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FARMERS-WILDLIFE CONFLICT TYPES, ADOPTED MITIGATION STRATEGIES AND THEIR EFFECTIVENESS IN SUBSISTENCE FARMING IN IDO-OSI LOCAL GOVERNMENT AREA, EKITI STATE, NIGERIA

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ABSTRACT

This study investigated Farmers-Wildlife conflicts in subsistence farming within the Ido Osi local government area of Ekiti State, Nigeria. The research encompasses the identification of conflict types, adopted mitigation measures, and their effectiveness. Through the use of standardized questionnaires, information from 150 participants across all the 11 towns was gathered. IBM SPSS and Microsoft Excel were used for the analysis. The results showed that majority (65%) of the respondents were male majority and a dominant age range of 55-64 years (44%) for both genders. Highest percentage (51%) of the farmers had informal education, with 43% of them practiced traditional religion. Majority (46%) of homes which had 4-5 people, were married. The Yoruba ethnic group constitutes 91% of the participants. The following wildlife species were found to be involved in conflicts: vervet monkeys (Chlorocebus pygerythrus) (crop raiding during harvest - 22%), porcupines (Erethizon dorsaum) (crop destruction - 69%), African civet cats (Civettictis civetta) (livestock predation - 53%), waterbucks (Kobus ellipsiprymnus) (water source conflicts - 37%), and spitting cobras (Naja nigricollis) (direct attacks during farming - 51%). Crop rotation ($\bar{x}$=4.11), scare tactics ($\bar{x}$=4.04), nocturnal vigilance ($\bar{x}$=2.55), scent-based deterrents ($\bar{x}$=2.83), wooden fences ($\bar{x}$=4.41), crop netting ($\bar{x}$=3.91), motion-activated lighting ($\bar{x}$=3.95), altering harvest timing ($\bar{x}$=4.36), non-lethal traps ($\bar{x}$=3.39), and direct killing ($\bar{x}$=4.29) are the mitigating strategies that were observed. The study concluded that a combination of these preventive measures effectively reduces conflict incidents. Development and execution of community-specific wildlife management plans and the support of initiatives that spread knowledge and awareness will help lessen conflict.

Keywords: Farmers-wildlife conflicts, subsistence farming, mitigating strategies, farming

Correct Citation of this Publication

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INTRODUCTION

For innumerable rural people, subsistence farming is a key technique for generating income, but it frequently gets caught up in a complicated web of wildlife conflicts (Yeshey *et al.*, 2022; Davidova *et al.*, 2012; Mbatha *et al.*, 2021). According to Barbosa *et al*. (2020), these conflicts develop as a result of the interaction between agricultural practices and the habitats of diverse wild animal species. These interactions are becoming more intense, which poses serious problems for both biodiversity preservation and human nutrition (Mekonen, 2020). Subsistence farmers, who are mainly found in areas with little

resources, depend largely on the agricultural products they produce for food (Burlingame *et al.*, 2019). However, the actions of wildlife that intrude upon croplands and livestock usually foil their efforts. The vulnerability of already marginalized groups is made worse by crop destruction and decreased yields, which result in significant economic losses (De Rossi *et al.*, 2022). The loss of habitat, altered wildlife behavior brought on by human encroachment, and climatic changes affecting resource availability are some of the causes of this conflict intensification (Barbosa *et al.*, 2020; Abrahms, 2021).

In addition to endangering farmers' ability to survive, wildlife invasions on agricultural property also fuel hostility toward initiatives to conserve wildlife (Horgan *et al.*, 2020). This emphasizes the requirement for thorough investigation that takes into account the complexity of these issues. Subsistence farmers have developed a variety of mitigation techniques to address these issues (Kolinski and Milich, 2021). These tactics are a synthesis of local expertise, adaptability, and invention. In order to keep wildlife from encroaching, physical barriers like wooden fences and trenches are constructed to safeguard livestock and crops (Rwetsiba and Rusoke, 2021). These conventional wisdom-based strategies coexist with more contemporary ones, like the deployment of guard animals and electric fencing (Honda *et al.*, 2009).

In order to stop wildlife intrusions, farmers frequently perform vigilance and guard responsibilities by keeping an eye on their livestock and crops (Ajayi *et al.*, 2019). Farmers may band together to preserve their common interests through joint patrols or the creation of community-managed conservation zones in some instances (Hsaio *et al.*, 2013). These activities not only provide conflict prevention but also promote a sense of responsibility and stewardship for the local biodiversity. To lessen conflict triggers, farmers can diversify their crops, grow wildlife-resistant cultivars, and use unappealing agricultural methods (Matsika *et al.*, 2023; Akinyemi, 2010). To lessen the reliance entirely on agriculture, alternative livelihood possibilities including beekeeping, ecotourism, and non-farm income sources being investigated (Etxegarai-Legarreta, and Sanchez-Famoso, 2022; Ramaano, 2023). These tactics increase adaptability and act as a safety net against the risks provided by wildlife interactions.

Nevertheless, the socioeconomic environments, the resources at hand, and the individual wildlife species generating conflicts continue to influence how effective these efforts will be (Mayele, 2022). While some tactics might succeed, others might unintentionally worsen conflicts or have unforeseen environmental effects (Mekonen, 2020). To ensure any strategy's long-term sustainability, it is essential to comprehend the wider ecological and socio-economic repercussions of each strategy. The complex connection between wildlife conflicts and subsistence farming emphasizes the need for a sophisticated understanding of the difficulties these communities face. This study aims to determine the various types of subsistence farming-wildlife conflicts as well as the adopted mitigation strategies along with their effectiveness level in Ido-Osi local government area, Ekiti State, Nigeria. It does this by acknowledging the symbiotic relationship between community well-being and biodiversity conservation.

MATERIALS AND METHODS

Study Area

Ido-Osi is one of the 16 Local Government Areas of Ekiti State, Nigeria. It is located between the equator's latitudes of 7045°N and 7054°N and the Greenwish Meridian's longitudes of 500°E and 5015°E (Figure 1). It has both rainy and dry seasons. According to Tunde *et al.* (2022) the local temperature ranges from 32°C to 35°C with a high relative humidity of 85%. According to the National Population Commission's 2006 data, the local government area has a population of approximately 159,114. A variety of fruits, cotton, cocoa, rubber, tobacco, and palm products are among the agricultural products (Tunde *et al.*, 2022). The towns in Ido-Osi L.G.A. are Ido, Usi, Ora, Ifaki, Ifisin, Igbole, Orin, Osi, Aiyetoro, Aaye, and Ilogbo.

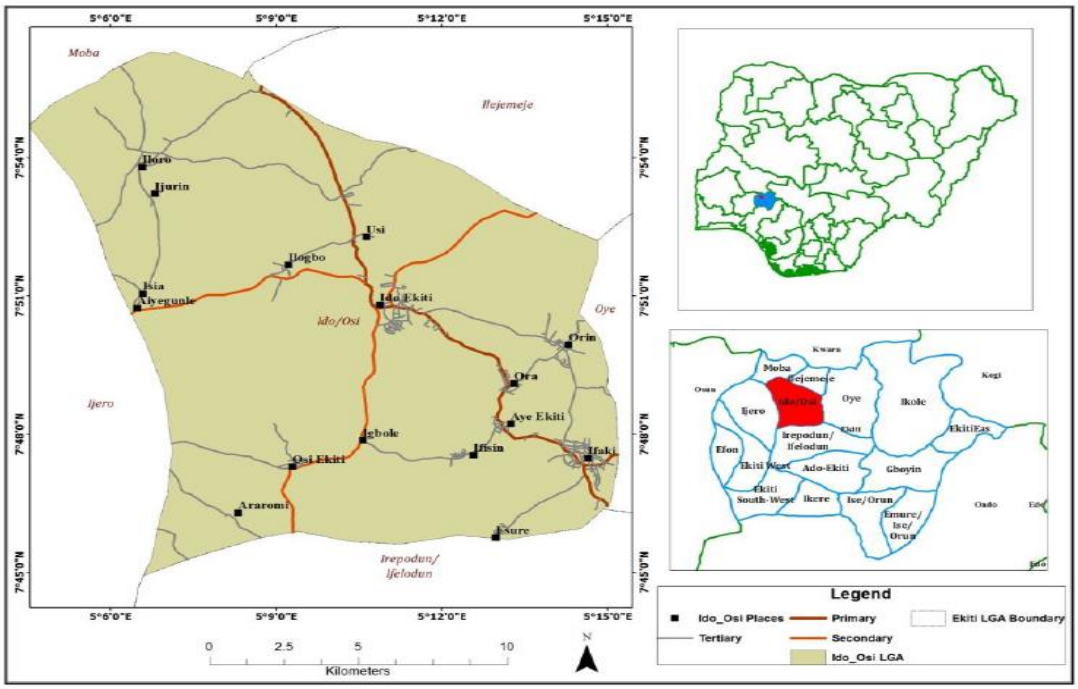

Figure 1. Ido-Osi L.G.A. Inserted maps showing Ekiti State and Nigeria.
Source: Ekiti State Ministry of Information (2018)

Data Collection

Data for this study was generated through the primary and secondary sources. Pretested and structured questionnaires were used for the study. Pretested and organized questions were employed. In each of the 11 towns in the local government region, questionnaires were administered to subsistence farmers with various educational backgrounds. The sample was collected using the non-probability sampling (snowball sampling) technique, and it consist of accessible subsistence farmers. The farmers who are illiterate and unable to read for themselves received the surveys with the assistance of an expert who translated each and every question. The types of conflicts caused by different wild animals that have already been listed out through a thorough literature review, as well as the degree of effectiveness of the various mitigation measures they adopted to mitigate these conflicts, are among the sociodemographic characteristics of the farmers that are being questioned. Frequency distribution, percentages (%), and tables are some of the statistical analysis methods used in this study. Microsoft Excel was used for data entry and coding, and IBM SPSS (2015; Statistical Package for Social Sciences) was used for data analysis.

RESULTS

Socio-Demographic Characteristics

Table 1 lists the sociodemographic features of subsistence farmers. It reveals that 35% of responders were female and 65% were men. The majority of farmers (54%) are in the 55–64 age group; 51% of them lack a formal education, and only 1% have a higher education. Traditionalists made up the majority (43%) of the respondents, followed by Christians (35%), and Muslims (22%). The majority (46%) of respondents were housed in families of four to five (4-5) individuals. The majority (67%) of respondents were married, while the lowest percentage (7%), were separated or divorced. The majority (91%) of the respondents were Yoruba, followed by Igbo (2%), Hausa (1%), and other non-major ethnic group (6%).

Table 1: Socio-Demographic Characteristics of Subsistence Farmers

Variables	Frequency (N=150)	Percentage (%)
Age(years)		
Less than 18	3	2
18-24	15	10
25-54	45	30
55-64	66	44
65 and above	21	14
Total	**150**	**100**
Gender		
Male	98	65
Female	52	35
Total	**150**	**100**
Education Level		
No formal Education	76	51
Primary	33	22
Secondary	39	26
Tertiary	2	1
Total	**150**	**100**
Religion		
Christianity	53	35
Islam	33	22
Traditional	64	43
Total	**150**	**100**
Household Size		
1	19	13
2-3	43	29
4-5	69	46
6-7	17	11
8 and above	2	1
Total	**150**	**100**
Marital Status		
Single	19	13
Married	101	67
Divorced/Separated	11	7
Widowed	19	13
Total	**150**	**100**
Ethnicity		
Yoruba	136	91
Hausa	2	1
Igbo	3	2
Others	9	6
Total	**150**	**100**

Wildlife Species and Categories of Farm Conflicts Identified with them

The results in Table 2 showed that various farm-wildlife conflicts are identified with certain wild animals. According to the subsistence farmers, Porcupine was the major (69%) wild animal species identified with the destruction of crop plants while Rabbit was identified with less (6%) damaging ability. African civet cat and Monitor lizards are the major (53% and 10% respectively) predator of livestock while tree damages are mostly (37%) caused by Bush pig among other while Vervet monkey was only identified with lesser (7%) tree damages.

Conflict over water sources also exist with Waterbuck mostly (37%) identified by farmers while Porcupine was only assigned 3%. Vervet monkey was identified as the major (22%) wild animal that raid crop during harvest while both red-flanked duiker and porcupine causes lesser (7%) impact on crops during harvest. Direct attack of farmers during farm operations are majorly (51%) caused by Splitting cobra while Gaboon viper, African rock python and Olive baboon caused lesser (3%) attack on farmers of the species identified.

Table 2: Wildlife Species and Categories of Farm Conflicts Identified with them

Wildlife Species Identified	Conflict Types					
	*Damage of crop plants (%)	*Livestock predation (%)	*Tree damage (%)	*Conflict over water sources (%)	*Crop raid during harvest (%)	*Direct attack on farmers (%)
Bushbuck (*Tragelaphus scriptus*)	78(52)	-	34(23)	10(7)	30(20)	-
African civet cat (*Civettictis civetta*)	-	79(53)	-	21(14)	-	-
Bush pig (*Potamochoerus porcus*)	88(59)	-	55(37)	9(6)	22(15)	7(5)
Grasscutter (*Thryonomys swinderianus*)	92(61)	-	-	-	29(19)	-
Porcupine (Erethizon dorsaum)	104(69)	-	20(13)	5(3)	11(7)	-
Gaboon viper (*Bitis gabonica*)	-	-	-	-	-	4(3)
Monitor lizard (*Varanus varius*)	29(19)	15(10)	-	44(29)	17(11)	14(9)
Vervet monkey (*Chlorocebus pygerythrus*)	91(61)	-	11(7)	43(29)	33(22)	-
Black cobra (*Naja melanoleuca*)	-	-	-	-	-	12(8)
Impala (*Aepyceros melampus*)	66(44)	-	14(9)	29(19)	-	-
Pangolin (*Manis tricuspis*)	11(7)	-	-	-	-	-
Mona monkey (*Cercopithecus mona*)	56(37)	-	17(11)	22(15)	16(11)	-
Patas monkey (*Erythrocebus patas*)	64(43)	-	33(22)	17(11)	12(8)	-
Maxwell's duiker (*Philantomba maxwellii*)	33(22)	-	13(9)	27(18)	-	-
Tree hyrax (*Dendrohyrax dorsalis*)	15(10)	-	39(26)	12(8)	-	-
African rock python (*Python sebae*)	-	-	-	19(13)	-	5(3)
Splitting cobra (*Naja nigricollis*)	-	-	-	-	-	76(51)
Puff adder (*Bitis arietans*)	-	-	-	13(9)	-	44(29)
Rock hyrax (*Procavia capensis*)	-	-	-	-	-	9(6)
Squirrel (*Protoxerus stangeri*)	56(37)	-	-	-	-	-
Pouch rat (*Cricetomys gambianus*)	74(49)	-	-	-	-	-
Olive baboon (*Papio anubis*)	60(40)	-	23(15)	23(15)	13(7)	5(3)
Red-flanked duiker (*Cephalophus rufilatus*)	22(15)	-	-	-	-	-
Waterbuck (*Kobus ellipsiprymnus*)	26(17)	-	45(30)	56(37)	18(12)	-
Rabbit (*Oryctolagus cuniculus*)	9(6)	-	-	-	-	-

**Multiple responses recorded*

Mitigation Strategies Adopted and their Level of Effectiveness in Reducing Farmer-Wildlife Conflicts

Table 3 showed the various mitigation strategies adopted by farmers. The mean ranged from 2.55 to 4.41. The lowest mean value of 2.55 relates that on the average, community patrols/nighttime vigilance is not as effective strategy in the mitigation of farm-wildlife conflict as the measure with the highest mean value (4.41).

Table 3: Mitigation Strategies Adopted and their Level of Effectiveness in Reducing Farmer-Wildlife Conflicts

Measures	Mean	Standard deviation
Crop rotation	4.11	0.97
Scare tactics	4.04	1.09
Nighttime vigilance/Community patrols	2.55	1.37
Scent-based deterrents	2.83	1.21
Use of wooden fence	4.41	1.12
Crop netting	3.91	1.24
Motion-activated lights and sound devices	3.95	1.32
Adjustment of harvest timing	4.36	0.94
Use of non-lethal traps	3.39	1.10
Direct killing	4.29	1.00

DISCUSSION

Farm-wildlife conflicts in the Ido Osi Local Government Area of Ekiti State, Nigeria are shaped by a complex interplay of sociodemographic factors, the wildlife species involved, and the efficacy of mitigation measures. It is interesting to notice that farmers in the study area are primarily between the ages of 55 and 64. This is congruent with the findings of Zhou *et al*. (2018) and Hashemi *et al*. (2012), where the categories of old farmers are represented by 60.21% in their study on farmer's perceptions of safe use of pesticides. This demographic trend is a reflection of a larger phenomenon that is occurring in many rural areas, where younger generations are becoming less involved in agriculture, either as a result of poor economic prospects or the appeal of metropolitan alternatives. The majority of farmers (65%) are men, which is in line with the findings of Lu (2007), who reported that 71.8% of farmers were men, highlighting the gender disparity that is pervasive in agricultural operations in his research on gender differentiation among farmers in the agricultural sector. Considering the diverse experiences and resource availability of male and female farmers, this points to the necessity for gender-sensitive interventions in conflict prevention strategies. The respondents' educational backgrounds are a crucial socio-demographic factor as well. Over half (51%) of the farmers said they had never attended school. The findings of Etim and Udoh (2020), who assert that every farmer has at least an elementary education, are at contrast with this. This educational gap may limit farmers' ability to use and adopt contemporary conflict-mitigation strategies. Furthermore, it is striking how common traditional religious beliefs are among farmers. It emphasizes how cultural and religious systems influence how people see situations and react to them.

The household size of 4-5 members was common among farmers (46%). On the other hand, Zhou *et al.* (2018) indicated that 5-7 people made up the largest farmer's household in their research on socio-economic analysis and technical efficiency among smallholder sorghum farmers. This home arrangement implies that a large number of families in the study area heavily rely on farming as their main source of income. In this situation, farm-wildlife conflicts can have a significant negative impact on household well-being that goes beyond merely economic losses. Furthermore, the region's ethnic homogeneity is highlighted by the startling 91% of farmers who identify as Yoruba. This demographic cohesiveness has effects on how indigenous knowledge is passed down, how communities handle conflicts, and whether or not there is a chance for grassroots solutions.

According to Ehtisham *et al*. (2020) who worked on identification and crop damage assessment of Indian crested porcupine, porcupines were the primary culprits harming crop plants more than other wild species such bush pigs, grass cutters, bushbucks, and monitor lizards. The fact that porcupines are such a common danger highlights the necessity for focused mitigation techniques tailored to porcupine-related conflicts. The success of these tactics will depend on how well we comprehend the ecology and behavior of porcupines. Predators of farm animals include African civet cats and monitor lizards. In this situation, farmers dealing primarily with crop damage may need different remedies than those coping with livestock-related problems. Prioritizing the safeguarding of livestock assets may call for taking precautions for predator management. In consistency with Fern *et al*. (2020) who studied the ecological factors influencing wild pig damage to planted pine and hardwood seedlings, farm trees were damaged by bush pigs among other various species, including tree hyraxes, waterbucks, and bushbucks. Protecting valuable trees from wildlife damage is essential for both ecological and economic reasons. Strategies must be developed to safeguard these important natural resources while minimizing conflicts.

The research revealed that monitor lizards, waterbucks, and vervet monkeys were involved in disputes over water supplies with farmers since both wildlife and farmers depend on access to water as a basic requirement. Therefore, it is necessary to develop carefully thought-out methods that protect wildlife access to water while reducing confrontations with farmers in order to ensure their coexistence. Vervet monkeys have been found to be the main offenders in crop raiding during harvest. This research aligns with the findings of Siljander *et al.* (2020) that stress the seasonality of disputes and the significance of timing-specific mitigating measures in their research on primates on the farm-spatial patterns of human-wildlife conflict in forest-agricultural landscape. Implementing protection measures for crops during crucial times, like harvest, can greatly reduce losses. Furthermore, some wild animals, such as splitting cobras and puff adder, directly harm farmers who work on agriculture. The possible danger experienced by farmers during contacts with wildlife is justified by the findings of Habib *et al*. (2001) in their research on snake bite in Nigeria, which underline the necessity for safety measures and awareness campaigns.

The effectiveness of the various mitigation methods used by farmers in the study area to manage farm-wildlife conflicts varies. These tactics show how the neighborhood has learned to deal with the ongoing problems brought on by wildlife interactions. A thorough examination of these tactics' effectiveness can shed light on their applicability and potential impact. Crop rotation, the use of wooden fences, and direct killing appeared as very effective techniques, in line with the findings of Osipova *et al.* (2018) and Odunlami and Osumenya (2020) who revealed the use of fencing to resolve human-wildlife conflicts on farms. These tactics are frequently chosen because of how quickly they reduce conflicts. However, they also bring up important ethical and environmental issues. Particularly direct killing may have unforeseen repercussions, such as harming endangered species and altering the dynamics of an ecosystem (Viollaz *et al.*, 2021). Approaching these highly effective solutions with caution and taking into account the larger context of sustainability and conservation.

The effectiveness of scare techniques, crop netting, adjusting harvest timing, motion-activated lighting, and sound devices was rated as moderate. This is in line with the findings of Angkaew *et al.* (2022) from their research on the collateral damage from agricultural netting to open-country bird populations They found that agricultural netting, a fear technique, can help protect crops from potential bird damage. Gilsdorf *et al.* (2003) also stressed the use of reflecting coatings to deter wild animals from destroying agricultural products and motion-activated lightning in general. These techniques provide a harmony between efficacy and moral considerations. Even while they might not offer instant and comprehensive solutions, their continual application and improvement might lead to a better long-term method of handling conflicts. The effectiveness of using non-lethal

traps, keeping watch at night (Gilsdorf *et al.*, 2003), scent-based deterrents (Schlagester and Haag-Wackernagel, 2012), and altering harvest schedule was ranked lower. Even if these tactics are less effective, they may still be useful in some circumstances or when used in conjunction with other techniques. For instance, scent-based deterrents could be employed in conjunction with physical obstacles to increase their efficacy. Effective mitigation measures must take into account not only their short-term effects but also their long-term sustainability and moral ramifications. A thorough approach to conflict resolution should combine a variety of tactics adapted to the local environment, taking into account the variety of species and the particular difficulties faced by farmers.

CONCLUSION AND RECOMMENDATION

According to the study, a mix of preventive measures, including fence, scare tactics, scent-based deterrents, crop rotation, crop netting, nighttime patrol, adjusting harvest timing, and motion-activated lighting, can significantly lower conflict instances. However, these techniques only work as effectively as inclusive, flexible approaches that take into account the particular difficulties of the area. Development and implementation of community-specific wildlife management plans, promotion of education and awareness campaigns to encourage conflict mitigation, assistance to farmers in implementing sustainable agricultural practices, enhancing cooperation between government and agencies, NGOs, and local communities, and establishment of a system for ongoing monitoring and evaluation to adapt and guarantee the long-term effectiveness of mitigation strategies will help to lessen conflict.

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