ASSESSMENT OF FARMERS' PERCEPTION OF CLIMATE CHANGE ISSUES AND RESILIENCE TOWARDS FOOD SECURITY IN KUBAU LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

BY

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ABSTRACT

This study assessed farmers' perception of climate change issues and resilience towards food security in Kubau Local Government Area, Kaduna State. The study design involved the collection and analyses of rainfall and temperature data (1970–2021) using trend line equations. The data were used to characterize the climate of the study area. A total of 385 farmers were purposively sampled. Structured questionnaire and Key Informant Interviews (KII) were used to get information from the farmers. Descriptive statistics were employed in the analysis. Likert rating-scale for frequency level were used and analysed using mean and standard deviation distribution. Constant comparison analysis model was used to analyse the responses during the interviews and focus group discussion. The results of the trend line equation showed an increase in total annual rainfall and temperature. The results further showed that the farmers' perception of climate change was in line with the analysed rainfall and temperature data. Ninety-five percent of the farmers were aware of climate change issues; the farmers perceived late onset and early cessation as pointers to climate change in the study area. Mixed cropping, use of early maturing crop, use of organic manure and chemical fertilizer were the major resilient strategies adopted by the farmers. Based on the findings, the study recommended that government at all levels and farm extension agents should consistently educate farmers on the dynamics of weather and climate; agricultural research institutions in Nigeria should develop more drought resistant and early maturing seeds to boost crop production in order to ensure food security.

Keywords: Crop production, Perception, Rainfall, Resilience and Temperature.

INTRODUCTION

Climate change is real. It has caused substantial damages and increasingly irreversible losses, in terrestrial, freshwater, coastal and open ocean marine ecosystems in every region across the globe (Intergovernmental Panel on Climate Change [IPCC], 2021). It respects no political boundary and poses severe risks to nation's socio-economic development. Africa is one of the continents that is most vulnerable to the effect of climate variability and change. Thus, agricultural production and food security are likely to be severely compromised by climate change thereby putting some regions of marginal agriculture out of production (IPCC, 2022). It is thus of paramount importance that measures are taken to mitigate the consequences of climate change by way of research, adaptation and domestic resources mobilization since most of the agriculture in Nigeria is rain-fed.

Resilience in the literature has a wide range of meanings. Adaptation is often organized around resilience as bouncing back and returning to a previous state after a disturbance. More broadly, resilience describes not just the ability to maintain essential function, identity and structure, but also the capacity for transformation. Resilience as defined by IPCC (2022), is the capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure as well as biodiversity in case of ecosystems while also maintaining the capacity for adaptation, learning and transformation. Resilience is necessary because the world climate is changing and will continue to change at rates unprecedented. Setting limits on emissions will not be enough or happen soon enough to avoid all impacts of climate change.

Food security exists when all people, always, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilization and stability. The nutritional dimension is integral to the concept of food security and to the work of Committee on World Food Security (CWFS, 2014).

Perception refers to beliefs or opinions often held by many people based on how things seem to them. Awareness, on the other hand, is to be informed, it concerns the way people understand the world, and how they interpret and apply meaning to their experiences (Blaikie et al., 1997). Both perception and awareness guide decision making and consequently, farmers' action on climate change adaptation. Indigenous farmers are not only keen observers of climate changes but are also actively trying to adapt to the changing conditions (Stott & Kettleborough, 2002). Related to that, over the past years, many scholars such as Deressa, et al., (2008), Ogunleye & Yekini (2012), Ejeh (2014), Umar et al., (2015) and Ikpe (2021), maintained the thinking that farmers' perception on climate change issues are very important in adopting coping strategies.

Farmers' ability to perceive climate change is a key precondition for their choice to resilience. Farmers with little or no awareness/perception of climate change may not be able to fully take advantage of the technical and economic opportunities around them since adoption of resilience strategies only take place after awareness. Therefore, studying the farmers' perception and awareness of climate change issues and resilience strategies in Kubau Local Government Area (LGA) is justifiable. The findings and recommendations of this research would go a long way to assist the farmers in understanding the climatic characteristics of the area and how to respond to the current upsurge in climate change via the adoption of viable resilience strategies. It is time to develop effective ways to integrate psychological research into these efforts. Thus, this study is aimed at assessing farmers' perception and awareness on climate change and resilience towards food security in Kubau LGA, Kaduna State.

THE STUDY AREA

Kubau LGA is in the North-Eastern part of Kaduna State, Nigeria. Its geographical coordinates lie between Latitudes 10º48′ 45″ to 10º48′ 49″ and Longitudes 8º22′ 11″ to 8º23′ 09″. It shares boundaries with Ikara LGA to the north-east, Soba LGA to the West, Kauru LGA to the south-west and Lere LGA to the South-East. The LGA also shares boundaries with Kano State to the North-East and the North respectively (Mohammed et al., 2022). The LGA covers an area of approximately 2,363 square kilometers (km²). Kubau LGA had a

population of 282,045 people during the 2006 census, with 2022 projected population of 414,700 and a population density of 175 per/km² (Aliyu et al., 2022).

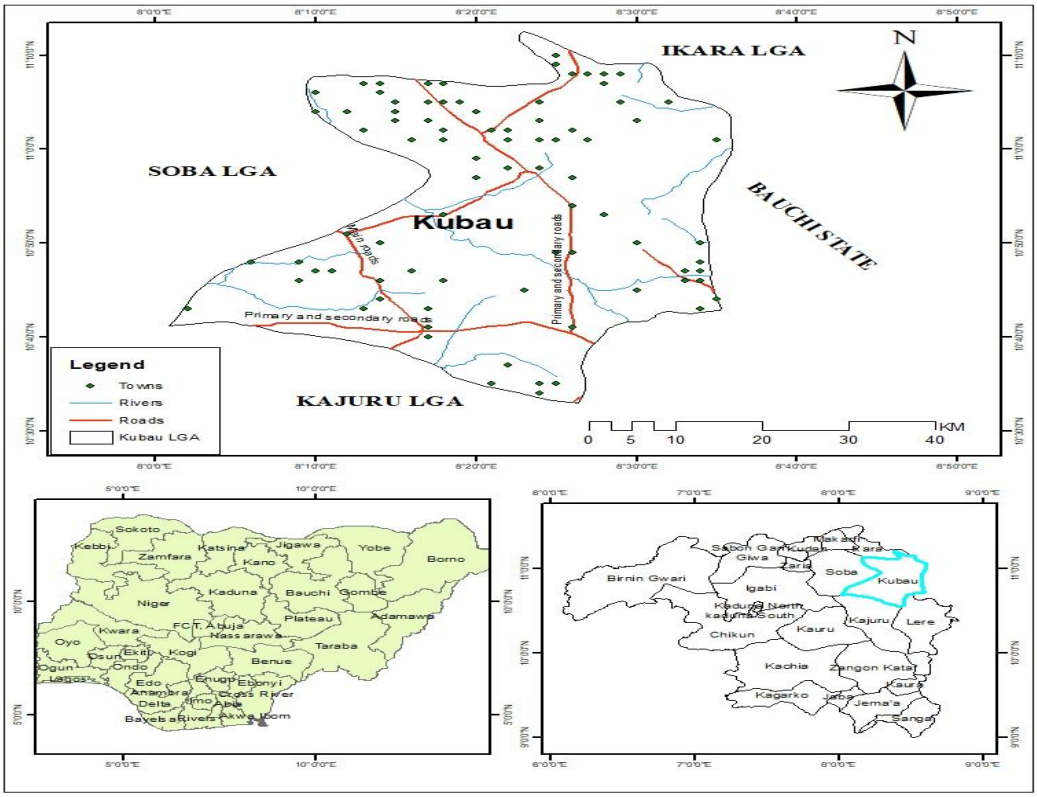

Figure 1: Map of Nigeria showing the Study Area

The study area enjoys a tropical climate and has two distinct seasons, dry and wet seasons. The area lies within the northern guinea savanna vegetation zone characterized by a well-developed grass layer, shrubs and few trees. Many of the trees have thick backs which restricts excessive transpiration and preserve it from the effects of bush fire. Others develops long tap roots which help them reach the very low water table level (during water shortage). Most of the grasses are perennials with first drop of rain (Mohammed, et al., 2022).

Numerous streams facilitate natural drainage in the LGA, these streams include Rivers Galma, Kachiwargi, Likarbu and River Lungu. These flow throughout the year. The rivers in the area deposit some alluvial soils in the floodable region which provides additional fertility to the agricultural soils. Agriculture flourishes in the LGA with the presence of a large population of farmers who cultivate both during the dry and wet season (Ahmed, 2015).

METHODOLOGY

Krejcie and Morgan's (1970) method of determining sample size was used to sample 385 farmers. Purposeful sampling technique was used to select farmers who are above 30 years of age, who must have lived at least 20 years within the study area. The reason for this decision is that those within the age bracket may have the information needed about climate change in the area. A total of 368 copies of questionnaire were successfully returned and validated for the analysis and discussion. Trendline equations were used to analyse the rainfall and temperature data (1970-2021). The data were used to characterize the climate of the study area. Questionnaire survey and Focused Group Discussion (FGD) were used to elicit relevant information from the sampled farmers.

Descriptive statistics were used to analyse the socio-demographic data. The questionnaire uses Likert Rating Scale (LRS). The four-point LRS was assigned numerical values thus: SA (Strongly Agree) =5; A (Agree) =4; D (Disagree) =3, and SD (Strongly Disagree) =2 and U (Undecided) =1. Thus, 3.0 was the decision mean, implying that any mean score $(\bar{X})$ above 3.0 will be accepted as being significant. Relative Importance Index Technique (RII) was used to determine the extent of adoption of the resilient strategies by farmers. The various strategies used were examined and ranked in terms of their frequency using the RII (Muhwezi & Otim, 2014; Idoma, 2016).

RII is denoted by $\Sigma W / (A*N)$ ---------- (3)

Where;

W = Weight given to each factor by the respondents,
A = Highest weight (i.e., 3 in this case),
N = the total number of respondents.

The three-point scale ranged from 1 (Not at all) to 3 (Always). The higher the value of RII, the more important or effective was the resilience strategy to climate change in the study area. Constant comparison analysis model (Charmaz, 2000) was used to analyse and compare whether the constant key words and pertinent themes on the effects of climate change on crop yield and farmers' resilience that emerged from one FGD also emerged on other groups.

RESULTS AND DISCUSSION

The demographic characteristics of the farmers in the area were identified, analysed and presented in Tables 1. The result showed that majority (91%) of the sampled farmers were male, while 9% were female. That majority of the farmers were male might be because, male have a dominant role to play in the family as household heads in providing the households basic needs such as food. Gbegeh and Akubuilo (2013) observed that in some parts of Africa, including Nigeria, womenfolk are often deprived of property rights owing to social barriers. As a result, they tend to have lesser capabilities and resources than men. This result agrees with the findings of Umar et al. (2015) which reported that males dominate the agricultural workforce in Sokoto State with 99.1%.

Adenugba and Raji-Mustapha (2013) reported that women farmers particularly in rural areas of Nigeria have always worked, and their labour plays a key role in the survival of millions of families. Most rural women are the invisible farmers in Nigeria and form the backbone of rural development. The age distribution of the farmers (Table 1) shows that 6% were within

30 – 40 years; 28% were within 41–50 year; 52% fell within 51-60 years; 12% were 61–70 years and 2% fell within 71 years and above. Majority (94%) of the farmers fell within the age of 41 and above. The average age of the farmers was 50 years.

Gbegeh and Akubuilo (2013) acknowledged that the age of a farmer may positively or negatively influence the decision to adopt new technologies as older farmers have more experience in farming and consequently have a higher probability of adopting modern technology than younger farmers. Deressa et al. (2008), reported that the age of the respondents represent experience on climate change. The older the respondent, the more experienced he was in knowledge of climate change and the more exposed to past and present climatic conditions over a longer horizon of his lifespan.

Table 1 further indicates that 59% of the farmers are Muslims and 40% are Christians. The religious belief/faith of the respondents plays a major role on their perception of climate change and resilience measures, especially on what causes climate change. According to Constable (2016), the influence of religion, especially the Christian principles was evident in her study area (Jamaica) in the assertion that climate change is an act of God, a punishment for man's disobedience and a sign to end of the world. Feder et al. (2013) also noted that there may be instances in which religious belief hinder resilience to natural disaster.

The distribution by marital status of the farmers is presented in Table 1. The result shows that 87% of the sampled farmers were married, 3% were divorced, while 6% were single and 4% were widowed. These indicate that majority of the farming household members were married. This suggests that married household members have many mouths to feed, therefore, engage more in farming activities in order to provide food and income for the family. Family labour is recognized as a major source of labour supply in smallholder crop production in most parts of Africa, including Nigeria. This comprises the labour of all males, females including children in a household, who contribute their mental and physical efforts to the household holdings.

The result on the household size of the farmers show that majority (32%) of the farmers are within the household size of 6-10 (Table 1), followed by 23% which fell within the household size of 11-15; 19% are within the range of 16-20 household size; 13.5% were within the range of 21-25 household size, while 7% were within the household size of 1-5 and 5.6% fell within the household size of 26 household members and above. Large family size to some extent translate to higher use of family labour in the farming activities in the study area. According to Iheanacho (2000), household size is an important factor in traditional agriculture and affects farm labour sources and supply in northern Nigeria.

Table 1 further presented that 41% of the farmers attended primary school; 34% had secondary school; 8% attended higher institution at various levels; 17% had no formal education at all. The results, therefore, indicate that most of the respondents received various forms of education in the area. This might have probably helped them in their farming activities.

Table 1: Demographic characteristics of the farmers

Distribution of Farmers by Sex		
Variable	**Respondents**	**Percentage**
Male	334	91
Female	34	9
Total	**368**	**100**
Distribution of the Farmers by Age		
Age	**Respondents**	**Percentage**
30 – 40	23	6
41 – 50	104	28
51 –60	187	52
61 – 70	45	12
71 & above	9	2
Total	**368**	**100**
Religious Belief of the Farmers		
Religion	**Respondents**	**Percentage**
Islam	217	59
Christianity	149	40
Others	2	1
Total	**368**	**100**
Marital Status of the Farmers		
Marital Status	**Respondents**	**Percentage**
Married	320	87
Divorced	12	3
Single	23	6
Widowed	13	4
Total	**368**	**100**
Distribution of Farmers by Level of Education		
Level of Education	**Respondents**	**Percentage**
Primary	150	41
Secondary	126	34
Tertiary	31	8
Koranic	61	17
Total	**368**	**100**
Household Size of the Farmers		
Household Size	**Respondents**	**Percentage**
1 – 5	12	3
6 – 10	115	31
11 – 15	81	22
16 – 20	140	39
21 – 25	10	3
26 & above	8	2
Total	**368**	**100**
Farmers' Years of Residency		
Years of Residency	**Respondents**	**Percentage**
20 – 30	115	31
31 – 40	66	18
41 & above	187	51
Total	**368**	**100**

According to Enete et al. (2011), there is positive and highly significant relationship between farmers' level of education with the level of investment in indigenous and emerging climate change adaptation practices. This is to be expected as educated farmers may better understand and process information provided by different sources regarding new farm technologies, thereby increasing their allocation and technical efficiency.

The farmers' years of residency in the area (Table 1) shows that 31% of the farmers had lived for the period of 20–30 years; 18% between 31–40 years and 51% had lived in the area for the period of 41 years and above. That majority (51%) of the respondents had lived above 41 years in the area agrees with the study of Nhemachena and Hassan (2008), which reported that the longer a farmer lives and farms in an environment, the more experienced and knowledgeable he will be about the environment of the study area.

Climatic Characteristics of the Study Area

The Total Annual Rainfall (TAR) and temperature of the study area (1970-2021) were analysed and presented in Figures 2 and 3. Rainfall is the most variable of all climatic elements and determines the growing season in developing countries like Nigeria where agriculture is predominantly rain-fed. Almost every farmer is interested in what the expected rainfall would be, more than any other climatic elements as it determines the success or failure of crops. Timely and accurate weather forecasting and sharing is crucial to improving farming activities.

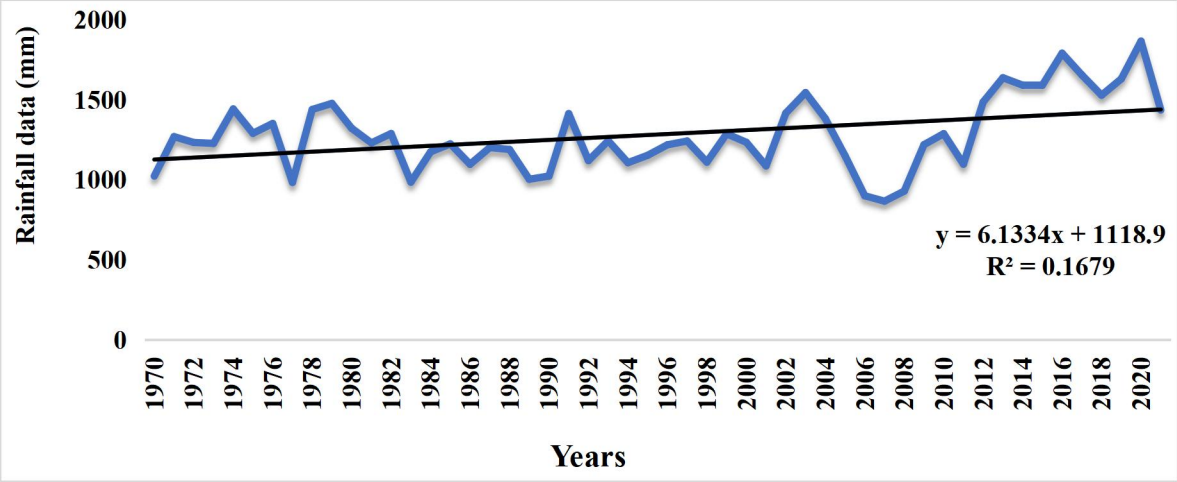

Figure 2: **Trends in Total Annual Rainfall for Kaduna State (1970 – 2021)**

The trend shows a fluctuating pattern in the TAR for the 51 years reviewed. That the TAR is increasing agree with the findings of Umar et al. (2015) which stated that TAR is increasing in Sokoto State. According to Ayoade (2004), rainfall has more significant effect on inter-annual changes in crop yield in a tropical environment as it determines the supplies of water to plants.

Temperature plays a significant role in agriculture. The average maximum and minimum temperature of Kaduna State is shown in Figure 3. The trend line equation for the average annual maximum and minimum temperature (1970-2021) shows increasing temperature (y = 0.0147x + 31.314 and y = -0.0153x + 20.771) respectively.

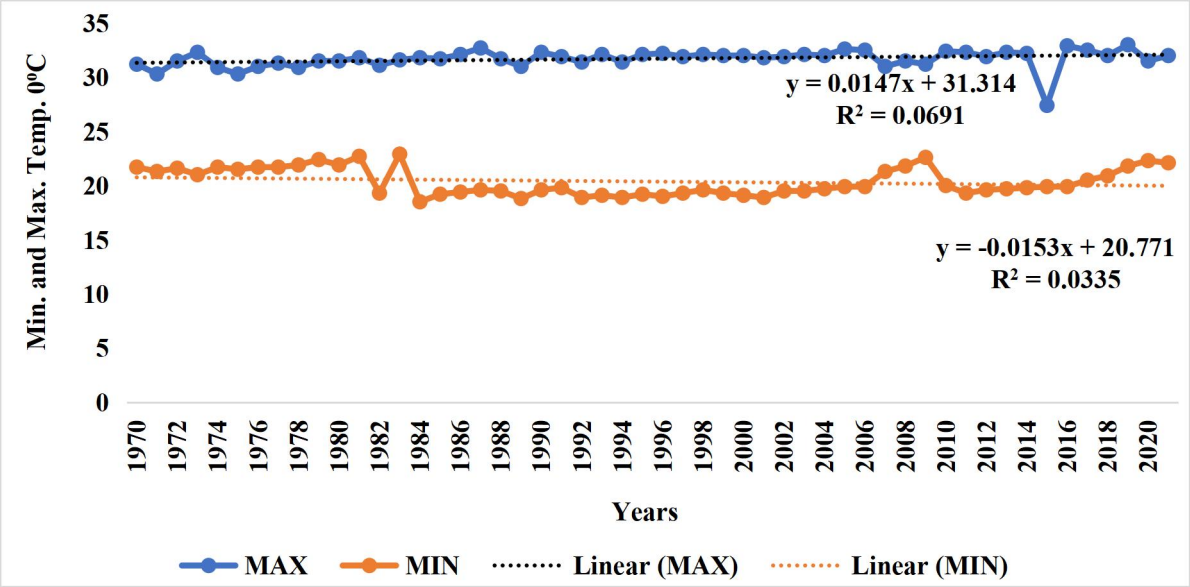

Figure 3: **Trends in Annual Max. and Min. Temperature for Kaduna State (1970 – 2021)**

Farmers' Awareness of Climate Change in the Study Area

Response to farmers' awareness of climate change is presented in Figure 4.

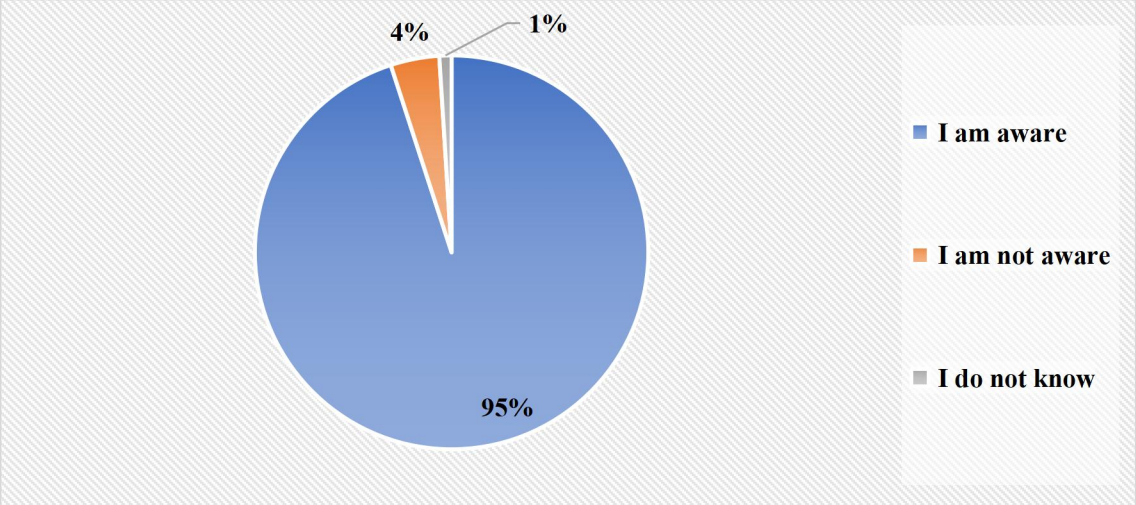

Figure 4: Farmers Awareness of Climate Change

Figure 4 shows that 95% of the farmers were aware of climate change, 4% were not aware and 1% were have not heard about their perception of climate change in the study area. According to Maddison (2006), farmer's awareness of change in climate attributes (temperature and precipitation) is important to adaptation decision making. The awareness of climate problems and the potential benefits of acting is an important determinant of adoption of agricultural technologies (Hassan & Nhemachena, 2008). Araya & Adjaye (2001) reported that farmers' awareness and perceptions of climate change on agriculture positively and significantly affect their decisions to adopt viable adaptation measures.

Farmers' Perception of Climate Change Issues

The farmers' perception of onset, cessation dates, number of rainy days and the effectiveness of rainfall for crop yield in the study area are presented in Table 2.

Table 2: Farmers' Perception of Onset, Cessation, Number of Rainy Days and Effectiveness of Rainfall in the area

Weather and Climate Change Indices	Mean ($\overline{X}$)	SD
A. Rainfall onset is now coming late (late onset)	4.3	2.07
B. Rainfall cessation is now earlier than before	4.2	2.04
C. Number of rainy days/months/years is increasing	3.6	1.90
D. The yearly rains are not supporting crop production as before	4.2	2.12
E. Rainfall amount compared to the past years is decreasing every year	3.8	1.94
F. The temperature around this village is rising	3.9	1.89
G. The weather is becoming drier	3.8	1.94
H. The changing climate has led to crop infestation and disease by pest	3.8	1.94
I. The changing climate is affecting human and animal health	4.1	2.02

***Significant Perception ($\overline{X}$) ≥ 3.0)**

The result of the study shows that majority of the farmers (4.3 $\overline{X}$) affirmed that rainfall onset is now coming late compared to the past ten years. On whether rainfall cessation is now earlier than before, majority of the farmers (4.2 $\overline{X}$) agreed that rainfall cessation is now earlier than before. The fact that majority of the farmers characterized the climate of the study area as having late onset and early cessation agrees with the study of Odjugo (2010) which stated that the semi-arid region of Northwest Nigeria is experiencing late onset and early cessation of rains which affects crop production. The results further agree with the study of Sawa et al. (2014) which reported that crop farmers in Kano State perceived late onset and early cessation of rainfall.

The farmers' perception that the number of rainy days is increasing is presented in Table 2. The result show that a good number of the farmers (3.6 $\overline{X}$) affirmed that the number of rainy days is increasing in Kubau LGA. The perception that the number of rainy days is increasing disagree with the study of Odjugo (2010) who observed that rainfall amount and duration is decreasing as rainfall amount was reduced by 178mm within the 70 years reviewed (1940 – 2010) in the Northwest States of Sokoto and Zamfara.

The farmers agreed that the yearly rains no longer support effective crop production as before (4.2 $\overline{X}$). This result agrees with the study of Odjugo (2010) which observed that the rainfall amount in the northwest zone of Nigeria is decreasing with an increasing temperature which has eventually shortened the growing season of crops. He further stated that this decreasing amount of rainfall in the Northwest zone of Nigeria has forced the farmers to shift from the cultivation of maize and sorghum as their best crops to millet which has a short growing season of 2–3 months.

On whether temperature is increasing in the study area, a good number of the farmers (3.9 $\overline{X}$) agreed that temperature is increasing. The farmers (3.8 $\overline{X}$) also stated that the weather is becoming drier (Table 2). An appreciable number of the farmers (3.8 $\overline{X}$) reported that the changing climate has led to crop infestation and disease by pest. On the changing climate affecting human and animal health, an appreciable number of the farmers (4.1 $\overline{X}$) agreed that the changing climate is affecting human and animal health in the study area.

Results from the FGD further affirmed their perception of rising temperature, increase in crop infestation by pest and the changing climate affecting human and animal health. The fact that majority of the farmers have perceived higher temperature for at least 10 years agreed with the findings of Ejeh (2014) who in his study noted that majority of the farmers at Kano perceived that there is an increase in the mean temperature for at least two decades.

Farmers' Sources of Information about Climate Change Issues

The sources of information about climate change are presented in Figure 5. The result shows that 56% got information about climate change through personal observation of the environment; 13% through interacting with extension workers and researchers; 20% through interacting with friends; 1% from the printed materials; 8% from electronic media; 1% from schools and 1% from all the above-mentioned sources.

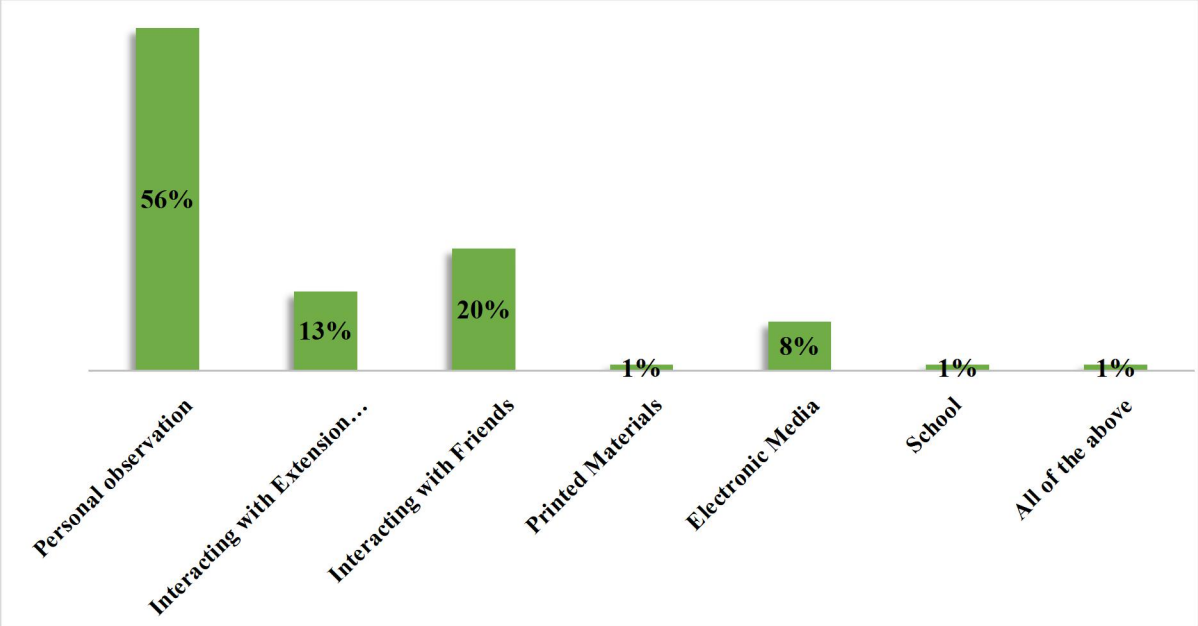

Fig. 5: Farmers Sources of Information on Climate Change Issues

That the majority (56%) stated that they got information on climate change from personal observation is in contrast with the study of Umar et al. (2015) which reported that 96% of farmers in Katsina State identified other farmers and extension workers as important source of information on climate change which implies that information on climate change is majorly disseminated informally in his study area. More so, the results disagree with the findings of Ejeh (2014) which stated that the farmers in Kano State received information on climate change majorly from Radio and Television as agreed by 73.1% of his respondents.

Adapting to Climate Change

The results of the possibility of farmers' adapting to climate change are presented in Figure 6.

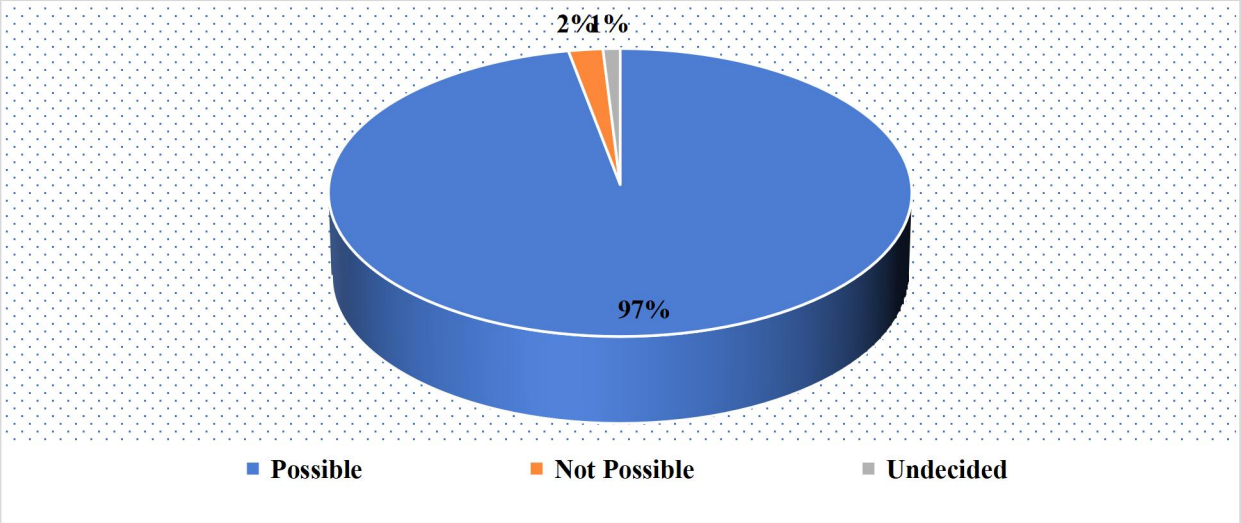

Figure 6: Possibility of Adapting to Climate Change

Figure 6 shows that 97% of the farmers stated that it is possible to adapt to climate change, 2% stated that it is not possible to adapt to climate change in the study area, while 1% were undecided about the possibility of adapting to climate change in the study area. This result confirmed the findings of Adeshina and Odekunle (2011) which stated that through adaptation strategies, it is possible for farmers to adapt to the effect of climate change in the semi-arid regions of Nigeria. Ikpe (2021) further stated that through viable adaptation strategies, farmers have been able to effectively cultivate crops in Sokoto State. The results also corroborated with the findings of Ejeh (2014) which reported that farmers in Kano State are coping with the effects of climate change through various adaptation strategies.

Farmers' Coping Strategies for Climate Change Resilience

According to IPCC (2007), adaptation has three possible objectives: to reduce exposure to the risk of damage; to develop the capacity to cope with unavoidable damages; and to take advantage of new opportunities. The climate change adaptation strategies used by the farmers in the study area are presented in Table 3.

Table 3 presents a summarized 15 coping strategies employed by farmers to improve their resilience to climate change impacts in Kubau LGA. The result revealed that out of the 15 adaptive strategies, 8 were "highly adopted" by the farmers as reflected in their mean score values of ≥2.5. The most significant adaptation strategies to climate change used by the farmers in the study area are mixed cropping, use of early maturing crop varieties and use of crop varieties that are well acclimatized (ranked 1) with a mean score ($\bar{X}$ = 2.9). Next in rank are early and late planting, use of weather- resistant variety and preservation of seeds/seedlings for planting (ranked 4) with a mean score ($\bar{X}$ = 2.7). The remaining 7 strategies were "adequately adopted" given mean score values from 1.5 to 2.49. It was

however noteworthy that none of the strategies was poorly adopted". These findings corroborated (Ogunleye & Yekini, 2012) who concluded that the widely adopted resilience measures of climate in the Niger Delta region were planting of cover crops like melon to help conserve soil moisture.

Table 3: Climate Change Resilience Strategies

S/N	Resilience Strategies	Always	Rarely	Not at all	$\bar{X}$	Rank
1	Early and late planting	297	60	11	2.7*	4
2	Use of organic manure	248	76	44	2.5*	8
3	Use of inorganic fertilizer	264	70	34	2.6*	6
4	Use of well acclimatized crop varieties	296	65	7	2.9*	1
5	Planting of cover crops	273	75	20	2.6*	6
6	Use of irrigation system/water storage	60	84	224	1.6	15
7	Use of chemicals like herbicide etc.	174	97	97	2.2	9
8	Increase in number of weeding	166	127	75	2.2	9
9	Use of early maturing crop varieties	327	39	2	2.9*	1
10	Preservation of seedlings for planting	290	59	19	2.7*	4
11	Mixed farming practices	136	139	93	2.1	11
12	Changing the timing of land preparation	129	139	100	2.1	11
13	Changing harvesting dates	108	122	138	1.9	14
14	Loans, grants and subsidies	119	148	101	2.0	13
15	Mixed cropping	359	8	1	2.9*	1

***Significant Resilience Strategies ($\bar{X} \geq 2.5$)**

This result has shown that, despite the prevailing effects of climate change on crop production in Kubau LGA, farmers have been able to maintain food security through the adoption of viable resilience strategies in crop production. Agricultural systems can be made more resilient, by implementing measures that are very system- and local-specific. Crop farmers will need to adopt viable measures to enable them maintain food security, notwithstanding the numerous impacts of climate change on crop production.

CONCLUSION

This study has assessed farmers' perception and awareness on climate change issues and resilience towards food security in Kubau LGA of Kaduna State. Based on the findings, it could be concluded that majority of the sampled farmers are aware of climate change issues in the study area. The farmers strongly agreed that rainfall onset is now late compared to past years, while rainfall cessation dates are now earlier than before. The farmers perceived increasing trends in temperature. Personal observation was the major source of information on climate change issues. Mixed cropping, use of organic and inorganic manure and the use of improved seed varieties are the main resilient strategies adopted by the farmers. The study concluded that, despite the prevailing impact of climate change in the area, the farmers have been able to provide food for the teeming population via the adoption of viable resilient measures.

Based on the study findings, it is therefore recommended that:

i. The Nigerian Meteorological Agency (NiMET) can do more in issuing seasonal forecasts of onset and cessation dates of rainy season and temperature each year.

Considering the sensitivity of agricultural activities to these variables, farmers and other respondents should be encouraged to avail themselves of these services and apply such information on their livelihoods as it affects them;

ii. Since 95% of the respondents are aware of climate change issues, farm extension agents, the government and NGOs should continue to sensitize the farmers on climate change issues and other viable ways of adapting to climate change in the study area using all available means;

iii. Since the use of improved seed varieties is a major adaptation strategy, the Research Institutes should develop more drought resistant seeds and early maturing varieties in the study area.

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