



SOURCES OF INFORMATION ON CLIMATE CHANGE AMONG MAIZE FARMERS IN NORTHEASTERN NIGERIA

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ABSTRACTS

The study examined the sources of information on climate change among maize farmers in Northeastern Nigeria. Multi-stage sampling procedure was employed in the selection of 337 respondents for the study. Data were collected through structured questionnaire and analyzed using descriptive and inferential statistics. The results showed that personal experience was the major source of information on climate change with a mean value of 3.777 and telephone call, newspaper and radio had a mean of 3.715, 3.709 and 3.436, respectively. The study also indicated that the least considered factor was workshop, the lowest with a mean of 3.202. The result of the rotated component matrix on sources of information on climate change indicated that only social, technical know-how, institutional and mass media factors were extracted. The rotational factor analysis is suitable as the Kaiser-Meyer-Olkin (KMO) value is 0.613 which is above the Kaiser recommended value and the Bartlett's test of Sphericity was significant at (1092.589; $P < 0.001$). The finding revealed that maize farmers employed different climate change adaptation strategies based on their perception on the effects of climate change obtained mainly from their sources of information. The study recommends that Government should subsidize all means of information source to farmers and all information should be correctly, timely information to farmers that led to profit maximization, thus high standard of living to rural dwellers

Keyword; Information, climate change, adaptation and extension service systems

INTRODUCTION

Maize (*Zea mays*) is one of the most important Nigeria's food crops that contribute to household security in Nigeria (Muhammad, *et al.*, 2020). Ikeh and Amusa (2014) also reported that the importance of maize in Nigeria cannot be over emphasized due to its economic value to Gross Domestic Product (GDP). Maize is the Nigerian second leading staple food crop apart from rice with increasing domestic demand and plays key role in food security and generation of income for most farmers. Maize has recently surpassed cassava as Nigerian's most important food crop in terms of calories and nutritional contained (carbohydrate, protein, vitamins and minerals) consumed and serves as a main source of income to producers in the maize growing area (Webb and Highly, 2019). Besides, the production of maize is severely affected by climate change in Africa generally.

According to Ali (2018) opined that climate change is one of the potential threats to human development and survival -socially, politically, and economically. He further buttressed that, a change in climate can have impact on many vulnerable individual as it relates to awareness, knowledge and information on where and how people, plants and animals live as



well as other components of agricultural activities. In recent times, climate change has gained great attention in global discussion. This concern about climate change is due to its adverse effects on the living conditions of mankind. Though when it comes to some developmental issues like poverty, discussions are normally skewed to developing countries like countries in Sub-Saharan Africa, Latin America and some countries in Asia; however, issues on climate change have taken the Centre stage of developmental discussion globally. Increasingly, developing countries particularly countries in Africa are much concerned about climate change since they are more vulnerable. Webb and Highly (2019) state that climate change can be seen as a major threat to sustainable growth and development in Africa. As a result, the efforts of African countries to achieve the Millennium Development Goals may be seen as a mirage if the adverse effects of climate change are not addressed. Among the continents which are responsible for climate change, Africa is the least contributor; however, the continent is more vulnerable to the effects of climate change due to its overdependence on rain-fed agriculture, compounded by factors such as widespread poverty and weak capacity and poor sources of information to the farmers. These poor linkages of information between farmers and good source of farming information led to great loss in yield of crops and resulted in poor living standard of farm family in the study area. Poortinga and Pidgeon (2018) suggested that knowledge about global warming was formerly the exclusive purview of climatologists and a small subset of environmental activists. But people actions influenced on global warming and climate change: people's actions to reduce the effects of global warming and climate change in the community will encourage others to reduce the effects of global warming through their own actions. Thus, it is expected that persons with higher perceived personal knowledge will accept climate change information as a personal responsibility to be more likely to define climate change as a risky and are more likely to act on the perceived risks.

Diekmann (2018) revealed that information on climate, global warming, and efficacy of information, trust media, trust experts and confidence in science was the factors that influenced farmers' perception on climate change. The results stated that the farmers who showed a great deal of confidence that scientists understand global warming and climate change showed significantly less concern for the risks of global warming than those who had lower trust in scientists. Though, this effect differs from the expectations of the research, it is consistent with the notion that people trust that scientists, somehow devised technical solutions to any problems that arise because of global warming and climate change (Webb and Highly, 2019). Thus, their study indicated the two key knowledge gaps regarding how efficacy relates to slowing or stopping climate change viz. lack of a comprehensive framework for measuring efficacy beliefs consistently and it appears that people distinguish between actions that were more or less effective, and more or less easy to take individually or collectively.

Abaje (2015) indicated that higher literacy levels increase adaptive capacity by increasing people's capabilities and access to information, thereby enhancing their ability to cope with adversities. Besides, high literacy is therefore considered to have high adaptive capacity to climate change than low literacy rate with low adaptive capacity. Since, lower education level reduces the ability to understand warning information on climate change adaptation. Ngogwe *et al.* (2019) confirmed that higher literacy level always results in greater earnings and the ability of one having access to farm inputs, infrastructures and understand warning information that can also be used to adapt to climate change. Furthermore, wealth and literacy level recorded high adaptive capacity that may helped the rural people had access



to other resources that could be used for climate change adaptation hence, less impacts of climate change.

Ojo *et al.* (2021) showed that farmers' access to support services that include credit, training and information from cooperatives is more likely to make them more adaptive to climate change. Further, farmers satisfied with cooperatives can potentially be members of cooperatives. Since participating in cooperatives is potentially instrumental in shaping farmers' motivation and facilitates the decision to adapt to climate change through cooperatives. Cooperative plays a pivotal role by enabling technological adaptation by promoting certain technologies. Steffen *et al.* (2021) opined that information sources; internet, and training attendance as well as institutional factors; cooperative membership and credit access positively influenced the degree of climate change adaptation among the respondents. Furthermore, easier credit access and joining cooperatives could enhance the adaptive capacity of smallholder farmers. Abdul-Fatah *et al.* (2022) revealed that access to agricultural extension services and assets are the key drivers of smallholder farmer's joint decision to access climate information and adopt climate smart adaptation practices. Further, government, district assemblies and non-governmental organizations supporting smallholder farmers' adoption of climate smart adaptation strategies in order to overcome climate risk should also assist in the accessibility of climate information since they complement one another. Ikeh and Amusa (2014) stated that smallholder farmer's literacy and knowledge level should be increased through non-formal and informal educational programmed, and extension education using the farmer-field schools method will reduce the effects of climate change and improve source of information on climate change to farmers in the study area.

Inadequate sources of information to climate change are perhaps a critical challenge which confronts North-East maize farmers and is an emerging problem that will continue to threaten food security. Northeastern Nigeria is caught up in this web of climate change challenges as a result of poor source of information to farmers and the vulnerability to the vagaries of climate change has been proven by inadequate sources of information to maize farmers and there is need to improve the linkage between governments, subjects matter specialist and the farmers. The study tries to cover entire Northeastern Nigeria because most of studies review only look at individual state or compared two or more states. This informs the need to carry out a study on maize farmers sources of information on climate change in Northeastern Nigeria. It is in view of the above that the study will seek answers to the following research questions:

1. identify the major sources of information on climate change; and,
2. determine the factors that influencing sources of information on climate change among maize farmers in the study area.

METHODOLOGY

The Study Area

The study was conducted in Northeastern Nigeria which consists of six States viz. Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe states. The study area is located between Latitude 9° 08' - 14°N and Longitude 8° 68' - 14°E. The study area has land mass of 272,455 square kilometers (105,194 square miles) and a projected population of 27,169,568 people by 2022 based on 3.1- 3.2% annual population growth rate (National Population Commission, 2006). North-east is bordered by the States of Jigawa to the North-west, Kaduna to the West and Plateau to the South-west. Its eastern border forms the national border with Cameroon and Chad Republic while to the North, with Niger Republic (Ali, 2018).



The study area has a distinct dry season from (November to March) and the rainy season from (April to October). However, rainfall generally range between 1,300 millimeters (36.7 inch) per annum in the Southern part to about 900 millimeters (28 inch) per annum in the extreme Northern part of the study area with mean annual temperature, ranging between 28°C to 42°C. The vegetation zones in the study area are three; Sahel, Guinea and Sudan Savannah. The diversity of the soil type includes; clay soil, loamy and loam- sandy in the Southern part and sandy- loam, sandy and sand to the most Northern part of Borno and Yobe States.

The study area is considered to be agrarian as more than 90% percent of the working adults engage in agricultural directly or indirectly as a means of livelihood. The main economic activities in the area include; crop farming and livestock rearing, hunting, fishing, food processing, transportation and craft businesses. Most farm families reside in rural areas and farmers still use traditional cultivation methods in the area (Lawal and Osuji, 2017). Agriculture in the study area is largely rain fed and highly dependent on natural phenomena. North East consists of people of different background, tribes and beliefs. More so, the major ethnic groups across the region include; Hausa, Fulani, Kanuri, Badawa, Bolewa, Tangale, Jara, Hausa, Warjawa, Zulawa, Mumuye, Tiv, Warkun, Kaka, Ngizim, Kare-kare, Baburawa, Kamba and Shuwa Arabic etc.

Sampling Procedure

A multi-stage sampling procedure was used for the study. In the first stage, Adamawa, Bauchi and Gombe States were purposively selected in order to avoid major communities affected with insurgency. In the second stage, the stratified selection was adopted and involved selection of three Agricultural zones from each state, giving a total of nine (9) agricultural zones. In the third stage, from each of the agricultural zones, two (2) Local Government Areas (LGAs) were randomly selected, thus giving a total of eighteen (18) LGAs. In the fourth stage, from each of the selected LGAs, three (3) villages were also randomly selected, thus giving a total of fifty-four (54) villages. In the fifth stage, samples of 337 farmers were randomly selected from a population of 7,630 farmers. The sampling frame was obtained from the state ADPs.

Data Collection

Primary data were obtained directly from the respondent through the use of structured questionnaire complemented with interview schedule. However, the questionnaire was pre-tested on few selected respondents. Both the researcher and trained enumerators were engaged in data collection. The questionnaire sought information on source of information on climate change.

Method of Data Analysis

Data were analyzed using both descriptive and inferential statistics. The descriptive statistics used were frequency distribution, mean and percentage. The inferential statistic used factor analysis (FA) is one of the most commonly used methods for summarizing and reducing data to significant ones in social science researches. FA assumes that underlying dimensions of factors can be used to explain complex phenomena. It attempts to identify underlying variables or factors that explain the patterns of correlations within a set of observed variables (Johnson and Wichern, 2017). FA is often used in data reduction to identify a small number of factors that explain most of the variances observed in a much larger number of manifest variables.

Principle component analysis (PCA) was used to group the constraints with the aid of principal factor method call Varimax Orthogonal rotation method. The factor solution were used in objective Two (ii) Six (vi) and Eight (viii). The rotational components of the matrix

should explain at least half of each original variable's variance and the criterion of eigen-value or characteristic root (Eigen value) greater than 1.0 was used for defining the number of the factors that were retained (Sallawu *et al*, 2020). Model acceptance was based on three criteria: each variable, in order to be included in the variable cluster of a factor, must load to it more than 0.4, and each factor must have at least two variables and variables that load in more than two constraints were discarded. The dimensionality of this matrix can be reduced by looking for variables that correlate highly with a group of other variables, but correlate very badly with variables outside of that group.

The factor analysis model as stated by Johnson and Wichern (2017) is:

$$\begin{aligned} X_1 - \mu_1 &= l_{11}F_1 + l_{12}F_2 + \dots + l_{1m}F_m + \varepsilon_1 \\ X_2 - \mu_2 &= l_{21}F_1 + l_{22}F_2 + \dots + l_{2m}F_m + \varepsilon_2 \\ X_p - \mu_p &= l_{p1}F_1 + l_{p2}F_2 + \dots + l_{pm}F_m + \varepsilon_p \end{aligned} \quad (19)$$

Further, the orthogonal factor model with m common factor is as follows:

$$X = \mu + LF + \varepsilon \quad (20)$$

(P x 1) (p x 1) (p x m) (m x m) (p x 1)

Where;

μ_i = Mean of i^{th} variable

ε_i = i^{th} specific factor

F_i = j^{th} common factor

l_{ij} = Loading of the i^{th} variable on the j^{th} factor

Johnson and Wichern (2017) also estimated the communalities as

$$h_i^2 = l_{i1}^2 + l_{i2}^2 + \dots + l_{im}^2 \quad (21)$$

The principal component factor analysis of the sample covariance matrix S is specified in terms of its eigen-value and eigen vector pairs $(\lambda_1, e^{\wedge}_1), (\lambda_2, e^{\wedge}_2), \dots, (\lambda_p, e^{\wedge}_p)$, where $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_p$.

Let $m < p$ be the number of common factors. Then the matrix of estimated factor loadings $\{l^{\wedge}_{ij}\}$ is given by

$$L = [\sqrt{\lambda_1} \hat{e}_1 : \sqrt{\lambda_2} \hat{e}_2 : \dots : \sqrt{\lambda_m} \hat{e}_m] \quad (22)$$

Johnson and Wichern in (2017) stated that the estimated specific variances are provided by the diagonal elements of the matrix.

Varimax seeks to maximize a specific criterion; it produces a unique solution (except for differences in sign). Let the matrix $G = \{g_{ij}\}$ represents the rotated factors. The goal of Varimax rotation is to maximize the quantity:

$$Q_i = \sum_{j=1}^k \left[\frac{P \sum_{i=1}^p g_{ij}^4 - \sum_{i=1}^p g_{ij}^2}{P} \right] \quad (23)$$

The above rotation has the disadvantage of not spreading the variance very evenly among the new factors. It tends to form one large factor followed by many small ones. To correct this, normalized-Varimax rotation is used. Where c_i is the square root of the communality of variable i .

The quantity maximized in this case is:

$$Q_n = \sum_{j=1}^k \left[\frac{P \sum_{i=1}^p \left[\frac{g_{ij}}{c_i} \right]^4 - \sum_{i=1}^p \left[\frac{g_{ij}}{c_i} \right]^2}{P} \right] \quad (24)$$



To look for factor outliers, we used standardized score to compute the factor score for a given case for a given factor.

$$Z = \frac{X - \mu}{\sigma} \dots\dots\dots (25)$$

Where;

Z = Standard score

X = Variable of the population

μ = Mean of the population

σ = Standard deviation of the population

RESULTS AND DISCUSSION

Sources of Information on Climate Change

Results in Table 1 showed the source of information on climate change among respondents. The finding indicate that personal experience of farmers was found to be a major source of information on climate change adaptation, with a mean of 3.777. Personal knowledge allowed respondents to form complex mental reasoning of the climate which can affect their farming operations. This implied that personal experiences make farmers to understand the reality of climate change more easily than less experience one. The findings agreed with Nelson *et al.* (2017) who found that the farmers who showed a great deal of personal experience, confidence and understand of adaptation to climate change showed significantly less concern for the risks of weather variability than those who had lower personal experience.

Farmers agreed that telephone call was a major source of information on climate change adaptation with a mean of 3.715. Telephone call serves as easy way for farmer's to have access to climate information on adaptation strategies. This implied that farmers must invest in communication for easy access to information on climate change adaptation. The results agreed with Nirmal and Ravi (2021) who found that telephone calls are cheap and cost less in getting information to famers on adaptation practices in order to mitigate the effects of climate change.

The results indicated that town meeting was found to be a major source of information on adaptation to climate change adaptation, with a mean of 3.299. This showed that town meeting bring farmers together for cooperation, association and brainstorm on other issues affecting adaptation to climate change. Information on adaptation to climate change was easily communicated to farmers in town hall meeting. This implied that farmer needs to participate in cooperative organization in order to achieve a common goal or economic of scale, thus get information and other support service to aid their adaptation to climate change. The results go in line with Ojo *et al.* (2021) in their study on quantifying the determinants of climate change adaptation strategies in South Africa. Their finding revealed that cooperation of farmers under one umbrella, thus achieving economic of scale and easy source of information on adaptation to climate change in the study area.

Newspaper was also found to be a major source of information on climate change with a mean of 3.709. Newspapers are quick means of dissemination of information to respondents. Newspapers are effective ways of conveying information to people in large numbers, where farming population is largely literate. Newspapers can be very effective in conveying information to them. This implied that the role of newspapers in coping the hazards of climate change is evenly recognized by respondents in the study areas. The result agreed with Ngoe *et al.* (2019) in their study on farmer's perceptions of climate variability and determinants of adaptation strategies in the highlands of South-West, Cameroon. Their



finding revealed that newspaper is among the major source of information on climate change that most of the farmers belief in the study area.

Respondents affirmed that a research institution was a major source of information on climate change with a mean of 3.676. Research institution serve as engine room for innovation on various methods of dissemination of information to farmers on climate change. Thus, research institutions create innovation on modern technologies on adaptation to climate change. This implied that farmer call for research finding on modern adaptation to climate change. The result goes in line with Steffen *et al.* (2021) in their study on climate change adaptation by smallholder farmers in Nepal. Their finding viewed that research institution was the backbone of innovation on adaptation strategies to climate change. These innovations help farmers in adaptation to climate change easily.

Majority of respondents agreed that university was a major source of information on climate change, with a mean of 3.626. University are research innovation center, use to provide formal information on improved adaptation strategies to climate change. University also engaged in enlightening campaign to farmers on new adaptation strategies to climate change. This implied that government most invest on education, in order to get more in terms of improved strategies on adaptation to climate change. The result agreed with Mugwisi *et al.* (2017) in their study on information needs for farmers on climate change in Zimbabwe. Their finding highlighted that majority of crop farmers' sources their information on climate change from university. Also, university serve as research center for innovation of modern adaptation strategies to climate change.

Radio was found to be a major source of information on adaptation to climate change, with a mean of 3.436. This implied that radio can be a powerful communication channel for dissemination of information on climate change to farmers. Rural farmers mostly have easy access to radio and use to hear information on adaptation strategies. Pettengell (2018) in his study on climate change adaptation strategies. Their results showed that majority of the farmers family received information about climate change through radio. Their finding revealed that radio is the most common and cheap source of information to farmers on adaptation to climate change.

Majority of respondents agreed that an extension worker is a major source of information on adaptation to climate change, with a mean of 3.522. This showed that majority of the respondents have access to extension worker as source of information on adaptation to climate change. This implied that farmers need to invest on extension service delivery viz, extension worker serve as most effective source of information on climate change adaptation strategies in the study area. The results agreed with Nose and John (2020) who results revealed that extension workers were the most preferred and reliable source of information to farmers on climate change adaptation in the study area.

Friends were also found to be a major source of information on adaptation to climate change, with a mean of 3.306. The farmers' friend is a good source of information on climate change and farmers use to share knowledge on adaptation to climate change. This implied that farmers should participate in farms association, thus relate with other farmers for information on adaptation to climate change. The result agreed with Ngogwe *et al.* (2019) in their study on farmer's perceptions of climate variability and determinants of adaptation strategies in the highlands of South-West, Cameroon. Their finding stated that majority of farmers affirmed that friends and family are the main source of information to climate change adaptation. Many farmers learn adaptation to climate change through friends.

Television was also found to be a major source of information on adaptation to climate change adaptation, with a mean of 3.505. Television serve as easy way through with



government and other cooperate body (NGOs) disseminate information on adaptation to climate change. This implied that farmers should invest in infrastructural facilities, thus links with mass media for updated information on adaptation to climate change. The result agreed with Mugwisi *et al.* (2017) in their study on information needs for farmers on climate change in Zimbabwe. Their finding indicated that television was a major information source on adaptation to climate change to farmers. Televisions play a vital role in passing information to farmers on adaptations to climate change.

Table 1: Sources of Information on Climate Change

Sources	Mean	Rank
Personal experience	3.7774	1
Telephone calls	3.7151	2
Newspaper	3.7092	3
Universities	3.6261	4
NGOs	3.5994	5
Extension workers	3.5223	6
Television	3.5045	7
Radio	3.4362	8
Friends	3.3056	9
Internet	3.3027	10
Town meeting	3.2997	11
Seminars	3.2938	12
Workshops	3.2018	13

Source: Field Survey 2023. Note: Base line mean (\bar{X}) = 3.

Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity

Table 2 shows that the principle component analysis (PCA) was use and the rotational analysis is suitable as the Kaiser- Meyer-Olkin (KMO) value is 0.613 and is above the Kaiser recommended value of 0.50, thus the adequacy of the sample for the analysis (Sadiq *et al.*, 2019). The Bartlett's test of Sphericity was significant at (1092.589; $P < 0.001$). This indicated that there are sufficient inter-correlations to conduct the factor analysis based on the results. Given all the above indicators, factor analysis was deemed to be suitable with all the variables. The criteria of eigen-value or characteristic root (Eigen value) greater than 1.0 was used for defining the number of the factors that were retained. The variables model acceptance was based on three criteria: each variable, to be included in the variable cluster of a factor, must load to have it more than 0.4 (Sallawu *et al.*, 2020). The result of the rotated component matrix showing the extracted factors, based on the response of sources of information only four factors were extracted. Factors 1, 2, 3 and 4 were named social, technical know-how, institutional and mass media factors. The extracted four factors accounted for 66.8% of the total variance, which is above the percentage recommended being satisfactory for social science research.

Table 2: Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.613
Bartlett's Test of Sphericity Approximate Chi-Square	1967.441
Degree of freedom df	91
Significant level sig	0.000***

Source: Field survey, 2023.



Factor Influencing Sources of Information on Climate Change

Results in Table 3 shows that Factor analysis was use in determining the factors that influence sources of information on climate change in the study area. The high loading under factor 1 are social factor highly loaded from five factor loadings and accounted for total Eigen value of 3.241 amounting to 23.15% of the total variance, showed farmers concern on the use of town meeting, workshops and seminars. Thus call for the needs of fortnight extension visit from subject matter specialist on improved adaptation technologies to climate change.

The high loading under factor 2 are technical know-how factor highly loaded from three factor loadings and accounted for total Eigen value of 2.956 amounting to 21.11% of the total variance, revealed farmers worry on the use of extension workers and personal experience. The study call for farmers' interventions, thus their personal skill and farmer to farmer extension approach to tackle these constraints affecting maize adaptation to climate change in the study area.

The high loading under factor 3 are institutional factor highly loaded from three factor loadings and accounted for total Eigen value of 1.854 amounting to 13.24% of the total variance, showed farmers' concern on the use of friends, NGOs and universities. Thus, the study call for research interventions, thus need effective sources of information from top-down and bottom-up extension approach in the study area to address the issue of adaptation to climate change. The high loading under factor 4 are mass media factor highly loaded from three factor loadings and accounted for total Eigen value of 1.304 amounting to 9.317% of the total variance, showed farmers' concern on the use of radio, television and telephone calls. Therefore, this called for the provision of adequate communication facilities and farmers effective information service delivery on climate change in the study area to address the adaptation to climate change.

Table 3: Factor Influencing Sources of Information on Climate Change

Variables	Factors			
	1 Social	2 Technical know-how	3 Institutional	4 Mass media
Town meeting	0.886			
Workshops	0.754			
Seminars	0.732			
Internet	0.658			
Newspaper		0.591		
Extension workers		0.820		
Personal experience		0.798		
Friends			0.696	
NGOs			0.878	
Universities			0.825	
Radio				0.821
Television				0.712
Telephone calls				0.521
Eigen values	3.241	2.956	1.854	1.304
% of Variance	23.153	21.114	13.241	9.317

Source: Field survey, 2023.



CONCLUSION AND RECOMMENDATIONS

Based on the findings, the study concludes that maize farmers used personal experience, telephone, newspapers and universities among others as their sources of information on climate change in the study area. Therefore, the recommends release of good and timely information on climate change to farmers will led to profit maximization, thus high standard of living to rural dwellers.

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