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FACTORS INFLUENCING MAIZE FARMERS LEVEL OF AWARENESS ON FLOOD DISASTER ADAPTATION STRATEGIES IN GOMBE STATE, NIGERIA

Abubakar, U., Abdullahi, S. and Garba, M.
Department of Agricultural Extension and Rural Development, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi.
Corresponding Author's E-mail: ukasha3839@gmail.com

ABSTRACT
The study examined the factors influencing maize farmers' level of awareness on flood disaster adaptation strategies in Gombe State, Nigeria. A multi stage random sampling technique was used in selecting 172 respondents. Data were collected using structured questionnaire and analysed using descriptive and inferential statistics. The study revealed that majority (77.3%) of the respondents were male and married (72.7%) with a reasonable proportion (34.9% and 34.3%) having secondary and tertiary education, respectively. The mean age, household size, farm size and farming experience of the respondents were 34 years, 6 persons, 2 ha and 8 years, respectively. The study also depicts that majority (66.3%) had access to extension services. Less than half (44.2%) had medium level of awareness on flood disaster adaptation strategy. Almost all (98.8%) and most (92.4%) sourced their information on flood disaster from radio/television and personal observation while majority (87.2%) got it from extension agents. Crop diversification (84.9%) and contour terracing (65.7%) were the major adaptation strategies adapted to avert flooding while use of sandbags was also adapted by 59.3% of the respondents. The findings further reveal that farming experience ($P<0.05$), educational level ($P<0.05$), annual income ($P<0.01$) and household size ($P<0.1$) had significant influence on level of awareness of flood disaster adaptation strategy. The study concluded that farm size, farming experience, educational level and income significantly influenced the respondents' level of awareness on flood disaster adaptation strategies. It is recommended that Farmers should be encouraged to participate in agricultural extension services which will educate them on the effects of climate change and adaptation strategies such as insurance cover; respondents should be sensitized by the extension agents on the early sign of flooding and different adaptation mitigating strategies to mention but a few.

Keywords: Flood, Disaster, Effect, Maize.

INTRODUCTION
Agricultural production remains the primary source of livelihood for most rural communities in developing countries (Serote *et al*., 2021). It provides a source of employment for more than 60% of the population in Sub- Saharan Africa (SSA) (Giller *et al*., 2021). Climate change is increasingly recognized as a major challenge to agriculture worldwide, particularly in developing countries where small-scale farmers are highly vulnerable to its impacts (Ren *et al.*, 2019). However, small-scale farmers in Nigeria face numerous challenges, including inadequate access to resources, limited technological know-how, and environmental hazards such as flooding (Kamara *et al*., 2020). Floods often lead to significant damage to crops, livestock, infrastructure, and livelihoods, affecting the food security and income of small-scale farmers in the region United Nations Development Programme (UNDP), (2019).

Flood is one of the most common type of disaster causing serious economic losses in various part of the world (Ramakrishna *et al*. 2014). It has been described as a condition of complete or partial inundation of normally dry area due to overflow of tidal, inland water or rapid accumulation of runoff (Mmom and Ayakpo, (2014). Etuonovbe (2017) defined flood as the overflowing of the normal confines of a stream or other body of water or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods United Nations Disaster and Reduction (UNISDR, 2018). The immediate effect of this natural disaster includes destruction of crops, loss of livestock, damage to properties, food insecurity, loss of lives among the affected communities (Alam *et al*. 2010;

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Islam & Wong 2017; Okeleye *et al*. 2016). Nigeria experienced several devastating floods as a result of climate change which has affected millions of people and resulted in fiscal losses amounting to billions of US dollars (National Emergency Management Agency (NEMA), 2013).

Maize (*Zea mays*), is one of the most important cereal crops in Nigeria that contributes to household food security (Muhammad, *et al.*, 2020). It 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 (Akpabio *et al.*, 2021). 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 areas (Minocha *et al.* (2019). Tweneboah (2000) regarded the maize contribution to the growth of Nigerian's economy in various ways, namely, in the provision of food for the increasing population, and supply of adequate raw materials to a growing industrial sector such as major source of employment and generation of foreign exchange earnings.

It is important to note that while the vulnerability to climate change impacts is higher in lower-middle- and low-income countries, particularly Africa, the readiness to improve level of awareness and resilience ranks very low in such countries (Notre Dame Global Adaptation Index (ND-GAIN, 2021). A recent report, for example, shows that Nigeria is one of the top ten of the most exposed countries to the effects of climate change, with about 6% of its land area estimated to be exposed to extreme weather events (World Bank, 2019). Understanding the factors influencing maize farmers' level of awareness of flood disaster adaptation strategies is essential for developing effective intervention measures. This study aims to investigate these factors in Gombe State, Nigeria, focusing on the socio-economic characteristics of farmers, their access to information, and their past experiences with flood disasters. By identifying these factors, policymakers and agricultural extension services can tailor their interventions to improve farmers' awareness and adoption of effective flood disaster adaptation strategies. This, in turn, can enhance the resilience of maize farming communities in Gombe State to future flood events.

Gombe State, located in Northeastern Nigeria, is one of the areas prone to recurrent flood disasters, which have been exacerbated by climate change Nigerian Metrological Agency (NIMET, 2018). Therefore, examining the factors influencing maize farmers' level of awareness on flood disaster adaptation strategies in Gombe State is crucial for developing effective adaptation strategies and policies to enhance resilience and mitigate its impacts on maize production and agriculture in general. However, there is little studies that examined the maze farmers level of awareness on flood disaster adaptation strategies in Gombe State, Nigeria, studies have not been conducted on the maze farmers level of awareness on flood disaster adaptation strategies in Gombe State, Nigeria. This research intends to address the gap in the literature by providing information on the maze farmers level of awareness on flood disaster adaptation strategies in Gombe State, Nigeria. The study attempted to**;**

i. describe the socio-economic characteristics of the respondents;
ii. describe the respondents' level of awareness on adaptation strategies to flood disaster;
iii. examine the factors influencing level of awareness of flood disaster adaptation strategies;

MATERIALS AND METHODS

The Study Area

Gombe State is located between Longitude $10^0 15^1 – 10^0 50^1$N and Latitude 11^0 00 – 11^0 45^1E of the Greenwich meridian. It lies within the North East region of Nigeria and occupies a total land area of about 20,265 km^2. The number of inhabitants of the area has a projection population of 3,822,081 based on 3.2% annual population growth (NBS,2021). The major ethnic groups are Tera, Bolewa, Hausa, Fulani, Tangale, Lunguda, Waja, Kamo, Kanuri, Jukun, Peroshonge, Cham, Dadiya, and Tula. The State shares boundary with Yobe State to the North, Adamawa and Taraba State to the South, Borno and Bauchi State to the West. As presented in Figure 1, the State is administratively divided into 11 Local Government Areas, which include: Akko, Balanga, Billiri, Dukku, Funakaye, Gombe, Kaltungo, Kwami, Nafada, Shongom and Yamaltu Deba. The mean annual rainfall ranges from 800 mm to over 900 mm with rainfall duration of 4-5 months. The mean minimum daily temperature recorded ranges

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from 13.6^{0}C – 31.9^{0}C in January and 9.0^{0}C to 28.5^{0}C in August. (Gombe State Agricultural Development Programme [GSADP], 2018).

The vegetation type in the area is predominantly natural growing trees, such as *afzelia Africana acasia SSP* which are found on heavier soil. The area is characterized by shrubs savannah on fertile soil, short grass and thorny vegetation on cetaceous sediments. All the rivers are seasonal (GSADP, 2018). The Area is gentle undulating plains both east and west of an escarpment, which is defined by localized sandstone hills. Gombe State is mainly an agrarian State, and some of the major crops grown include food crop like sorghum, rice, millet, maize, cowpea, sweet potatoes, cassava and a wide variety of vegetables such as tomato, pepper, onion, melon etc. Also, other crops; groundnut, soya beans, benny seed and cotton are also being produced. Other trades of the peasants include hunting, fishing and carving. Livestock rearing including cattle. sheep, goats and poultry contribute immensely to the economy of the study area.

Sampling Technique and Sampling Size

A multi-stage sampling technique was used for the study. In the first stage, the Local Government Areas (LGAs) in the State were clustered into the three agricultural zones of Northern, central, and South zone. In the second stage, purposive sampling technique was used in selecting 2 LGAs from the Northern zone, 1 LGA from the central zone and 2 LGAs from the Western zone making a total of five (5) LGAs. The selection was based on the intensity of maize production. Thus, the selected LGAs were Dukku, Kwami, Akko, Balanga and shongom. In the third stage, 172 respondents were randomly and proportionately (30%) selected as the sample size for the study. The Sample size selection was based on the list of registered maize farmers obtained from each of the selected LGAs as described in Table 1.

Table 1: Sampling Outline for the Study

State	Zones	LGA's	Sampling frame	Sampling Size (30%)
Gombe	Northern zone	Kwami	102	31
		Dukku	100	30
	Central zone	Akko	163	49
	Western zone	Balanga	118	35
		Shongom	90	27
		Total	**573**	**172**

Source: Gombe State Agricultural Development Programme, (GSADP), (2023)

Method of Data Collection

Data were collected using structured questionnaires administered to the respondents. Information collected include socio-economics characteristics (age, sex, education, occupation and income among others), adaptation strategies used by the maize farmers and level of awareness on flood disaster adaptation strategies. A total of 172 questionnaires were administered to the selected maize farmers that serves as the respondents of the study.

Method of Data Analysis

Data collected were analysed using descriptive and inferential statistics.

Descriptive Statistics

Descriptive statistics such as frequency distribution table, mean, and standard deviation were used to achieve objective i and ii.

Multiple regression model

Multiple regression model was used to achieve objective iii which was the effects of socio-economic characteristics on the respondents' level of awareness on flood disaster adaptation strategies. It is specified as $Y= B_0 + \beta_1X_1 + \beta_2X_2 + \beta_3 X_3 \ldots + \beta_{10}X_{11} + ei$

where;

Y= level of awareness on adaptation strategies (3= High, 2 = Very high, 1 = Low)

β1 to β10= Coefficients to be estimated;

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B_0 = Constant term;
ei = Error term;
X_1= Age (Years)
X_2= Gender (1= Male, 2= Female),
X_3= Household size (number),
X_4= Farm size (ha),
X_5=Extension contact (Yes=1, 2=No),
X_6= Educational level (years),
X_7= Farming experience (years),
X_8= Income (Naira),
X_9= Off farm income (Naira),
X_{10}= Access to credit (Yes =1, No = 2),
X_{11}= experience of flood (Yes =1, No = 2).

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

Sex, Marital Status and Educational Level of the Respondents

The result in Table 2 reveal that majority (77.3%) of the respondents were male, while females comprised 22.7%. This gender distribution suggests a higher participation of males in maize farming in Gombe State compared to females. This affirms the findings of Osoba *et al*. (2019) who noted that women prefer to venture in domestic home front activities rather than engage in farming occupation. Majority (72.7%) of the respondents were married. Single respondents accounted for 14.0%, while divorced and widowed respondents made up 4.1% and 9.3%, respectively. The high proportion of married respondents is consistent with the typical demographic profile of farmers, as agriculture is often a family enterprise. Regarding educational attainment, the distribution was as follows: 18.0% had primary education, 34.9% had secondary education, and 34.3% had tertiary education. Additionally, 5.2% had adult and literacy education, 7.0% had Qur'anic education, and 0.6% had never been to school. This distribution indicates a relatively high level of formal education among the respondents, with a significant proportion having at least secondary education. As observed by Adekunle (2019), education is a major and vital human capital which play significant roles in determining an individual's status in society. Education is expected not only to contribute to people's ability to read and understand instructions but also help them to adopt and utilize new techniques.

Table 2: Distribution of Respondents according to Sex, Marital status and Educational level **(n = 172)**

Variable	Frequency	Percentage
Sex		
Male	133	77.3
Female	39	22.7
Marital status		
Single	24	14.0
Married	125	72.7
Divorced	7	4.1
Widowed	16	9.3
Educational level		
Primary education	31	18.0
Secondary education	60	34.9
Tertiary education	59	34.3
Adult and literacy education	9	5.2
Qur'anic education	12	7.0
Never go to school	1	.6

Source: Field Survey, 2023

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Age, Household Size, Farm Size and Farming Years of the Respondents

Table 3 revealed that the almost half (47.1%) of the respondents were in the age range of 28-36 years, followed by 37-45 years (22.7%). The mean age of the respondents was 34 years. This distribution indicates that the respondents were relatively young, which could impact their level of experience and awareness of flood disaster adaptation strategies. This agreed with Oti *et al*. (2017) that ability to work and contribute to the economy is expected to have positive implications on adaptation strategies to flood disaster as well as for food security. The household size was 4-6 members (35.5%), followed by 1-3 members (32.0%). The mean household size was 6 persons. Larger household sizes may indicate a greater need for income generation from farming, potentially influencing farmers' motivation to adopt adaptation strategies to protect their livelihoods. This result is in tandem with the reports of Koyenikan and Anozie (2017) and Ifeanyi-Obi *et al*. (2017) who reported an average of six for household size in a study carried out on climate change adaptation in Nigeria. Similarly, Seth (2017) reported that, the number of households reflect the burden experienced during flooding. A reasonable proportion (33.7%) of respondents had a farm size of 0.5-1 hectare, followed by 4.5 hectares and above (19.2%). The mean farm size was 2 hectares. Farm size can influence farmers' ability to adaptation strategies, as larger farms may require more resources for implementation. Smallholder farmers are expected to suffer food insecurity due to flood disaster compared to medium and large holders of farm land (Osuji *et al*., 2017). The Table further revealed that almost half (45.3%) of the respondents had farming experience range between 1-5 years, followed by 6-10 years (36.6%). The mean farming experience was 8 years. Farmers with more years of experience may have a better understanding of climate risks and adaptation strategies, potentially influencing their level of awareness. Experience is expected to improve farmers' production activities and have positive effects on their welfare and food security level (Aromolaran *et al*., 2017).

Table 3: Distribution of Respondents according to Age, Household size, Farm Size and Farming years (n = 172)

Variable	Frequency	Percentage	Mean
Age (years)			
18 – 27	33	19.2	
28 – 36	81	47.1	
37 – 45	39	22.7	34
46 – 54	17	9.9	
55 and above	2	1.2	
Household size (number)			
1 – 3	55	32.0	
4 – 6	61	35.5	6
7 – 9	25	14.5	
10 – 12	19	11.0	
13 and above	12	7.0	
Farm size (ha)			
0.5 – 1	58	33.7	
1.5 – 2	29	16.9	2
2.5 – 3	32	18.6	
3.5 – 4	20	11.6	
4.5 and above	33	19.2	
Farming experience (years)			
1 – 5	78	45.3	
6 – 10	63	36.6	
11 – 15	4	2.3	8
16 – 20	15	8.7	
21 and above	12	7.0	

Source: Field Survey, 2023

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Respondents' Access to Extension and Frequency of Extension Visit

Table 4 depicts the distribution of respondents according to their access to extension services and the frequency of extension visits. Majority (66.3%) of respondents reported having access to extension services, while 33.7% did not have access. This finding reveal that a significant portion of farmers in the study area have access to information and support services that could potentially enhance their awareness of flood disaster adaptation strategies. Among those who had access to extension services, the frequency of visits varied. A notable proportion of respondents reported weekly (17.5%) or fortnightly (20.2%) visits, indicating regular contact with extension agents. However, a considerable number reported less frequent visits, with 21.9% monthly, 14.9% quarterly, 16.7% semi-annually, and 8.8% annually. Regular access to extension services can positively impact farmers' awareness and adoption of flood disaster adaptation strategies by providing them with up-to-date information, training, and support. Farmers who have access to extension services are more likely to be aware of effective adaptation strategies and how to implement them. The frequency of extension visits is crucial, as more frequent visits allow for continuous learning and reinforcement of knowledge. Farmers who receive weekly or fortnightly visits may have better awareness and understanding of adaptation strategies compared to those who receive visits less frequently.

Table 4: Distribution of Respondents according to Access to Extension and Frequency of Extension Visit (n = 172)

Variable	Frequency	Percentage
Access to extension		
Yes	114	66.3
No	58	33.7
Frequency of extension visit (n= 114)		
Weekly	20	17.5
Fortnightly	23	20.2
Monthly	25	21.9
Quarterly	17	14.9
Semi-annually	19	16.7
Annually	10	8.8

Source: Field Survey, 2023

Adaptation Strategies used Toward Mitigating the Effect Flood Disaster

The result from Table 5 further revealed the adaptation strategies adopted by the respondents to mitigate the effects of flood disasters. Crop diversification was the most (84.9%) adopted strategy, Crop diversification can help farmers reduce the risk of total crop loss in the event of a flood, as different crops may have varying levels of tolerance to excess water. Ploughing Across Contour Terracing was adopted by 65.7% of the respondents. This strategy helps minimize runoff and soil erosion, reducing the impact of floods on farmland. Other adaptation strategies adopted by the respondents in the study area were conventional Flood Disaster (55.8%), Early Flood Warning System (54.7%), Deep Ploughing/Ridges (51.2%) while few (29.1%) of the respondents adopted the use of Insurance cover. Ozor *et al.* (2015) reported a similar finding that farmers often diversify their farm enterprise to caution the effect of flood disaster The result also agreed with Iheke and Agodike (2016) that farmers use sand bags as construction of barriers against run-off due to flooding.

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Table 5: Distribution of Respondents according to Adaptation Strategies Adopted

Strategies	Frequency	Percentage*
Crop diversification	146	84.9
Ploughing across contour terracing to minimize run off	113	65.7
Construction of new drainages	82	47.7
Use of terraces	56	32.6
Deep ploughing/Ridges	88	51.2
Early flood warning system	94	54.7
Conventional Flood disaster Sign	96	55.8
Afforestation	62	36.0
Migration	96	55.8
Insurance	50	29.1

Source: Field Survey, 2023 * Multiple response

Level of Awareness of the Respondents on Flood Disaster Adaptation Strategy

Table 6 provides insights into the level and sources of awareness among respondents regarding flood disaster adaptation strategies. The Table revealed a high awareness (32.0%) indicating that a significant proportion of respondents have good understanding of flood disaster adaptation strategies. These individuals could be likely to be more proactive in implementing measures to mitigate the impact of floods. Almost half (44.2%) had moderate level of awareness while about 23.8% of the respondents had low awareness and represents respondents with limited knowledge of flood disaster adaptation strategies.

The table also showed that most (92.4%) sourced information from personal observation indicating that most respondents rely on their own observations and experiences to learn about flood disaster adaptation strategies. Most (98.8% and 87.2%) of the respondents sourced their information from radio/television and extension agent respectively. Extension agents play a crucial role in disseminating information and providing guidance to farmers. The widespread use of radio and television as sources of awareness highlights the importance of mass media in reaching broad audience.

Table 6: Distribution of Respondents based on level and sources of awareness on Flood Disaster Adaptation Strategy (n = 172)

Category of awareness	Frequency	Percentage
High	55	32.0
Medium	76	44.2
Low	41	23.8
Sources of awareness		
Personal observation	159	92.4
NEMA	19	11.0
NIMET	21	12.2
Extension agent	150	87.2
Radio/Television	170	98.8

Source: Field Survey, 2023

Factors Influencing the Level of Awareness on Adaptation Strategies

Table 7 revealed the factors influencing the level of awareness of adaptation strategies of the respondents. The F-statistic is 3.504, indicating that the overall regression model is statistically significant. The R-squared value is 0.194, indicating that the model explains 19.4% of the variance in awareness. The adjusted R-squared value is 0.139, suggesting that the model may be slightly overfitting. The result pointed out that, the coefficient of farming experience is -0.035, indicating that a unit increase in farming experience decreases the likelihood of awareness by 3.5% and it is statistically significant ($P < 0.05$), educational level is positive and significant ($P < 0.05$), implying that a unit increase in

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educational level increases the likelihood of awareness by a factor (0.153). The annual income is also positive and significant (P <0.001) indicating that a unit increase in income, increases the likelihood of awareness by a factor (1.813). The results suggest that educational level and annual income are significant predictors of awareness of adaptation strategies, while farming experience is negatively associated with awareness. Other socio-economic characteristics, such as sex, age, household size, farm size, access to credit, access to extension, experience in flood disaster, and income from off-farm activities, have minimal or non-significant effects on awareness. This result validates the findings of Bazezew *et al*. (2013) who reported that farmers adopt flood disaster adaptation strategies based on their experience in farming activities.

Table 7: Factors Influencing Level of Awareness on Adaptation Strategies

Coefficient	**B**	**Std. Error**	**T**	**Sig.**
(Constant)	1.852	0.561	3.298	0.001***
Sex	-0.268	0.175	-1.536	0.127
Age	0.001	0.011	0.063	0.950
Household size	0.044	0.025	1.744	0.083*
Farm size	-0.007	0.038	-.172	0.864
Farming experience	-0.035	0.014	-2.571	0.011**
Educational level	0.153	0.067	2.277	0.024**
Access to credit	-0.204	0.159	-1.279	0.203
Annual income	1.813E-007	0.000	3.593	0.000***
Access to extension	0-.062	0.149	-0.419	0.676
experience in flood disaster	-0.030	0.161	-0.186	0.852
Income from off farm (₦)	3.902E-007	0.000	1.144	0.254
F–statistics =3.504* **				
R^2= 0.194				
Adjusted R^2= 0.139				

***= significant at 1%, **= significant at 5% and *= significant at 10%
Source: Field Survey, 2023

CONCLUSION AND RECOMMENDATIONS

The study concluded that most of the respondents were young, married and literate farmers. Farm size, farming experience, educational level and income significantly influenced the respondents level of awareness on flood disaster adaptation strategies.

Based on the finding of the study, the following recommendations were made,

i. Farmers should be encouraged to participate in agricultural extension services which will educate them on the effects of climate change and adaptation strategies such as insurance cover.
ii. Extension agents should assist in raising awareness on early signs of flood disaster;
iii. There should be adequate provision of weather forecast records and climate related data in addition to a timely revision and adequate monitoring of adaptation/mitigation strategies across the various categories are imperative to assess their effectiveness.

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