

Case Study

PERCEIVED EFFECTS OF CLIMATE CHANGE ON WILDLIFE SPECIES: A CASE STUDY OF SOKOTO METROPOLIS, NIGERIA

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ABSTRACT

This study assessed the perceived effects of climate change on wildlife species in Sokoto metropolis, Northwestern Nigeria. A total of 100 respondents were surveyed using semi structured questionnaires, and the data were analyzed using descriptive statistics, Likert scale and regression analysis. Results revealed that the respondents were predominantly male (58%), married (56%), and engaged in occupations closely tied to natural resources conservation such as farming (33%) and business (23%). Educational attainment of the study participants was relatively high, with 40% completing secondary and 30% tertiary education. The main drivers of climate change as perceived by the respondents were deforestation (71%), overgrazing (65%), and bush burning (58%), while fossil fuel use (42%) and industrial pollution (25%) were less frequently mentioned. Awareness of climate change was widespread, with 87% of respondents indicating awareness and perceiving moderate (44%) to high (41%) impacts on ecosystem services. Fish (36%) and avifauna (24%) were identified as the most vulnerable species. Majority (mean = 4.2) agreed that climate change significantly increases predation risk of wildlife species. Regression analysis showed that education ($\beta = 0.212$, $p = 0.001$) and occupation ($\beta = -0.183$, $p = 0.013$) significantly influenced the perception of the respondents on the effects of climate change on wildlife species, whereas age ($\beta = 0.004$, $p = 0.505$), sex ($\beta = -0.062$, $p = 0.460$), and years of experience ($\beta = 0.008$, $p = 0.259$) were not significant predictors of perception ($R^2 = 0.27$; Adjusted $R^2 = 0.23$). The study concludes that climate change is widely recognized as a pressing environmental challenge in Sokoto metropolis, Nigeria, with strong acknowledgment of its impacts on wildlife species and ecosystems. We recommend strengthening environmental education, promoting sustainable land-use practices, enhancing wildlife conservation, and improving institutional support for climate governance.

Keywords: Drivers of Climate Change, Sustainable Land Management, Environmental Changes, Deforestation and Climate Change, Nigeria

INTRODUCTION

Climate change, defined as significant, long-term alterations in global temperatures and weather patterns [Abbass et al. \(2022\)](#), has emerged as a critical environmental challenge facing mankind worldwide [Howard-Grenville et al. \(2014\)](#). While Earth's climate has naturally fluctuated over time, the rapid changes observed since the mid-20th century are predominantly attributed to human activities, notably the burning of fossil fuels, deforestation, and industrial processes that increase greenhouse gas concentrations in the atmosphere (Intergovernmental Panel on Climate Change [IPCC], 2021). These anthropogenic actions have led to unprecedented

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rates of warming, with global temperatures currently approximately 1.3 degrees Celsius higher than pre-industrial levels [Plumer \(2024\)](#).

The consequences of climate change are profound and multifaceted, impacting various facets of the natural world [Lu and Jiang, \(2023\)](#). Several studies on climate change have been carried out in northern Nigeria such as [Olanrewaju et al. \(2015\)](#), [Muhammad et al. \(2017\)](#), [Ayinde et al. \(2013\)](#), [Muhammad et al. \(2021\)](#). However, none of these studies was conducted in northwestern (Sokoto), Nigeria. Thus, there is limited literature on peoples' perception on the effects of climate change on wildlife species in the zone. This study is highly significant as it provides a comprehensive understanding of how climate change is perceived and its implication on wildlife, combining ecological evidence with the lived experiences of communities that interact with these species. It offers insights that can guide conservation strategies and inform policies that are responsive to both scientific data and local realities. The study contributes to the body of knowledge by generating empirical data on peoples' perception on how wildlife species are affected by climate change. Additionally, it has captured indigenous knowledge and local observations, which are often overlooked in formal scientific research. The integration of these perspectives will provide a comprehensive understanding of the problem and contribute to academic discussions on climate change and biodiversity conservation [Barau et al. \(2022\)](#). From a wildlife management perspective, this study is essential for developing adaptive strategies to mitigate the adverse effects of climate change on species survival. Effective wildlife conservation requires an in-depth understanding of the challenges that species face, particularly in regions where climate variability is increasing [Warren et al. \(2018\)](#). By identifying species that are perceived to be the most vulnerable to climate change and understanding how their habitats are being altered, it will help wildlife managers, conservationists, and policymakers implement informed decisions [Hansen et al. \(2022\)](#). These may include habitat restoration, establishment of climate-resilient protected areas, and development of sustainable land-use practices that support biodiversity conservation [Aremu et al. \(2022\)](#). The findings of this research support climate resilience planning by offering data-driven recommendations on ecosystem restoration, afforestation, and sustainable land management based on perceived knowledge of the study respondents. Beyond wildlife management and climate change mitigation, this study has broader implications for other relevant fields. In agriculture, the findings can inform sustainable farming practices that minimize habitat destruction while maintaining ecological balance. In tourism, understanding perceived climate change's effects on wildlife will help in developing strategies to sustain ecotourism, which is a key economic driver. The study has relevance in environmental policy formulation, as it provides data that can be used to advocate for stronger environmental protection laws and more effective implementation of existing climate policies in Nigeria. By bridging the gap between scientific assessments and local perceptions, it has the potential to inform holistic, practical, and sustainable solutions to the challenges posed by climate change on wildlife species [Vidal \(2024\)](#).

People's perception of climate change significantly influences conservation efforts, as awareness and attitudes shape policy support, resource allocation, and individual actions [Lee et al. \(2020\)](#). Misinformation or skepticism can hinder mitigation strategies, while proactive engagement fosters sustainable practices and ecosystem resilience [Stevenson and Peterson \(2019\)](#). Understanding the perceived effects of climate change on wildlife species is essential for developing effective conservation strategies [Adger et al. \(2021\)](#). Climate change poses significant threats to wildlife species globally [Howard-Grenville et al. \(2014\)](#). The substantial decline in biodiversity, driven by habitat loss, altered species behaviors, and increased vulnerability to diseases, necessitates urgent conservation interventions. Local communities possess valuable knowledge and observations regarding environmental changes and wildlife responses, by integrating scientific research with local knowledge and involving communities in conservation efforts, it is possible to develop effective strategies to mitigate the adverse effects of climate change and safeguard biodiversity for future generations

MATERIALS AND METHODS

DESCRIPTION OF THE STUDY AREA

CLIMATE AND VEGETATION

The area has a tropical continental type of climate dominated by two opposing air masses. The Tropical Maritime wind from the south and Tropical Continental from the north, while the Tropical Maritime wind brings moist conditions and rainfall, the Tropical Continental brings cold, dry and dusty weather. The annual rainfall is about 550mm with a high peak in August. The dry season sets in first with the cold harmattan from November to March and a hot period comes in from April to the end of May when temperature reach 45°C [Sani \(2012\)](#). In addition, the vegetation of the area is Sudan savannah which consists of continuous grass cover and low proportion of trees. The trees have an average height between 20-15 feet, the grasses here are shorter and less luxuriant, and some trees are thorny while others has broad leaves of the species of guinea savannah. Trees are deciduous, shorter and more scattered as well as the area is generally hot. The natural vegetation is often disturbed especially due to continued grazing, burning and farming activities. Common trees in the area include *Adansonia digitata* *Azadirachta indica*, *Khaya ivorensis*, and *Parkia biglobosa*. Grasses and shrubs are also available and they serve as pasture to animals such as cattle, sheep and goats that are being reared in the area [Ibrahim et al. \(2019\)](#).

DATA COLLECTION

SAMPLING PROCEDURE AND SAMPLE SIZE

A multi-stage sampling technique was used for this study. In the first stage, five (5) areas (Runjin-sambo, Kalambaina, Bado, Dambuwa and Mabera) were selected based the population of people engaged in conservation related activities. In the second stage, twenty (20) respondents were selected from each area, who are mostly farmers, herders, and other local community members based on their experience and expertise in wildlife conservation. Additionally, snowballing technique was used to select one hundred (100) respondents based on their availability, accessibility, and willingness to participate. Semi-structured questionnaire with relevant questions that are consistent with the aim and objectives of the study were administered to the respondents within Sokoto metropolis, Nigeria, who have good understanding of the wildlife conservation and are quite knowledgeable about climate change.

DATA ANALYSIS

Descriptive statistics (tables, frequencies, and percentages), regression, and Likert scale rating assessment was used measure perception and attitude of the respondents.

RESULT

SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Table 1 highlights that, Out of 100 respondents, 58 (58%) were male, while 42 (42%) were female. In terms of marital status, 56 (56%) were married, 38 (38%) were single, 3 (3%) were widowed, and 3 (3%) were divorced. Regarding education, 12 (12%) had no formal education, 18 (18%) had primary education, 40 (40.0%) had secondary education, and 30 (30.0%) attained tertiary education. For occupation, 33 (33%) were farmers, 18 (18%) were herders, 20 (20.0%) were civil servants, 23 (23%) were in business, while 6 (6.0%) engaged in other occupations

Table 1

Table 1 Socio-Economic Characteristics of the Respondents		
Variables	Frequency	Percentage (%)
Sex		
Male	58	58
Female	42	42
Marital status		
Married	56	56
Single	38	38
Widowed	3	3
Divorced	3	3
Education		
No formal	12	12
Primary	18	18
Secondary	40	40
Tertiary	30	30
Occupation		
Farmer	33	33
Herder	18	18
Civil servant	20	20
Business	23	23
Others	6	6
Total	100	100

Field survey, 2025**PERCEIVED DRIVERS OF CLIMATE CHANGE AS REPORTED BY THE RESPONDENTS**

With regard to drivers of climate change, 71 respondents (71%) identified deforestation, 65 (65%) identified overgrazing, and 58 (58%) identified bush burning as major factors responsible for climate change. In addition, 42 respondents (42%) mentioned the use of fossil fuels, while 25 respondents (25.0%) mentioned industrial pollution.

Table 2

Table 2 Perceived Drivers of Climate Change as Reported by the Respondents		
Driver	Frequency	Percentage (%)
Deforestation	71	71
Overgrazing	65	65
Bush burning	58	58
Use of fossil fuels	42	42
Industrial pollution	25	25

Field Survey, 2025***multiple responses were observed*****AWARENESS AND PERCEIVED EFFECTS OF CLIMATE CHANGE ON WILDLIFE**

The results revealed that 87% indicated that they are aware of climate change, while 13 (13%) indicated lack of awareness. This indicates a very good knowledge of the concept under study. On perceived impact on ecosystem services, 41% indicated high impact, 44% indicated moderate impact, and 12.7% indicated low impact, while 3% indicated no impact. Concerning vulnerable wildlife species to climate change, 36% identified fish as the most vulnerable species, 24% reported birds, and 20% reported reptiles and small mammals. On the most vulnerable component of ecosystem, 43% reported animals, 27% reported habitat, and 30% reported plants (Table 3).

Table 3

Table 3 Awareness and Effects of Climate Change on Wildlife		
Variables	Frequency	Percentage (%)
Awareness of Climate change		
Yes	87	87
No	13	13
Impact on ecosystem services		
High impact	41	41
Moderate impact	44	44
Low impact	12	12
No impact	3	3
Vulnerable species		
Fish	46	36
Birds	24	24
Reptiles	20	20
mammals	20	20
Most vulnerable component of ecosystem		
Animals	43	43

Habitat	27	27
Plants	30	30
Total	100	100

Field survey, 2025

RESPONDENTS' PERCEPTION OF CLIMATE CHANGE AND ITS EFFECTS ON WILDLIFE CONSERVATION

On the statement that human activities are the main drivers of climate change, 35% strongly agreed, 40% agreed, 15% were neutral, and 7% disagreed, while only 3% strongly disagreed. Also, 37% strongly agreed that climate change increase vulnerability of species to extinction, 43% agreed, 13% were neutral, 5% disagreed, and 2% strongly disagreed. Regarding the statement that local communities play a significant role climate change mitigation, 32% strongly agreed, 38% agreed, 17% were neutral, and 8% disagreed, while 5%) strongly disagreed (Table 4).

Table 4

Table 4 Respondents' Perception of Climate Change (CC)							
Perception Statement	S A	A	N	D	S D	MEAN	RANK
Human activities are the main drivers of CC	35 (35%)	40 (40%)	15 (15%)	7 (7%)	3 (3%)	4.1	2
Natural changes also contribute to CC	21 (21%)	30 (30%)	28 (28%)	13 (13%)	8 (8%)	3.5	5
CC significantly increases species extinction risk	37 (37%)	43 (43%)	13 (13%)	5 (5.0%)	2 (2%)	4.2	1
Local communities play a significant role in CC mitigation	32 (32%)	38 (38%)	17 (17%)	8 (8%)	5 (5%)	4	3
CC is mostly caused by deforestation	30 (30%)	35 (35%)	22 (22%)	8 (8%)	5 (5%)	3.9	4
CC is beyond our control	8 (8%)	13 (13%)	22 (22%)	30 (30%)	27 (27%)	2.4	6

Field survey, 2025

CC = Climate change

Socio-Economic Factors Influencing Respondents Perception towards climate change and its effects on wildlife conservation

The regression results revealed that the constant had a coefficient of 2.954 with a standard error of 0.452, a t-value of 6.54, and a p-value of 0.000. Age had a coefficient of 0.004, standard error of 0.006, t-value of 0.67, and p-value of 0.505. Sex had a coefficient of -0.062, standard error of 0.084, t-value of -0.74, and p-value of 0.460. Education level had a coefficient of 0.212, standard error of 0.063, t-value of 3.37, and p-value of 0.001. Occupation had a coefficient of -0.183, standard error of 0.072, t-value of -2.54, and p-value of 0.013. Years of experience had a coefficient of 0.008, standard error of 0.007, t-value of 1.14, and p-value of 0.259.

Table 5

Table 5 Influence of Socio-Economic Factors on Respondents Perception Towards Climate Change and Its Effects on Wildlife Conservation				
Variable	Coefficient	Std. Error	t-value	p-value
Constant	2.954	0.452	6.54	0.000
Age	0.004	0.006	0.67	0.505
Sex	-0.062	0.084	-0.74	0.460
Education level	0.212	0.063	3.37	0.001 **
Occupation	-0.183	0.072	-2.54	0.013 **

Years of experience	0.008	0.007	1.14	0.259
Model summary: $R^2 = 0.27$; Adjusted $R^2 = 0.23$ ($p < 0.05$ significant)				

DISCUSSION

SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

The socio-economic profile indicates a predominance of male respondents, which may reflect the gender division of labor in study area, where men are traditionally more involved in outdoor activities such as farming, herding, and trade. This finding supports the observation of [Adekunle \(2012\)](#) that men dominate environmental resource-based occupations in northern Nigeria. The relatively high proportion of respondents with secondary and tertiary education suggests an increasing literacy level in the region, which is expected to enhance awareness of climate-related issues. This agrees with [Oguntoké and Adeyemi \(2017\)](#), who reported that higher education levels are associated with better understanding of environmental challenges.

The notable fraction of respondents without formal education could limit the depth of climate change understanding in some households. This corresponds with the finding of [Gandiwa \(2011\)](#), who stressed that illiteracy constrains rural communities from fully appreciating the implications of climate change on biodiversity. The occupational distribution, dominated by farmers and business people, underscores the direct link between livelihood and the natural environment, which according to [Hassan \(2013\)](#), makes such populations more sensitive to climate variability.

PERCEIVED DRIVERS OF CLIMATE CHANGE AS REPORTED BY THE RESPONDENTS

Deforestation, overgrazing, and bush burning emerged as the dominant drivers of climate change in the study area. This is not surprising given the heavy reliance on firewood, agricultural expansion, and livestock rearing in Sokoto State, Nigeria. This is consistent with the observations of [Ojo \(2014\)](#) that land-use practices in northern Nigeria accelerate vegetation loss. The prominence of deforestation aligns with the report of [FAO \(2010\)](#), which highlighted firewood harvesting as the most significant factor driving forest cover decline in the region.

Interestingly, industrial pollution received the lowest mention, reflecting the limited industrial activities in Sokoto compared to more urbanized Nigerian cities. This agrees with the conclusion of [Yusuf \(2015\)](#) that in northern Nigeria, natural resource exploitation outweighs industrialization as the main climate driver. The relatively moderate recognition of fossil fuel use may be due to increasing awareness of emissions from vehicles and generators, though still not as pressing as land-use changes in the respondents lived experiences.

AWARENESS AND EFFECTS OF CLIMATE CHANGE ON WILDLIFE CONSERVATION

The high awareness of climate change among respondents suggests that climate issues have become well recognized at the community level. This aligns with [Adebayo \(2014\)](#), who found similar patterns of growing awareness of climate change in rural Nigeria. However, awareness alone may not translate into effective action, as [Okonkwo \(2012\)](#) argued that limited access to information channels and weak institutional support hinder communities from acting on their knowledge. Regarding the impact of climate change on ecosystem services, respondents highlighted moderate to high impacts, showing recognition that climate change is altering resource availability. This resonates with the findings of [IPCC \(2014\)](#), which emphasized that Africa's ecosystems are particularly vulnerable to climate variability. The identification of fish and birds as the most vulnerable species may be explained by their high sensitivity to changes in rainfall patterns and temperature. This agrees with the work of [Ayanlade and Jegede \(2016\)](#), who noted declining fish populations due to reduced water bodies in northern Nigeria.

The fact that animals and habitats were perceived as the most vulnerable biodiversity components, it corresponds with the view of [Shackleton \(2007\)](#) that faunal species are more visibly affected by ecosystem disruptions compared to plant species. However, plants receiving relatively less attention may reflect respondents' tendency to notice wildlife decline before vegetation loss, which, as [Gandiwa \(2011\)](#) observed, is common in rural perceptions of climate impacts.

RESPONDENTS' PERCEPTION OF CLIMATE CHANGE AND ITS EFFECT ON CONSERVATION

The strong belief that human activities are the main driver of climate change reinforces the anthropogenic perspective of environmental degradation. This is in line with the [IPCC \(2014\)](#) assertion that unsustainable human activities are the predominant causes of climate change in developing regions. The relatively positive response on extinction risks further indicates public recognition of biodiversity threats, echoing the conclusion of [Oguntoké and Adeyemi \(2017\)](#) that local communities are increasingly aware of the ecological consequences of climate change. On the other hand, the mixed perceptions regarding natural causes suggest some uncertainty or traditional beliefs still present among respondents. This partially agrees with [Adekunle \(2012\)](#), who noted that rural dwellers often attribute environmental changes to both natural and supernatural forces. The rejection of the idea that climate change is beyond human control is notable, as it shows optimism that mitigation is possible. This contrasts with [Gandiwa \(2011\)](#),

who reported fatalistic attitudes in some African communities. The positive perception index overall demonstrates readiness among respondents to support conservation interventions, this is in agreement with Hassan (2013) who argued that informed communities are more willing to participate in environmental initiatives.

5.5 Influence of some Socio-Economic Factors on the people's Perception of the effect of climate change on wildlife conservation

The regression results revealed that education significantly influenced respondents' perceptions of climate change. This confirms Oguntoke and Adeyemi (2017), who stated that literacy enhances environmental knowledge and shapes awareness. The significance of occupation further indicates that livelihood type shape how people experience and interpret climate variability. Farmers and herders, for example, are directly exposed to rainfall changes, while civil servants may be less sensitive. This finding is consistent with the observations of Adebayo (2014), who reported that occupational dependence on natural resources intensifies concern about climate impacts.

Other variables such as age, sex, and years of experience were not statistically significant. This is somewhat contrary to Adekunle (2012), who found that age was a determinant of environmental attitudes. The difference may be attributed to contextual variations, as age in this study area does not necessarily influence exposure to climate information. The model's explanatory power, though moderate, reflects the complexity of human perceptions, which, as Shackleton (2007) pointed out, are influenced by multiple socio-cultural and ecological factors beyond demographics alone.

CONCLUSION

The study concludes that communities in Sokoto metropolis, Nigeria, have substantial awareness of climate change and recognize its adverse effects on wildlife and ecosystem services. Anthropogenic drivers such as deforestation, overgrazing, and bush burning remain the major perceived contributors to climate variability in the region. Perceptions of climate change are largely shaped by education and occupation, suggesting that informed and resource-dependent individuals are more likely to appreciate the risks posed by climate variability. The findings highlight the urgent need for conservation and awareness initiatives, given the vulnerability of wildlife species such as fish and birds, and the recognition that climate change is a human-driven phenomenon that can be mitigated through collective action.

RECOMMENDATION

- 1) Awareness programs should be intensified, particularly aiming at individuals with little or no formal education, to bridge knowledge gaps and enhance understanding of climate change impacts.
- 2) Government and community stakeholders should encourage alternatives to deforestation, overgrazing, and bush burning through agroforestry, controlled grazing systems, and renewable energy use.
- 3) Conservation strategies should prioritize fish and bird species, as well as habitats identified as most vulnerable. This can be achieved through community-based wildlife protection and habitat restoration projects.
- 4) Policymakers should strengthen local institutions to promote participatory climate governance, ensuring that community perceptions are integrated into planning for sustainable wildlife management.

CONFLICT OF INTEREST DECLARATION

We hereby wish to declare that we do not have any conflict of interests to disclose. Moreover, we declare that the manuscript has not been published before and is not being considered for publication elsewhere.

AUTHOR CONTRIBUTIONS

This paper is a joint effort of the authors. Dr. Mustapha Sani BUNZA, the principal author, collected the data, wrote literature review and the method, interpretation and discussion of the results in consultation with co-authors. Martins LOIS Ndwok carried out the empirical analysis while Dr. Aishatu Abdullahi SENCHI and Zubairu Yakubu GADA prepared the draft of the paper. Maryam Ibrahim reviewed the first draft of the paper and Mr. Malik REUBEN edited the draft before sending it for publication.

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