AWARENESS AND ADAPTATION STRATEGIES TO CLIMATE CHANGE IN TUDUN WADA LOCAL GOVERNMENT AREA OF KANO STATE

BY

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ABSTRACT

The problem of Climate Change has become a serious issue and the concomitant effect is the increase in the rate of aridity in Northern Nigeria which hampers crop yield thereby affecting food security therefore making farmers adopt some strategies to ameliorate the phenomena. This study assessed farmers' adaptation strategies to Climate Change in Tudun Wada Local Government Area of Kano State. The study utilised both primary data which was sourced from 400 sampled respondents and secondary data which includes rainfall and temperature data. The data was analysed using inferential (trend line equation and Likert scale) and non-inferential statistics. Results revealed that rainfall in the area is slightly increasing as it has a Y - value of 0.383 while daily average temperature in the area is increasing with a trend of 0.026. Use of fertilizer/manure and improved plant variety are the most adopted strategies by farmers which ranks 1st and 2nd respectively. The binary logistic model shows a relationship between the use of fertilizer with rainfall and temperature. The study recommends that government should create conducive climate change policies and improve on the existing service delivery mechanism for climate change awareness and adaptation strategies.

Key words: Adaptation Strategies, Awareness, Climate change, Tudun Wada

INTRODUCTION

Climate change is one of the major issues that is threatening mankind globally today. This is as a result of man's various activities such as industrialization, testing of nuclear weapons, urbanization, bush burning, overgrazing, over cultivation, deforestation which subsequently results to widespread changes in the global distribution of plants and animals leading to desertification and extinction of life. Climate change is perhaps the most serious environmental threat facing mankind worldwide (Adebayo and Oruonye, 2013). It affects agriculture in several ways, one of which is its direct impact on crop production. Climatic change, which is attributable to natural climate cycle and human activities, has adversely affected crops productivity in Africa (Ziervogel, et al., 2006).

It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change particularly because African agriculture is predominantly rain-fed hence, fundamentally dependent on the vagaries of weather (Jones and Thornton, 2002). As the people of Africa strive to overcome poverty and advance economic growth, this phenomenon threatens to deepen vulnerabilities, erode hard-won gains and seriously undermine prospects for development (Zoellick 2009). The dynamics of climate change manifest through extreme aridity, drought, dryness, excessive heat waves, and high temperatures, floods, inundation of coastal Cities, submergence of islands, alteration of surface and shifts of ecosystems zones.

In response to these challenges of climate change, there is need for increased awareness and research by universities and research institutes so as to develop a multi-pronged capacity to tackle this imminent danger which is slowly eroding the gains of the fight against starvation, hunger and poverty among farming communities in Africa, particularly Nigeria because of its rapid growing population. Thus, for the farmers to adapt effectively to climate change impacts, they must be aware about the past, the present climate change pattern and possibly future trends. This demonstrates the imperativeness of the knowledge of how interacting climatic factors will affect crop productivity, soil and water resources to the success of effective adaptation.

According to the Intergovernmental Panel on Climate Change (IPCC, 2007a), adaptations are actions taken to help communities and ecosystem moderate, cope with, or take advantage of actual or expected changes in climatic conditions. Adaptation can also be the ability to respond and adjust to actual or potential impacts of changing climate conditions in ways that cause moderate harm or takes advantage of any positive opportunities that the climate may afford. It includes policies and measures to reduce exposure to climate variability and extremes, and the strengthening of adaptive capacity. Adaptation can be anticipatory, where systems adjust before the initial impacts take place, or it can be reactive, where change is introduced in response to the onset of impacts. They include local actions taken by the poor people themselves in response to changing crop production or environmental conditions. Such adaptation measures include; changing planting dates, planting improved varieties of crop species, use of intercropping, using sustainable fertilizer and tillage practices, improved crop residue and weed management, better pest and disease control for crops, implementing new irrigation systems, more use of agro-forestry practices, improving forest fire management, planting of early maturing crops and temporal migration.

The problem of Climate Change has become a serious issue and the concomitant effect is the increase in the rate of aridity in Northern Nigeria, Tudun Wada Local Government Area (LGA) inclusive. According to IPCC (2007b), most part of the interior West Africa will face the problem of loss of arable land, decrease in crop yield and may result to hunger and malnutrition. Crop farming has remained the major source of livelihood in Tudun Wada LGA of Kano State and is the major means by which the teeming population of the area is fed and also engage in regional trade.

Despite the potentials it has in crop production, Tudun Wada LGA of Kano State is faced with serious environmental changes such as, desert encroachment, drought, aridity, excessive heat, low rainfall and high or excessive temperature caused by climate change. This has affected productivity in terms of quantity and quality of crops in the area. This problem made the farmers to implore some adaptation strategies to climate change for maximum crop yield and sustainable development in the study area. The level of awareness on climate change is a prerequisite factor

to the mitigation and adaptation strategies which the farmers can implore in order to sustain their crop production (Oduniyi, 2013).

Ozor et al. (2015), assessed the perceived impacts of climate change among rural farmers in Imo State, Nigeria revealing an increase in the incidence of climate change in the area as typified by low rainfall, higher temperature and desertification. Babatolu and Akinnubi (2016), analyzed vulnerabilities and adaptation responses of smallholder farmers in the Upper and Lower Niger River Basin Development Authority areas. The study revealed that there is high level of climate change awareness in the study area. A significant number of the smallholder farmers attested to the fact that they were aware of the changing climate-increasing temperatures, unpredictable, erratic, heavy and increasing rainfall, late onset and early retreat of rains. Smallholder farmers in the study areas really possess knowledge of the impacts of climate change and variability which helped them to cope with climate change and variability. They were able to identify their areas of vulnerability and appropriate adaptation options in their own capacity. However, the awareness of and adaptation strategies to climate change have not been clearly understood especially in Tudun Wada LGA of Kano State. Therefore, this study assessed farmers' awareness on climate change and various adaptation strategies implored by farmers in Tudun Wada LGA of Kano State and the relationship between level of awareness and adaptation strategies.

THE STUDY AREA

Tudun Wada LGA of Kano State is located within Latitudes 11º 0′ N to 11º 27′ N of the equator and Longitudes 8º 16′ E to 8º 50′ E of the Greenwich meridian (Figure 1). It covers a total land area of approximately 1,204km^2 and shares boundary with Ikara LGA of Kaduna State and Doguwa LGA of Kano State to the South. To the West, it is bounded by Kiru and Bebeji LGA To the North, are Rano and Kibiya LGA and to the East, Garko and Sumaila LGA. The area falls under tropical wet and dry climate controlled by the tropical maritime air mass which originates from the Atlantic Ocean and blows Northward and the tropical continental air mass which originates from the Sahara Desert and blows southward. The area is under the influence of the North East trade wind from the Sahara Desert. The winds from October to February are dry and dusty. Between April to September, the South-West monsoon blows up to bring rainfall. The combination of evaporation and transpiration (evapotranspiration) is very high in the study area (Olofin, 1991).

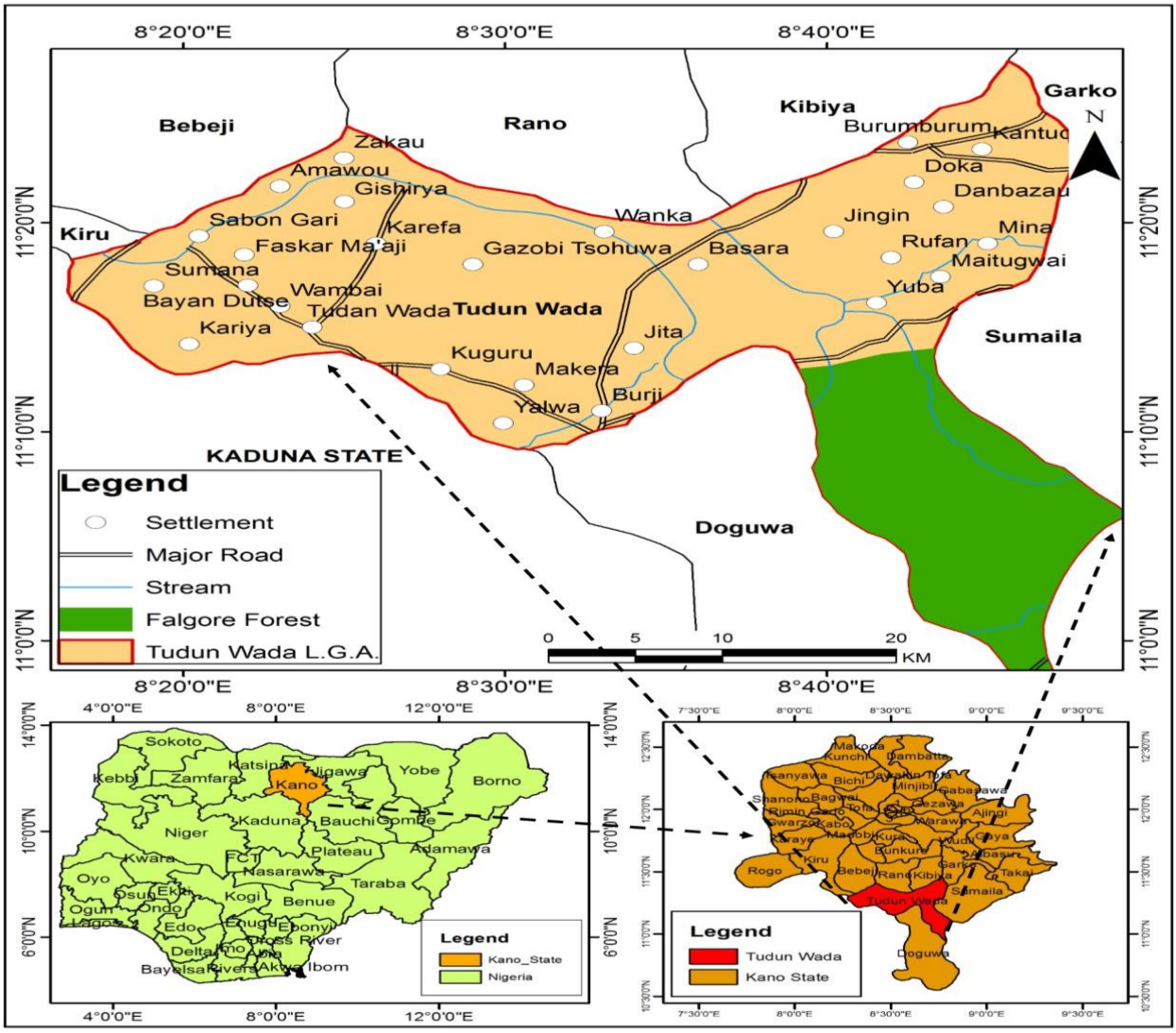

Figure 1: Tudun Wada Local Government Area, Kano State
Source: Adapted from the Administrative Map of Kano State.

The climate of the area is often classified as semi-arid climate. The onset of rainfall in the area usually starts around May and ceases around early September. The mean annual rainfall ranges from 800mm to 1000mm and the duration of rainfall is about 3 to 5 months. The mean annual temperature is about 26°C with monthly values ranging between 21°C in the coolest month (December/January) and 31°C in the hottest month (April/May) (Olofin, 1991). There are four seasons including a dry and cool season (*Kaka*), dry and hot season (*Bazara*), the wet and warm season (*Damina*) and lastly, a dry and warm season (*Rani*) (Federal Ministry of Environment, 2003). The mean annual humidity of the area is about 55% with the month of January, February and March recording the lowest humidity of between 35% - 50%. The highest values of 85%-95% is recorded in the month of July, August and September (Odjugo 2005).

MATERIALS AND METHODS

Two sets of data were used for this study. The first set of data were annual rainfall records (millimetres) and temperature (degree Celsius) obtained from NiMet for the period of 1988 to 2017, Aminu Kano International Airport, Kano state. Data for the adaptation strategies was obtained from 400 sampled farmers via field survey in 6 wards of the LGA (Babaru, Dalawa, Jita, Nata'Ala, Shuwaki and Yaryasa). Trend line equation was used to show the trend of the weather elements and 5-point Likert Scale was used to assess the various adaptation strategies. The mean value of the Likert scale was computed to be 3.0. Any strategy greater than or equal to 3.0 was considered the adopted strategy as used by Ishaya and Abaje, 2008; and Mshelia (2005). Binary logistic regression was used to model the relationship between farmers' adaptation strategies and the weather elements (rainfall and temperature) in which the rainfall and temperature were regarded as the independent variable while their adaptation strategies is the dependent variable at 0.05 significant level as used by Adebayo et al. (2012), Francis et al. (2013) and Babatolu and Akinnubi (2016).

A multi-stage sampling technique was used in the selection of the respondents for this research. The first stage is the selection of wards which were selected systematically. The wards were arranged alphabetically and the wards with odd numbers were selected. Therefore, out of the eleven wards six wards were selected. They are; Babaru, Dalawa, Jita, Nata'Ala, Shuwaki and Yaryasa wards. The second stage of the sampling technique was the selection of communities. Communities were selected using random sampling technique in each ward for the administration of questionnaire for easy coverage. Finally, the third stage of the sampling technique was the selection of respondents. This was done by allotting numbers to houses in the area and houses with even numbers were selected. The household heads in the houses were contacted to respond to questionnaire as most of them are farmers.

RESULTS AND DISCUSSION

Socioeconomic Characteristics

The socioeconomic characteristics of the farmers in the area is presented in Table 1. As shown in Table 1, there are more males (81%) than females (19%) in the study area. This is due to the cultural setting of the area which supports men to go to farm leaving their women at home. Regarding the marital status of the respondents, most of the respondents (89%) are married while 8% were divorced and the remaining 3% are either single or separated as a result of the cultural and religious background of the people in the area where early marriage is highly encouraged and practiced.

Table 1: Socioeconomic Characteristics of the Farmers

Socioeconomic data	Frequency	Percentage
Sex		
Male	324	19
Female	76	81
Total	**400**	**100**
Marital Status		
Single	5	1.3
Married	355	88.8
Separated	7	1.7
Divorced	33	8.2
Total	**400**	**100**
Age		
30-39years	213	53.3
40-49years	114	28.5
50-59years	36	9.3
60years and above	37	9.0
Total	**400**	**100**
Income level		
Less than ₦10,000	13	3.3
₦11,000- ₦20,000	47	11.7
₦21,000- ₦30,000	64	16.0
₦31,000 and above	276	69.0
Total	**400**	**100**

Source: Field Survey, 2018

Also, it was observed that majority (53%) of the respondents were between the ages of 30-39 years which indicates higher proportion of youth in the area. This could be because of the cultural background of the people in the study area in which early marriage is highly encouraged and practiced. The age distribution further shows that 29% are between 40-49 years, 9% were between the ages of 50-59 years and the least were respondents of age 60 years and above which recorded about 9% respectively. This shows that most farmers in the area are within the active age to participate in farming activities giving them more experience on climate change issues.

The farm income of the respondents in the study area showed that 69% generated ₦31,000 and above annually, 16% generated ₦21,000- ₦30,000, 12% generated ₦11,000-₦20,000, and 3% of the respondents generated less than ₦10,000 from the last farming production. The high income earned by farmers from crop production depicts more money that can be reinvested into agriculture by adopting new strategies to adapt to climate change.

Farming Practices in the Area

Findings on the farming practices in the area is presented in Table 2. It revealed that the respondents engage mostly in mixed-cropping system (37%), crop rotation (35%), mono-cropping (27%) and fallowing (2%) in the study area. This could be because of the inadequacy of access to agricultural land in the area as such they need to practice mixed-cropping to maximize the utilization of the available and accessible land.

Table 2: Farming Practices in Tudun Wada LGA

Cropping system	**Frequency**	**Percentage**
Mono-cropping	106	26.5
Crop rotation	138	34.5
Mixed cropping	148	37.0
Fallowing	8	2.0
Total	**400**	**100**
Crop type		
Rice	381	95.3
Maize	375	93.8
Sorghum	246	61.5
Millet	216	54.0
Late millet	106	26.5
Wheat	40	10.0
Total		100.0

Source: Field survey, 2018

The result as presented in Table 2 reveals that the respondents mostly engage in rice farming, maize production, sorghum and millet. Other crops cultivated in the area include late millet and wheat respectively in descending order. This shows the attributes of a typical Sudan savannah environment in which most of the crops cultivated are cereals which does not require high amount of rainfall. This also conforms to the findings of Udeh (2014) who also revealed that in Kano state, the dominant crops cultivated are maize, rice, sorghum and millet. This could be because of the type of soil in the study area which is basically the sandy soil type that is good for the cultivation of cereal crops.

Rainfall and Temperature Trends in the Study Area

Trends in Annual Rainfall

Figure 2 shows the graphical representation of the annual rainfall over the years (1988-2017) of this study in the study area.

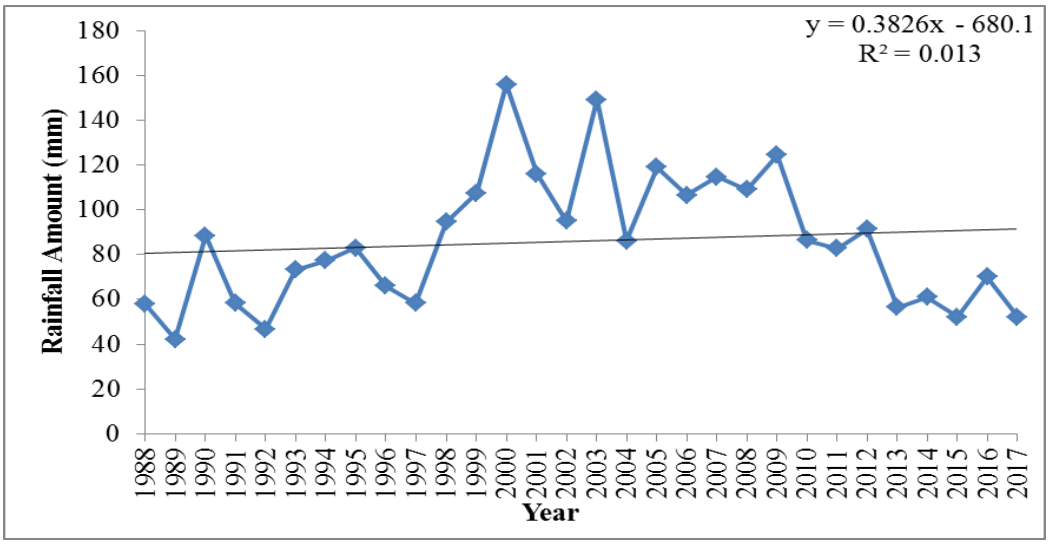

Figure 2: Annual Rainfall Trend
Source: Authors' Computation, 2018

The trend line in Figure 2 indicates a fluctuating pattern of annual rainfall distribution with 1989 having the lowest recorded rainfall of 40mm while the highest was recorded in the year 2000 with rainfall of 150mm. The result significantly shows a decline in rainfall from 2013 to 2017 having less than 70mm. It revealed that on a general note, rainfall in Tudun Wada LGA shows an increase with a Y value of 0.383. Although the variation in rainfall pattern indicates a fluctuating pattern from year to year, yet on the average an increase is being observed.

Trends in Daily Average Temperature

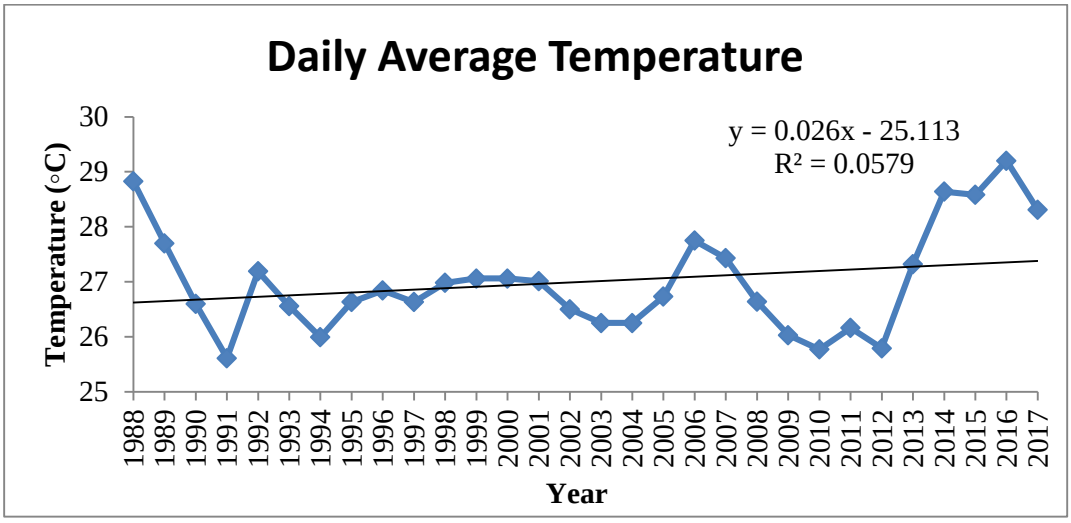

Figure 3: Daily Average Temperature
Source: Author's Computation, 2018

Figure 3 reveals graphical representation of the pattern of daily average temperature in the study area between the periods of 1988-2017. It revealed that the highest daily average temperature was recorded in 2016 at 29.4°C while the least daily average temperature was recorded in 1991 at

25.6°C. The study area experienced sharp decrease in daily average temperature from 1988 to 1991. In 1992, the daily average temperature rose to 27.2°C and further dropped to 25.7°C. Generally, the trend in the daily average temperature in the study area as shown in Figure 3 is increasing with a positive Y value of 0.026. This is a clear indication that temperature is on the increase in Tudun Wada LGA of Kano State.

Farmers Awareness of Rainfall and Temperature Changes in the Area

Figure 4 reveals the awareness of change in rainfall pattern by farmers since 1988 to 2017 in the study area.

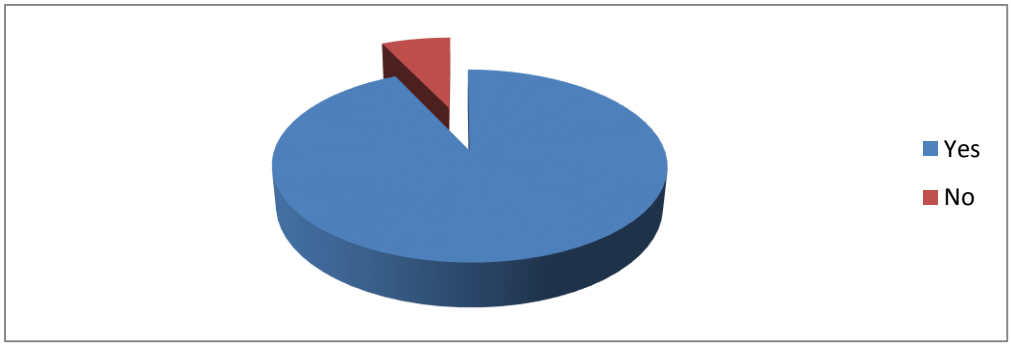

Figure 4: Awareness of Change in Rainfall and Temperture Pattern Since 1988
Source: Field Survey, 2018

The respondents in the area opined that pattern of rainfall and temperature has changed as compared to the 1980's with 93% representation while 7% believed that there has been no change in rainfall and temperature pattern as compared to 1980's.

Perceived Pattern of Change in Temperature and Rainfall Noticed since 1988

Table 4 reveals the pattern of change in rainfall and temperature noticed since 1988 to 2017. According to 41% of the farmers, rainfall has been decreasing slightly and 29% agreed that it has been highly decreasing over the years with very few (14%) testifying that it has been highly increasing. Only 15.4% agreed that rainfall has been slightly decreasing over the years.

Table 4: Pattern of Change in Rainfall and Temperature Noticed Since 1988 to 2017

Pattern of change	Temperature		Rainfall	
	Frequency	Percentage	Frequency	Percentage
Slightly increasing	147	38.7	59	41.1
Highly increasing	171	45.4	55	14.2
Slightly decreasing	49	12.9	155	15.4
Highly decreasing	13	3.0	111	29.3
Total	**400**	**100**	**400**	**100**

Source: Field Survey, 2018

About 45% of the respondents agreed that the temperature has highly increased over the years and only 3% agreed that temperature is highly decreasing. It is glaring that farmers in Tudun Wada LGA also have first-hand experience of the changing climatic over the years. It is obvious in the study area especially for those that have stayed in the area for over 30years that there is

slight increase in the amount of rainfall in the study area. Temperature in the area is highly increasing which sets in aridity and drought and subsequently affect crop production in the area. This affirms the assertion of Adebayo and Oruonye (2013) that extreme weather events are now on the rise worldwide and are more likely to increase in the future. These extreme weather events are perceived to be extreme temperature from time to time as shown in the study.

This study also conforms to the findings of the Federal Ministry of Environment (2003) on surface air temperature for Kano, Calabar and Lagos which shows evidence of increasing surface air temperatures since 1920. Their findings show an increase in surface air temperature of about 0.25°C for Calabar and Kano and 0.25-0.50°C for Lagos.

Adaptation strategies Implored by Farmers in the Area

Table 5 reveals the adaptation strategies to climate change adopted by farmers and the mean and standard deviation of the responses in Tudun Wada LGA. It revealed that the use of fertilizer/manure with a mean of 4.58 and standard deviation of 0.931 appeared to be the most adopted and practiced strategy to against climate change in the area. It is therefore ranked 1st which is followed by the use of improved plant variety which has a mean of 4.22 and a standard deviation of 0.914 which is ranked second.

The adaptation strategies which are mostly not used were found to be changing of farmers planting date, temporal migration and improvement of forest fire management and temporal migration. Farmers in the study area have adopted the use of fertilizer/manure as the major strategy as against others because most of the farmers in the study area practice mixed farming system whereby animal dungs/feaces are easily used to improve the soil fertility. Availability of improved plant variety has also made it easier for farmers to adapt to climate change, this is because improved seed variety produces high crop yields and this encourages the farmers in the study area to prefer the use improved seeds.

Table 5: Farmers Adaptation Strategies to Climate Change

Variable	Mean	Std. Deviation	Ranking
Use of fertilizer/manure	4.58	0.931	1
Use of improved plant variety	4.22	0.914	2
Early planting	3.91	1.066	3
Irrigation farming	3.90	1.037	4
Pest and disease control	3.84	1.207	5
Planting of hybrid varieties	3.71	1.131	6
Use of intercropping	3.66	1.156	7
Planting different crop varieties	3.63	1.244	8
Planting of trees	3.56	1.393	9
Use of soil conservation techniques	3.52	1.208	10
Changing planting date	3.41	1.324	11
Temporal migration	3.36	1.237	12
Improving forest fire management	3.11	1.367	13

Source: Field Survey, (2018)

On the other hand, changing planting date by farmers in the study area has always been a problem; this is because the onset of rainfall in the area has never been uniform. Therefore, farmers only plant if the soil moisture content is enough for planting. In the area of managing forest fire, farmers in the study area always prefer to use bush burning farming practice in farm clearing which always lead to forest fire. In the case of temporal migration, people living in the study area are mostly farmers; they mostly migrate into the city for maniac jobs during the dry season and return home as soon as the wet season sets in. Therefore, temporal migration is not a strong strategy adopted by the farmers.

Relationship between Awareness Level and Adaptation Strategies

The relationship between adaptation strategies and farmer's awareness level on rainfall and temperature changes is presented in Table 6.

Table 6: Relationship between Awareness Level in Rainfall and Temperature and Adaptation Strategies

Effect	95% C.I. for EXP(B) Temperature		95% C.I. for EXP(B) Rainfall	
	Lower	Upper	Lower	Upper
Use of fertilizer/manure	1.019	2.062	0.342	0.690
Use of improved plant variety	0.654	1.155	0.670	1.097
Early planting	0.716	1.300	0.892	1.437
Irrigation farming	0.592	0.907	0.739	1.076
Pest and disease control	0.956	1.534	0.793	1.157
Planting of hybrid varieties	0.439	0.855	0.669	1.114
Use of intercropping	0.741	1.207	0.721	1.085
Planting different crop varieties	0.820	1.408	0.656	1.067
Planting of trees	0.898	1.580	0.821	1.262
Use of soil conservation techniques	0.698	1.086	0.748	1.083
Changing planting date	1.350	2.619	0.809	1.228
Temporal migration	1.325	2.663	0.774	1.222
Improving forest fire management	0.828	1.804	1.099	1.823

Source: Field Survey, (2018)

A binary logistic regression was performed to model the relationship between adaptation strategies (predictors) and the farmer's awareness level to change in rainfall and temperature as shown in Table 6. The traditional 0.05 criterion of statistical significance was employed for the tests. Addition of the predictors to a model that contained only the intercept significantly improved the fit between model and data, $\chi^2(13, N = 400) = 45.73$, $R^2 = 0.19$ and 0.37, $p < .001$. The confidence interval for exp (B) is 0.342 to 0.690 indicates that farmers are between 0.342 and 0.690 times as likely to adopt the use of fertilizer/manure in the event of decrease in rainfall rather than increase. This is found to be statistically significant. The confidence interval for exp (B) is 1.019 to 2.062 indicates that farmers are between 1.019 to 2.062 times as likely to adopt the use of fertilizer/manure in the event of decrease in rainfall. This is found to be statistically significant.

CONCLUSION

From the results obtained, it is concluded that farmers are fully aware of the climate change phenomenon which was made available to them through radio stations. Meteorological data and farmers' perception proved the annual fluctuating nature of rainfall and temperature over 30years. There are few existing coping and traditional adaptation measures in the area. The study revealed that the use of fertilizer/manure appeared to be the most adopted and practiced strategy to adapt to climate change.

The study recommends that government should create conducive climate change policies and improve on the existing service delivery mechanism for climate change awareness and adaptation strategies. Also, weather patterns in the study area are changing (especially in recent times) and difficult to differentiate between normal short-time fluctuations and long-term trends by farmers. Hence, diversifying livelihoods and moving away from current over reliance on natural resources-dependent activity will be unavoidable, and must be pursued by the government.

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