ASSESSMENT OF CASHEW FARMERS' VULNERABILITY TO CLIMATE CHANGE IN OYO STATE, NIGERIA

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ABSTRACT

An assessment of farmers' vulnerability and their cashew output are required because of the variation in climate components. It hampers farmers' productivity and means of livelihoods. The main objective of the research work is to assess the cashew farmers' vulnerability to climate change in Oyo state, Nigeria. A multi-stage sampling technique was used to collect data. A sample size of 120 cashew farmers was obtained. Ogbomosho and Ibadan/Ibarapa Agricultural zones were purposive selected for being cashew grown zones. Descriptive statistics was used to analysis socioeconomic characteristics and adaptation methods adopted by the farmers. Climate Compost Vulnerability Index (CCVI) was adopted to assess the Livelihood Vulnerability Index (LVI) of the two zones. The findings showed that most (75.8%) of the cashew farmers were male and most (59.2%) were married. 67.5% obtained secondary education and 60.8% were within 51-60 years with a mean age of 55 years. Most (38.4%) of the respondents adopted improved seed variety. The Composite Climate Change Vulnerability Index revealed that cashew farmers' in Ogbomosho Agricultural Zone (0.319) are more vulnerable than their counterparts in Ibadan/Ibarapa Agricultural Zone (0.213). A high degree of exposure capability recorded might be associated with poor and insufficient adaptability. The Ogbomosho Agricultural Zone's cashew farmers increased vulnerability was mostly caused by improper monitoring, insufficient information distribution and poor adaptation for good developmental planning. It is recommended that extension officers should be proactive to their duties and proper distribution of any available adaptive measures put in place by the public and development agencies.

Keywords: Cashew nuts, Climate change, Farmers, Vulnerability index

1. | Introduction

Global warming is 21st century world environmental challenge. It affects ecosystems, economies, agricultural, water security and human health (United Nations (UN), 2025). Climate change effects are not hidden on food and nutritional security. Its climate-related disorders increasingly weaken agricultural systems. Malhi *et al.* (2021) reported that global warming has led to the global food crisis that led to the food scarcity and price instability of staple foods. Global warming can be simply referred to as a long-term variations of Earth's climate elements. It was instigated by anthropogenic activities such as: burning of fossil fuel, industrialisation and deforestation since the beginning of pre-industrial era (UN, 2025; National Aeronautics and Space Administration (NASA), 2024). Majority of human activities in searching for means of livelihood has led to an increased in Greenhouse Gas Emissions, intensifying global

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warming and climate change (NASA, 2024; Walker *et al.,* 2022; Muigua, 2024).

Climate change vulnerability can be simply referred to as an exposure of means of livelihood and inhabitants to the unfriendly results of climate shocks (Saha *et al.,* 2024). Intergovernmental Panel on Climate Change (IPCC), 2014; Rudiarto & Pamungkas, 2020 and Saha *et al.,* 2024 reported that vulnerability is a function of exposure, sensitivity and adaptive capacity. Exposure means a degree at which a system get involve in climate hazards while sensitivity means the amount of impact of the climate hazards and adaptive capacity means the capacity to manage or adjust to the trend of climate shocks (IPCC, 2014; Alam & Rukhsana, 2023). In agricultural systems, vulnerability can be assessed by the farmers' ability to adopt climate-resilient crop varieties, change farming practices toward climate change or diversify livelihood activities.

Climate vulnerability is linked to poverty trap, as reflecting the likelihood that climate shocks will push households below a minimum income thresholds or entrench existing poverty (Jalal *et al.,* 2021; Li *et al.,* 2022; Mohammed *et al.,* 2022; World Bank Group, 2025). Sensitivity of climate variations are not the same across regions and social groups. It is a function of: financial resources, institutional capacity, technological advancement and economic stability that are not the same from across regions and social groups (Adom, 2024). Agriculture is a weather-sensitive activities. Agriculture relies on temperature, rainfall and water availability for its operations. Climate change is negatively affect farm produces, livestock outputs, water availability and livelihood stability (Assan, 2022; United States Environmental Protection Agency (US-EPA), 2025).

Adaptation is the only surviving strategies to withstand the unpleasant effects of climate variation that has come to stay with human races. The IPCC (2015) and Walker *et al.,* (2022) defined adaptation as an adjustment in the natural or human systems that ease harm arise from climate change and their effects. Human being have historically demonstrated strong adaptive capacity across diverse environments. The rate and measure of present-day climate change has pose exceptional challenges, particularly for resource-constrained populations.

Agricultural sector is the greatest susceptible to the climate variation as a result of over reliance on climate elements and natural endowments (Bedo *et al.,* 2024; Bashiru *et al.,* 2022). In Africa, this vulnerability is deepened by the limited access to capital, contemporary technology tools and institutional supports. Majority of the farmers have adopted one or two coping techniques such as: crop diversification, changing planting date and means of livelihood diversification to cope with climate shocks (Dirani *et al.,* 2021; Gates, 2023). Accepting these coping strategies, it is essential to design effective policies that will promote agricultural sustainable and adaptation.

Livelihood options means the range of productive activities that households can undertake to secure income and better their well-being (Arifalo & Ilesanmi, 2023). These may be agricultural, non-agricultural or combined (Arifalo & Ilesanmi, 2023). Livelihood choices are created by economic incentives, social norms, access to assets, institutional arrangements and perceptions of risk (Kolog *et al.,* 2024; Talema & Nigusie, 2023). In Nigeria and Africa continent, climate variation has pose serious threats to the poverty alleviation and rate of development (Onyeaka *et al.,* 2024; Umeonyirioha., 2025). The absence of adaptation policies can worsen vulnerabilities and destabilise long-term economic growth of any country or society (Arogundade *et al.,* 2024; Jafaru *et al.,* 2025).

2. | Materials and Methods

2.1 | Study Area

The study took place in Oyo State, Nigeria. Oyo state is the commercial hub of cashew cultivation in

the southwest geo-political zone of the country. The population of Oyo State is about six million while the total land area is approximately 28,000 square kilometre (National Population Commission (NPC), 2006). The study area is located at the rainforest, guinea savannah and derived savannah area. The supply of rainfall in the area is bimodal enhancing the average water supply of about 1350mm annually with a mean temperature of $\pm 27^0$C. Oyo state is situated on latitude 6.5^0 and 9^0 north of the Equator and between longitudes 3^0 east of Greenwich meridian (Oyo State Diary, 2023). It has 4 agricultural zones and 28 blocks, namely: Oyo zone (4 LGAs and 5 blocks), Ibadan/ Ibarapa zone (14 LGAs and 9 blocks), Ogbomoso zone (5 LGAs and 5 blocks) and Saki zones (10 LGAs and 9 blocks) of which activities were being coordinated and monitored by the Agricultural Development Agencies (Ashley-Dejo *et al.,* 2021). Oyo state vegetation supports cultivation of both arable and cash crops; cashew is one of the cash crops (Olawuyi *et al.,* 2022).

2.2 | Sampling Technique and Data Collection

A multi-stage sampling procedure was used to select respondents for the study. Initially, Ogbomosho and Ibadan/Ibarapa, two agricultural zones that produced the most cashew nuts, were purposefully selected. The second step was the purposive selection of 3 LGAs from each agricultural zone that are well known for cashew cultivation and the random selection of four communities/villages from each LGAs to sample a total of 24 communities/ villages across the two agricultural districts. The last stage was choosing 5 cashew producers at random from each community using a sampling frame that the Agricultural Development Programme (ADP) provided. As a result, a sample size of 120 cashew farmers was obtained.

2.3 | Data analysis

Data on the socioeconomic features of the respondents and the adaptive measures they employed to strengthen the resilience of their

Table 1 | Sampled Local Government Areas and Communities/Villages of Ogbomosho Agricultural Zone, Oyo State.

1st Stage Agricultural Zone (Purposeful Selection)	2nd Stage LGAs (Purposeful Selection)	3rd Stage Communities/Villages (Random Selection)	4th Stage Respondents Sampled (Random Selection)
Ogbomosho	Orire	• Iluju	5
		• Ladokun	5
		• Onilaru	5
		• Ikoyi	5
	Ogo-Oluwa	• Oguro	5
		• Idi Araba	5
		• Ilofe	5
		• Esade	5
	Surulere	• Oko	5
		• Ebila	5
		• Abogunde	5
		• Gambari	5
Total	**3**	**12**	**60**

Source | Field Data, 2024

Table 2 | Sampled Local Government Areas and Communities/Villages of Ibadan/Ibarapa Agricultural Zone, Oyo State.

1st Stage Agricultural Zone (Purposeful Selection)	2nd Stage LGAs (Purposeful Selection	3rd Stage Communities/Villages (Random Selection)	4th Stage Respondents Sampled (Random Selection)
Ibadan/Ibarapa	Ibarapa East	• Temidire	5
		• Akete	5
		• Abule Baale	5
		• Babamogba	5
	Ibarapa North	• Omigo	5
		• Alagbaa	5
		• Ago iwafin	5
		• Asulara	5
	Ibarapa Central	• Idere	5
		• Lajorun	5
		• Igbole	5
		• Isale-oba	5
Total	**3**	**12**	**60**

Source | Field Data, 2024

coping techniques and Livelihood Vulnerability Index in the two districts were collected through a well-structured questionnaire and an interview schedule. The definite objectives of the study were met with the application of the following analytical techniques: Livelihood Vulnerability Index (LVI) and Descriptive statistics.

2.4 | Calculating the LVI: Composite Index A:roach

The Livelihood Vulnerability Index (LVI) computes averages using a balanced method, even though each major component is composed of a variable number of sub-components (Islam & Ghosh, 2024; Basiru *et al.,* 2022). This weighting system may be adopted and altered by users in the future as necessary. The Human Development Index (UNDP, 2024 and Rukhsana, 2023) formula was modified to create a conversion formula as stated below:

$$Index_{SZ} = \frac{S_Z - S_{min}}{S_{max} - S_{min}} \quad (1)$$

where:

S_Z - Observed Sub-component for Zones

S_{min} and S_{max} that is the minimum and maximum values, respectively, for each sub-component determined using data from the two agricultural zones. These minimum and maximum values were used to transform this indicator into a standardized index so it could be integrated into the major component of the LVI (Bashiru *et al.,* 2022). According to Bashiru *et al.,* 2022 after each is standardized, the sub-component indicators were averaged using Equation 2 to calculate the value of each major component:

$$M_Z = \frac{\sum_{i=1}^{n} indexS_Z}{n} \quad (2)$$

where:

M_Z is one of the seven major components: Socio-Demographic Profile (SDP), Livelihood Strategies (LS), Social Networks (SN), Health (H), Food and Nutrition (FN), Water (W) or Natural Disasters and Climate Variability (NDCV), the index represents

the sub-components, for zone Z, indexed by *I,* that make up each major component, and n is the numberof sub-components for the zone were calculated, they were averaged using equation 3 to obtain zone dimension of LVI (Basiru *et al.,* 2022):

$$LVI_Z = \frac{\sum_{i=1}^{n} WMiMZi}{\sum_{i=1}^{n} WMi} \quad (3)$$

which can also be express as:

$$LVI_Z = \frac{W_{SDP}SDP_Z + W_{LS}LS_Z + W_{SN}SN_Z + W_W Wz + W_H H_Z + W_{FN}FN_Z + W_{NDCV}NDCV_Z}{W_{SDP} + W_{LS} + W_{SN} + W_W + W_H + W_{FN} + W_{NDCV}} \quad (4)$$

where:

LVI_Z is the livelihood vulnerability index for agricultural zones, equals the weighted average of the seven major components. The weights of each major component, *WMi* are determined by the number of sub-components that make up each major component and are included to ensure that all sub-components contribute equally to the overall LVI (Basiru *et al.,* 2022). According to Hoang *et al.,* (2020); Hahn *et al.,* (2009); Basiru *et al.,* (2022) the LVI is a scale that goes from 0 (least vulnerable) to 1 (most vulnerable) in this study.

2.5 | Calculating the LVI-IPCC: IPCC Framework A:roach

The LVI-IPCC was computed using equation (1) through (4) and the same sub-components. The LVI-IPCC differs from the LVI when the main elements are added together (Basiru *et al.,* 2022).

Rather than merge the major components into the LVI in one step, they are first combined according to the categorization scheme in Table 5 and 6 using the following equation (5):

$$CF_Z = \frac{\sum_{i=1}^{n} WMiMZi}{\sum_{i=1}^{n} WMi} \quad (5)$$

Where CF_Z is an IPCC- defined contributing factor (exposure, sensitivity and adaptive capacity) for the zone z, MZ*i* is the major components for zone z indexed by *i*, WM*i* is the weight of each major component and *n* is the number of major components in each contributing factors were combined using the following equation 6:

$$LVI\text{-}IPCC_Z = (E_Z - A_Z) * S_Z \quad (6)$$

According to Bashiru *et al.,* (2022); Hoang *et al.,* (2020); Akafu *et al.,* (2025), the LVI-PCC was scaled from -1 (least vulnerable) to 1 (most vulnerable).

3. | Result and Discussion

The socioeconomic features of cashew farmers' are shown in Table 3. The table revealed that majority (75.8%) were male and larger proportion (60.8%) of them were between ages 51-60 years with the average age being 55 years. Similar reports were observed by Agada & Sule (2020) that about 78.4% of cashew farmers at Ugwolawo District, Kogi State were male. The patriarchal nature of the society, which grants land ownership rights to male household members, may be the reason for the dominance of males over females in cashew nuts production observed in the two regions. Most (59.2%) of the respondents were married and 67.5% of them had secondary education. Amaegberi & Oyintonbra (2023) reported that majority (86.7%) of the cashew farmers in Kogi state were married. The higher percentage of married cashew farmers suggest that this may be a relatively stable population that has a positive implication for sustainability of the enterprise (Amaegberi & Oyintonbra, 2023). Majority (41.7%) of the respondents acquired their farm land through inheritance. Analysing the year put into farming practice showed that most (55.8%) of them have been growing cashew for 15 years. Most (65.8%) of the respondents do not have access to extension service and 63.3% do not have access to credit facilities being a small scale farmers. Majority (68.3%) of the respondents has 6-10 household members with an average of 7 members. 53.3% of

Table 3 | Socioeconomic Characteristics of Cashew Farmers

Variables	Frequency	Percentage	Mean
Sex			
Male	91	75.8	
Female	29	24.2	
Age (Years)			
31 - 40	11	9.2	
41 - 50	17	14.2	55Years
51 - 60	73	60.8	
61 - 70	10	8.3	
71 - 80	9	7.5	
Marital statues			
Single	10	8.3	
Married	71	59.2	
Divorced	13	10.8	
Separated	15	12.5	
Widowed	11	9.2	
Level of Education			
No formal education	10	8.3	
Primary Education	17	14.2	
Secondary Education	81	67.5	
Tertiary Education	12	10	
Methods of land acquisition			
Leasehold	18	15	
Communal	4	3.3	
Gift	12	10	
Inherited	50	41.7	
Purchased	36	30	
Farming experience (Years)			
1 - 10	29	24.2	15 Years
11 - 20	67	55.8	
21 - 30	23	19.2	
Above 30	1	0.8	
Access to Extension Service			
Access	41	34.2	
No Access	79	65.8	
Sources of Credit Facilities			
Relatives and Friends	9	7.5	
Money Lender	11	9.2	
Personal Savings	17	14.2	
Co-operatives societies	60	50	
Cashew Merchant	16	13.3	
Government	7	5.8	
Respondents other sources of Income			
Farming	24	20	
Non-Farming	64	53.3	
Off-Farming	14	11.7	
Remittance/Transfer Payment	18	15	
Household size			
1 - 5	32	26.7	7 Members
6 - 10	82	68.3	
Above 10	6	5	
Total	120	100	

Source | Field Data, 2024

the respondents also realized income from non-farming activities.

The climate change awareness, sources of information and adaptive strategies of the respondents is shown on Table 4. The table revealed that 92.5% of the cashew farmers were fully aware of climate variation while the majority (46.7%) of the farmers' source of climate change information was solely through observation. The majority (37.5%) attested to rainfall and temperature as climatic elements that affect their output while most (45%) of the respondents observed high rainfall. This is in conformity with Adjei & Alormu, (2020) that reported the effect of exccesive rainfall and high sunlight on cashew production.The contributing factor values for Ogbomosho Agricultural zone is shown on Table 5. It shows the Adaptive capacity (0.535), Sensitivity (0.641) and Exposure (0.662). The LVI-IPCC for the zone is 0.319.

Table 4 | Climate Changes: Awareness, Sources and Adaptive Strategies used against Climate Shock

Variables	Rating Statements	Frequency	Percentage
Climate Change Awareness	Fully aware	111	92.5
	Not aware	9	7.5
Sources of Information on Climate Change	Observation	56	46.7
	Friends	35	29.2
	Extension Agents	12	10
	Mass Media	10	8.3
	Internet	7	5.8
Climatic elements that affect cashew production	Rainfall	25	20.8
	Temperature	23	19.2
	Sunshine	21	17.5
	Wind	6	5
	Rainfall and Temperature	45	37.5
Observed Changes in Climate Pattern	High Rainfall	54	45
	High Temperature	40	33.3
	Unfavourable sunlight	17	14.2
	High wind	9	7.5
Adaptation Strategies available	Conserving Moisture/Mulching	10	8.3
	Improved seed variety	60	50
	Crop diversification	30	25
	Irrigation techniques	5	4.2
	Fertilizer application	15	12.5
Total		**120**	**100**

Source | Field Data, 2024

The contributing factor values for Ibadan/Ibarapa Agricultural zone is shown on Table 6. It shows the Adaptive capacity (0.526), Sensitivity (0.671) and Exposure (0.566). The LVI-IPCC for the zone is 0.213.

Table 5 | Lvi-Ipcc Computation for Ogbomosho Agricultural Zone

Contributing Factor	Major Components For Ogbomosho	Major Components Values For Ogbomosho	No Of Sub-Component Per Major Component	Contributing Factor Values	LVI-IPCC for Ogbomosho
Adaptive capacity	Socio-Demographic Profile	0.407	8	0.535	
	Livelihood Strategies	0.557	7		
	Social Networks	0.708	5		0.319
Sensitivity	Health	0.606	8	0.641	
	Food and Nutrition	0.664	9		
	Water	0.650	7		
Exposure	Natural Disaster and Climate Variability	0.662	12	0.662	

Source | Field Data, 2024

Table 6 | LVI-IPCC Computation for Ibadan/Ibarapa Agricultural Zone

Contributing Factor	Major Components For Ibadan/Ibarapa	Major Components Values For Ibadan/Ibarapa	No Of Sub-Component Per Major Component	Contributing Factor Values	LVI-IPCC for Ibadan/ Ibarapa
Adaptive capacity	Socio-Demographic Profile	0.379	8	0.526	
	Livelihood Strategies	0.526	7		
	Social Networks	0.760	5		
Sensitivity	Health	0.797	8	0.671	0.213
	Food and Nutrition	0.673	9		
	Water	0.797	7		
Exposure	Natural Disaster and Climate Variability	0.566	12	0.566	

Source | Field Data, 2024

Table 7 | LVI-IPCC Computed Indices with Contributing Factors for Ogbomosho and Ibadan/Ibarapa Study Area

	Computed Indices:	
Contributing Factors	**Ogbomosho**	**Ibadan/Ibarapa**
Exposure	0.662	0.566
Sensitivity	0.641	0.671
Adaptive Capacity	0.535	0.526
LVI-IPCC	**0.319**	**0.213**
Results/Interpretation	**More Vulnerable**	**Less Vulnerable**

Source | Field Data, 2024

$$LVI - IPCC_{Ogbomosho} = (E_{ogbomosho} - A_{ogbomosho}) * S_{ogbomosho} = (0.662\text{-}0.535) * (0.641) = 0.319$$

$$LVI - IPCC_{Ib/Ibarapa} = (E_{Ib/Ibarapa} - A_{Ib/Ibarapa}) * S_{Ib/Ibarapa} = (0.566\text{-}0.526) * (0.671) = 0.213$$

The Composite Climate Change Index of the study area is shown on Table 7. It revealed that Ogbomosho Agricultural Zone (0.319) was more vulnerable than Ibadan/Ibarapa Agricultural District (0.213) due to poor adaptive capacity to combat the effect as being shown in Figures 1 and 2.The adaptation strategy adopted by the respondents is shown on Table 8. Majority (38.3%) of the respondents adopted drought resistant variety to combat the effect of harsh weather on their output. It is aligned with Abdullahi *et al.,* (2024) recommedation that planting of climate-resistant varieties can increase the chances of successful cashew nut production despite climate challenges.

Table 8 | Distribution of Adaptation Strategies Adopted by Respondents

Adaptation Strategies	Frequency	Percentage (%)
Modifying length of growing period	28	23.3
Changing planting dates	21	17.5
Drought resistant variety	46	38.3
Household headed migrated to other rural or urban area	10	8.3
Sought off-farm employment	8	6.7
Constant spraying	7	5.8
Total	**120**	**100.0**

Source | Field Data, 2024

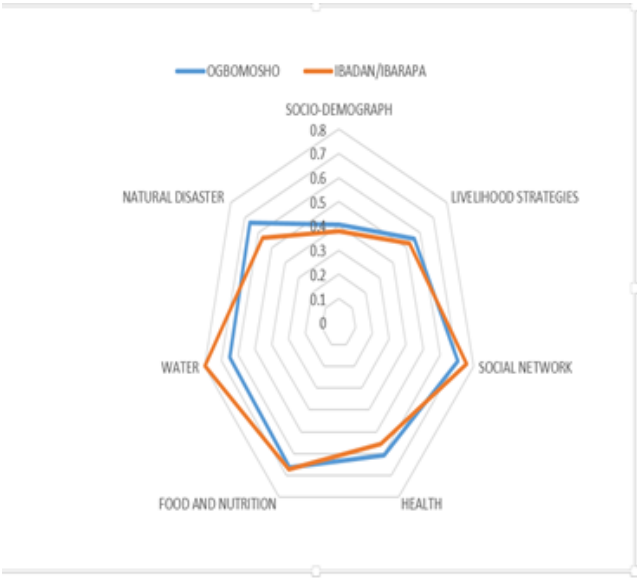

Figure 1 | Livelihood Vulnerability Index Spider Diagram
Source | Field Data, 2024

Figure 2 | Vulnerability Triangle Diagram of Determinants of Cashew Farmers
Source | Field Data, 2024

4. | Conclusion and Policy Issues

The Climate Change Vulnerability Index analysed for the study will assist decision makers, donor organisations and government in taking proactive measures as regard climate-smart development and interventions to mitigate vulnerability of cashew farmers in Oyo State.

The composite vulnerability index revealed that Ogbomosho cashew farmers were more vulnerable to harsh weather that their counterpart at Ibadan/ Ibarapa Agricultural zone of Oyo State. Livelihood Vulnerability Index spider diagram (Figure 1) revealed that Ogbomosho was seriously affected by Natural disaster, Livelihood Strategies and Health Components of the seven components of LVI.

The recommendations from this study are:

Substantial adaptation finances and resources should be channel directly towards increasing farmers' resilience in Ogbomosho Agricultural zone;

Local government authority should be empowered to provide basic amenities such as well-equipped basic health centres in Ogbomosho zone;

More adaptation resources should be transferred directly to the stakeholders in Ogbomosho and proper monitoring of the adaptive finance and resources and

Government agencies should create more awareness on challenges being posed by climate change.

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