum (Table 4). The study also discovered a significant relationship between households' annual income and the number of livestock lost to crop raiding, the number of livestock loss, and total livestock holdings. Given the small livestock holdings and the quantity of food crops produced by the study respondents (Tables 2 and 3), the livelihood effects of such losses can be enormous and detrimental to their survival. It is important to note that any damage to Livestock, stored foods, or field crops by wild animals has the potential to threaten the livelihoods of affected communities in the near future. Crop damage and livestock depredation affect a farmer's capacity to feed his family and reduce household income. These encounters not only endanger human lives and Livestock but also disrupt crop production, compromising food security and stability in an area where agriculture sustains livelihoods and cultural practices (BIO-HUB *et al.*, 2024).

The conflict between humans and wildlife and its effects on the livelihoods and food security of the study respondents can be serious. This is because farming is often the most important occupation for the majority of households in the park's surrounding communities. It contributes to the livelihoods of over fifty percent of the study participants. Livestock production is also found to be an integral part of their livelihoods because the sale of Livestock makes a significant contribution to households' income, particularly households headed by females. However, because the majority of households in this study depend on crop and livestock production, the significant

association between percentage crop loss and yield may have serious negative consequences for households' livelihoods and food security in the affected communities.

The reliance of people on Livestock and crop production to provide food for their families may lead to hunger within the family when Livestock are killed and crops are raided, and children are mostly at the receiving end. One of the group discussants in communities close to the park boundary (category A) was a widow with 9 children and just a few Livestock (mostly poultry). About 30% of her hand-hoed maize farm was destroyed by primates and wild birds. She emphatically said, "Her only source of food has been destroyed, and at the time of this study, she had not figured out how she was going to survive the year with her growing." She further lamented that income from her petty business (sales of condiments) was too small to sustain them; more so, the same resources will be used to settle hospital bills and other urgent and important family issues. However, most of the hardships encountered could be due to the failure of affected households to report wildlife destruction to park authorities. This is in consonance with Baral *et al.* (2021), who reported that most Human-Wildlife Conflicts experienced by locals went unreported unless they involved significant damage, such as the destruction of the whole farm or the killing of a family member by wild animals. Coincidentally, most of the damages by wildlife were not adequately compensated (Table 8). Failure to report conflicts to park officials may be a possible explanation for the high number of HWC cases experienced by households in the park's surrounding communities. Agriculture is an important sector for achieving food security, creating employment, and driving economic growth, as well as supplying raw materials for agro-based industries. But the challenges experienced by the households in the surrounding communities of the park could result in reduced agricultural productivity, thus undermining food security.

CONCLUSION

This study concluded that human-wildlife conflict significantly affects the livelihoods and incomes of households in the surrounding communities of Kainji Lake National Park and has the potential to reduce household food security. This is evident in the significant crop damage and livestock losses caused by wildlife despite the use of various mitigation strategies. The effects of wildlife damage on the livelihoods and food security of people living around Kainji Lake National Park vary with respect to the distance of communities from the park boundary. This implies that the greater economic and financial losses were borne by communities closer to the park. However, increasing Human-Wildlife Conflicts are likely to threaten the long-term coexistence of people and wildlife in the area. We recommend establishing buffer zones and compensation schemes to mitigate the effects of HWC in the study area.

RECOMMENDATIONS

1. The government should be proactive in initiating poverty-reduction programs, such as beekeeping and grasscutter farming. This will help to reduce pressure on Park's resources
2. Employment should be given to the people around the park.
3. A combination of different mitigation measures (crop guarding and deterrent methods) will go a long way toward reducing the impasse between humans and wildlife.
4. Expansion of formal and adult education, as well as livelihood diversification (through skills-acquisition programs), would go a long way toward improving community attitudes toward wildlife.

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