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ANALYSIS OF MAIZE FARMERS PERCEPTION OF CLIMATE CHANGE AND ADAPTATION STRATEGIES ADOPTED IN NORTHERN GUINEA SAVANNAH OF KADUNA STATE, NIGERIA

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ABSTRACT

This study examined the perception of climate change and adaptation strategies of maize farmers in Northern Guinea Savannah of Kaduna State, Nigeria. Multistage sampling procedure was used to select 224 maize farmers for the study. Data were collected from the respondents with the aid of structured questionnaire using interview schedule. The Data were analysed using descriptive statistics (frequency counts, percentages, ranking and weighted means). Results revealed that 45% of the respondents were not more than 30 years of age with a mean age of 31 years with majority (90%) of them being male with about 80% of them having formal education. Findings of the study also shows that 38% and 34% of the respondents had maize farming experience of between 21-30 years and 11-20 years, respectively. Almost all (99%) of the respondents are practicing subsistence farming with inheritance as the major source of land acquisition. Fellow farmers (68%) and farmers' associations (28%) were the main sources of information used by the respondents. Perception of main indicators of climate change were unusual rainfall (X=3.4), late onsets of Harmatan period ($\boldsymbol{X}$ =3.2) and decrease in crop yield ($\boldsymbol{X}$ =3.1) while main adaptation strategies employed by the respondents included use of improved varieties ($\boldsymbol{X}$ =3.52), use of organic manure ($\boldsymbol{X}$ =3.39), and, early planting ($\boldsymbol{X}$ =3.37). The study found that farmers are hesitating to use most adaptation strategies in order to improve their maize production. The study recommends increasing proper awareness on climate change issues and realistic adaptation strategies to the farmers by relevant governmental and non-governmental support.

Keywords: Perception; climate change; maize farmers; adaptation strategies

INTRODUCTION

Maize (*Zea mays*), is one of the important Nigeria's household grains that contributes to food security in Nigeria. Food security is of high importance on the Nigeria's national

agenda, taken into account the increasing demand for food for its increasing population (Intergovernmental Panel on Climate Change, IPCC, 2007). The importance of maize in Nigeria is underscored in its economic value to the Gross Domestic Product (GDP), given the high number of subsistence maize farmers in the country (Ikeh and Amusa, 2014).

It is estimated that more than 60% of farmers in sub-Saharan Africa are small scale with small landholdings, and this number accounts for up to 90% of the total farm outputs (Keats, 2013). According to IPCC (2007), Nigeria was ranked tenth as the largest producer of maize in the world, sliding to twelfth in 2019. It is the second and the largest maize producer in Africa after South Africa in Africa in 2019 (Knoema.com, 2020). Nigeria maize output has substantially changed in recent years and its yield was projected to increase to about 11.0 million tons in 2019 representing 0.009% of world production (FAO, 2020).

As one of Nigeria's staple food crops, maize is being processed and utilized in different ways from one region to another, and from one ethnic group to the other. These include *pap, tuwo, gwate, biski, fura and donkunu* among others. It is also used in industrial processing as a raw material, for animal feed formulation, and as medicines (Abdulrahman and Kolawole, 2006). Fresh maize is also boiled or roasted or boiled along streets in urban and rural areas and hawked by women and children, providing livelihood for many of the poor households. This important cereal crop is widely cultivated across all zones of the country but its production is greatly hampered by climate change (Shuaibu *et al*., 2016).

Climate change is seen as change in climate over time, due to natural fluctuations or due to human activities. It is the one of the major contemporary environmental threat facing mankind today as many elements and features of the earth are changing mainly due to anthropogenic or human-induced activities (Apata *et al.*, 2009). This development raises climate change concerns for sustainable maize production. According to IPCC, Africa seems to be the most inherently vulnerable continent to future climate change impacts given that agriculture is the main stay of its food production and economy which accounts for over 80% of occupation of the continent. Justly, climate change is already a reality for millions of Africa's farmers, especially maize producers (Stings, 2017).

Nigeria's maize production scenario and conditions including the agro-cultural diversities had placed it at an advantage for production of a wide range of food products (Ogbodo, 2017). However, the Climate Change Vulnerability Index of 2014 has placed Nigeria as extreme in Africa's vulnerability index, ranking the country as number six most vulnerable country to climate change. Ike and Amusa, (2014) have reported how this extreme vulnerability lead to negative implications for agricultural production and food security. This sector is presently facing challenges from erratic weather pattern such as heat stress, longer dry seasons and uncertain rainfall and longer dry spells in the rainy season (Onumadu *et al.*, 2009)

The awareness of farmers to adopting improved adaptation measures as a panacea for climate change issues has been relatively studied in Nigeria. However, most previous climate change research measured the level of long-term changes in decades (long term) without considering the mitigation and adaptation strategies of especially maize farmer's short-term effects and adaptations (Odjugo, 2010). Also, worse-still, many farmers are resource constrained, therefore, their demands for certain improved seed and other inputs vary as much as agro-climatic conditions. However, the formal seed sector has made some success in raising adoption of various improved maize varieties such as stress-tolerant variety, early and extra-early variety, or nitrogen efficient variety (Olakojo and Akinlosotu, 2004)

Many varieties of maize were developed and available for cultivation in Nigeria. However, maize production is greatly limited by the impact of climate change (Lawal *et al*, 2005). Given that maize plays fundamental role to national food security in Africa and its production is highly dependent on climatic variables (Apata, 2009).

Therefore, concern have been widely expressed, over the years by agronomist, research institutions, governmental agencies at both local and international fora, on the need to tackle the impacts of climate variability on maize yield (WHO, 2002).

However, perception may not be sufficient condition for adaptation to climate change issues by the farmers but better understanding of local perception issues and adaptive behaviors of the farmers will provide information to alleviate the challenges of sustainable agricultural development.

The specific objectives of the study included the description of the socio-economic characteristics of maize farmers, identify maize farmers' sources of information, examine the perception of maize farmers to climate change, and, ascertain maize farmers adaptation strategies to climate change in the study area

MATERIALS AND METHODS

The Study Area

The study was carried out in Lere Local Government Area (LGA) of Northern Guinea Savannah vegetation zone of Kaduna State. Lere Local Government Area is the largest maize production hub of the state's Southern Guinea Savannah vegetation belt and indeed, Kaduna State in general. Lere LGA is geographically located in the Northeastern part of the State, with a land mass of 2,158km^2 and a projected population of 483,276 as at 2018 at annual growth rate of 3.2% (NBS, 2017). The LGA lies between Latitude 10^{0}50'N and Longitude 7^{0}54'E and has a tropical climate. The average temperature is 24.1^{0}Celsius with average precipitation of 1190 mm per annum. The driest month is January with 0 mm of rainfall, most of precipitation is in August, averaging 282 mm. The warmest month is April with an average temperature of 27.5^{0}C and the coldest month is January with temperature averaging 22.2^{0}C.

Lere LGA is bounded by Kubau and Kauru Local Government Areas to the West and South respectively while it is bordered by Ikara LGA to the North. The Area also shared boarders with Plateau and Bauchi States. Lere LGA is mainly inhabited by ethnic *Hausas, Fulanis, Kuramas, Gures, Amawas* and *Kahugus*, among others (EFO, 2014).

Sampling Procedure and Data Analysis

Multistage sampling technique was employed for the study. A population of 2800 registered maize farmers were obtained from the Lere zonal office of Kaduna Agricultural Development Authority. Lere LGA was purposively selected for this study because it is the major maize production area in the vegetation belt and also in Kaduna State. The second stage involves the purposive selection of 7 wards out of the 11 existing wards. The wards selected for sampling were Abadawa, Garu, Kayarda, Lazuru, Sabon-birni, Saminaka and Yarkasuwa. The third stage is the random selection of 4 villages from each of the wards and lastly, 8% of the registered maize farmers were sampled to give total of 224 respondents were sampled. Data were analysed using descriptive statistics of frequency distribution, percentages, mean and weighted average to achieve the objectives of the study.

A 5-pointLikert scale was used to measure perception and adaptation strategies of the respondents in the study. The specification of the Likert scale is given as follows: Strongly agree =5; Agree = 4; Undecided = 3; Disagree = 2 and, Strongly Disagree = 1 for positive statements while Strongly disagree =5; disagree = 4; Undecided = 3; Agree = 2 and, Strongly agree = 1 for negative attitudinal statements.

To get mean score using 5 scale Likert scale: 5 + 4 + 3 + 2 + 1/5 = 3.0

An index of 3 was employed. Any climate change indicator with less than 3 is regarded as not important indicator and any climate indicator with 3 and above is regarded as important climate change indicator. Need to tell how to arrive at the index of 3 and below

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The results in Table 1 shows that almost half (45%) of the respondents were less than or about 30 years of age with a mean age of 31 years. This implies that the farmers involved in maize production were young and in their productive ages. This finding closely agrees with Otitioju and Arene (2010) who reported average age of farmers to be 33 years. Also, a majority (90%) of the respondents were male while only 10% were female. This finding could be indicative of the significant and important role played by male as household heads which agrees with Umar *et al.* (2015) who reported that men dominate agricultural workforce, probably due to social and religious reasons. However, the marital status of the respondents showed that 60% of the respondents were married who had family to cater for as shown in Table 1.

Table 1 also gives the level of education of the respondents where 20% of the respondents had no formal education. Most (29%) of the respondents attended tertiary schools. About 28% and 24% of the respondents attended secondary and primary schools, respectively. This indicates that the respondents attained different forms of education, especially formal education. The results in Table 1 also shows that about 38% and 34% had maize farming experience of between 21-30 years and 11-20 years, respectively. Farming experience, according to Hassan and Nhemachena (2008) matters more than that of age as it significantly affects farm management and decision making. The farming system in Table 1 revealed that almost all (99.1%) was subsistence farming while inheritance was the major source of land acquisition as 82% of the respondents reported it as the main source of land acquisition. Purchase and rent accounted for about 10% and 8% respectively of the respondents' sources of land acquisition.

Table 1: Socio-economic characteristics of the respondents

Variables	Frequency (n=224)	Percentage	Mean	Minimum	Maximum
Age (years)					
20-30	102	45.5			
31-40	67	29.9			
41-50	30	13.4	34.6	20	69
51-60	13	5.8			
61-70	12	5.4			
Sex					
Female	23	10.3			
Male	201	89.7			
Marital status					
Married	134	60			
Single	78	34.7			
Widowed	12	5.3			
Educational Level					
No formal education	45	20.1			
Primary school	53	23.7			
Secondary School	62	27.7		3	21
Tertiary Schools	64	28.6			
Maize farming Experience (years)					
< 10	37	16.5			
11-20	84	37.5	24.7	3	52
21-30	75	33.5			
> 30	28	12.5			
Farming System					
Subsistence	222	99.1			
Commercial	2	0.9			
Method of Land Acquisition					
Inheritance	183	81.7			
Purchase	22	9.8			
Rent	17	7.6			
Others	2	0.9			

Source: Field Survey, 2019

Respondents' Main Sources of Information

Table 2 indicates multiple responses on information sources used by the respondents in the study area. Examining main sources of information used by the respondents is important because it will lead to different levels of perception of climate change indicators. The result shows that most (66.7%) of respondents obtained information from fellow farmers, (28%) sourced farm information from farmers' associations, with 18.7% of the respondents getting information from extension agents. Thus, fellow farmers, farmers' associations and extension agents ranked first, second and third, respectively as the main sources of the maize farmers sources of information. Only 9.3% and 2.7% of the respondents obtained farm information from research institutes and seed companies, respectively. Thus, this implies that maize farmers obtain their agricultural information from different sources but the implication is that farmers that belong to agricultural groups are more likely to have access to information on climate changes than those who do not belong to any. This finding is in consonance with

that of Muhammad (2016) who found fellow farmers as the main source which farmers obtain farm information from.

Table 2: Distribution of respondents according to their source of information (n= >224)

Source of Information	Frequency	Percentage	Ranking
Fellow farmers	149	66.7	1st
Farmers association	63	28.0	2nd
Extension officers	42	18.7	3rd
Electronic media	33	14.7	4th
NGOs	25	11.3	5th
Research Institutes	21	9.3	6th
Seed companies	6	2.7	7th

Multiple responses used Source: Field survey, 2019

Perception of Climate Change Indicators by Respondents

Table 3 shows the perception of respondents according to some climate change indicators using a mean score of 3.0 as decision rule.

Table 3: Distribution of maize farmers perception on climate change indicators

	Climate Change Indicators	Weighted Sum	Weighted Average	Decision
1	Early onset of rainfall	505	2.3	disagree
2	Late onset of rainfall	487	2.5	disagree
3	Shorter than normal rainfall	499	2.2	disagree
4	Continuous rise in temperature	478	2.1	disagree
5	Decrease in rainfall days	550	2.5	disagree
6	High sunshine intensity	516	2.3	disagree
7	Increase in crop yield	524	2.4	disagree
8	Decrease in crop yield	684	3.1	Agree
9	Unusual rain	752	3.4	Agree
10	Above normal rainfall	559	2.5	disagree
11	Longer than normal rainfall	682	3.1	Agree
12	Constant drought	581	2.6	disagree
13	High humidity	691	3.1	Agree
14	Low humidity	631	2.8	disagree
15	Erratic wind	652	2.9	disagree
16	Early onset of harmattan	651	2.9	disagree
17	Late onset of harmattan	711	3.2	Agree
18	Loss of soil fertility	541	2.5	disagree
19	Increase in erosion	677	3.0	Agree

Source: Field survey, 2019

The result shows that early onset of rainfall ($\bar{X}$=2.3), late onset of rainfall ($\bar{X}$=2.5), shorter than normal rainfall($\bar{X}$=2.2), continuous rise in temperature($\bar{X}$=2.1), decrease in rainfall days($\bar{X}$=2.5), above normal rainfall($\bar{X}$=2.5),high sunshine intensity($\bar{X}$=2.3), increase in crop yield($\bar{X}$=2.4), erratic wind($\bar{X}$=2.9), constant drought($\bar{X}$=2.6), early onset of harmattan ($\bar{X}$=2.9), low humidity ($\bar{X}$=2.8) and loss of soil fertility($\bar{X}$=2.5). These had a

perception index of less than 3 and hence the respondents disagreed that these are not important indicators for climate change in study area. Decrease in crop yield(***X***=3.1), unusual rainfall (***X***=3.4), longer than normal rainfall(***X***=3.1), high humidity(***X***=3.1), late onsets of harmattan(***X***=3.2), increase in erosion(***X***=3.0), had an index of 3 and above and are perceived as important indicators for climate change. This implies that the respondents have some favourable and unfavourable perception towards climate change in the study area. These findings were in line with the result from studies of Nwaiwu (2014), which shows that climate change effect is disastrous to agricultural production and requires mitigation. Findings are also in agreement with that of Ogbodo *et al.* (2018) who reported erratic rainfall and decrease in crop yield as perceived climate change indicators among Kenyan maize farmers. However, this study disagreed with that of Irénikatché *et al.* (2010) which reported dryness and late onset of rains as major climate change indicators perceived in their study of farmers' perception of climate change and adaptation strategies in sub Saharan West Africa.

Adaptation Strategies used by Respondents

Table 4 shows eleven emerging and indigenous methods used for climate change adaptation in the study area. These strategies include multiple cropping, use of irrigation and water storage and conservation, early and late planting, use of organic manure, and use of inorganic fertilizers. Others include planting of trees, early harvesting of crops, prompt and multiple weeding, use of pesticides, herbicides, insecticides, use of loans, grants and subsidies, and use of improved varieties. Of these adaptation strategies, multiple cropping(***X***=3.22), early and late planting(***X***=3.29), use of organic manure(***X***=3.37), early harvesting of crops(***X***=3.01), use loans, grants and subsidies(***X***=3.01) and, use of improved varieties were agreed as adaptation strategies used by the respondents in the study area. Use of improved varieties (***X***=3.52), use of organic manure (***X***=3.39), and, early and late planting (***X***=3.37) ranked first, second and third, respectively**.** The findings in in consonant with that of Ogbodo *et al.* (2018) which found early planting, multiple cropping and use of organic manure as main key adaptation strategies used by farmers in sub Saharan Africa.

Table 4: Distribution of adaptation strategies used by respondents in the study area (N >224)

S/no.	Adaptation strategies	Sum	Mean	Decision
1	Multiple cropping	722	3.22	Agree
2	Use of irrigation and water storage and conservation	602	2.69	Disagree
3	Early planting	739	3.29	Agree
4	Late planting	621	2.78	Disagree
5	Use of organic manure	757	3.37	Agree
6	Use of inorganic fertilizers	657	2.92	Disagree
7	Planting of trees	588	2.63	Disagree
8	Early harvesting of crops	675	3.01	Agree
9	Prompt and multiple weeding	623	2.78	Disagree
10	Use of pesticides, herbicides and insecticides	661	2.95	Disagree
11	Use of loans, grants and subsidies	682	3.04	Agree
12	Use of improved varieties	789	3.52	Agree

Source: Field survey, 2019 N > 224 due to multiple responses

CONCLUSION

Understanding of maize farmers' perception of climate change and adaptation strategies will unarguably increase the maize farmers' knowledge on climate change and adaptation to associated climate change issues in the study area. The study has established unusual rainfall ($\bar{X}$ =3.4), late onsets of Harmatan period ($\bar{X}$ =3.2) and decrease in crop yield ($\bar{X}$ =3.1) as the main perceived climate change indicators while major adaptation strategies employed by the respondents included use of improved varieties ($\bar{X}$ =3.52), use of organic manure ($\bar{X}$ =3.39), and, early planting ($\bar{X}$ =3.37). Sources of information on climate change were mainly through the use of personal sources of information. The study recommends increasing proper awareness on climate change issues and realistic adaptation strategies to the farmers by relevant governmental and non-governmental support.

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