Analysis of Small-scale Maize Farmers Climate Change Adaptation Strategies in North Central Nigeria

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Abstract- ***This study is focused on small-scale maize farmers climate change adaptation strategies in north central Nigeria. A total of four hundred and twenty-four (424) respondents were randomly selected for the study. Primary data were collected using a well-structured questionnaire and were analyzed using correlation, percentages and mean. The findings of the study show that many (37.3%) of the maize farmers were aged about 36 years. Males were 89.2% and 57.5% were married with secondary education (30.2%) as their highest qualification. The result also indicates that maize farmers have been coping through adaptation strategies such as: multiple cropping (3.15), early planting (3.05), improved varieties (3.02). In conclusion, small scale maize farmers in the study area use inorganic fertilizers, early planting of maize, planting of improved varieties of maize seed, use of loans, grants and subsidies as a climate change adaptation strategy. They do not use organic manure, irrigation and water storage and conservation, planting of trees, late planting of maize, early harvesting, use of pesticides, herbicides, prompt and multiple weeding as a climate change adaptation strategy. The study recommendations include: the practice of underground water storage for irrigation purpose especially during the period when the rainfall volume will be low and the need to sensitize farmers on climate change adaptation strategies for better yield.***

Indexed Terms- ***Small-scale, Maize, Farmers, Climate change, Adaptation, Strategies***

I. INTRODUCTION

Adaptation is a method by which people make themselves better able to cope with an uncertain future (Aderinoye-Abdulwahab, and Abdulbak, 2021). Adapting to climate change will therefore entail the application of efficient actions to lessen the adverse effects of climate change (or exploit the positive ones) by making the necessary modifications in order not to greatly feel the negative impact. Emerging countries, such as Nigeria, typically perceives industrialized countries as climes with reduced vulnerability and better adaptation strategies given that such regions are better able to realize the prospects in cold weather episodes and hence make calculated moves to strengthen their agricultural production (Achike and Onoja 2014).

Recent study offered that farmers in Africa use crop diversification to build resilience in the agriculture sector (Mango *et al*. 2018), although this method may not be a favorable means among certain other farmers. However, adaptation, regardless of whatever form it takes, is already considered a major and important integral part of any future climate change regime. Some of the known technologies in use for climate change variability and impacts include: crop diversification, the adoption of drought-tolerant and early-maturing varieties of crops, and planting of cover crops (Federal Ministry of Environment 2014). Studies have shown that farmers in Nigeria are being supported by government and other nongovernmental organizations to better adapt to climate change using these, as well as other methods to deal with climate change impact (Ifeanyi-obi and Nnadi 2014). In addition, relevant weather-related information and skills training that can enhance productivity can be offered by agricultural extension services (Akintonde and Shuaib 2016). Although the current irregularity of extension services in Nigeria is a limitation to the adaptation strategies (Akintonde and Shuaib 2016).

Other adaptation strategies used by farmers in SSA, according to Aderinoye-Abdulwahab, and Abdulbak (2021) including Nigeria are: early planting of crops, a condition where crops would have enjoyed some reasonable amount of rain before it ceases. Improved

variety is another adaptation strategy in use in order to cope with climate change impact. Farmers now plant improved varieties that have high resistance to pest and diseases, requires low water, matures quickly, and with many more qualities (Aderinoye-Abdulwahab, and Abdulbak, 2021).

Crop rotation is also one of the strategies used by the farmers to assuage the impact of climate change. Farmers in SSA including Nigeria do not restrict themselves to sowing a mono-crop. They use grains and/or legumes to rotate across seasons. A farmer might plant corn along with other tuber crops such as cassava in one season, and then proceed to corn and cowpea in another season (Aderinoye-Abdulwahab, and Abdulbak, 2021). There are times when farmers are able to predict what the next planting season would look like given their experiences from previous climate variation patterns and based on local climatic indicators, although their predictions may not always work as projected (Aderinoye-Abdulwahab, and Abdulbak, 2021). At some other times, farmers may rely on weather forecasts from relevant government agencies to determine what the forthcoming growing season would look like and adequately prepare for the crops that would thrive better in such weathers (Aderinoye-Abdulwahab, and Abdulbak, 2021).

Crop diversification is another adaptation strategy. For example, farmers have changed the crops grown on previously cultivated lands from a particular cereal crop to another due to climatic changes. Land that was previously being farmed for rice production because of abundance of water have now been converted to cultivation of maize and sorghum after such lands have lost their water content due to enduring droughts (Achike and Onoja 2014). Irrigation and drainage activities were also adaptive measures that farmers in Nigeria usually put into consideration during planting operations in order to secure water for plants during dearth periods (Aderinoye-Abdulwahab, and Abdulbak, 2021).

Cultivation of more agricultural areas is also an adaptation strategy. By this, it was observed that farmers chose not to wait until harvest period before they will discover heavy crop losses and/or damages; hence they became proactive by cultivating large expanse of lands to increase their productivity (Aderinoye-Abdulwahab, and Abdulbak, 2021). Livelihood diversification is also one strategy being used by cereal farmers in the focus site. Some farmers who feel they could no longer cope with the climate change impacts have decided to change the means/source of livelihood.

This study is focused on small-scale maize farmers climate change adaptation strategies in north central Nigeria.

II. METHODOLOGY

This research employed public opinion design which made use of well-structured questionnaire for data collection. This study was carried out in North Central Nigeria. It lies between latitude $4^0$30N and $11^0$20N of the equator and longitude3^0E and 14^0E of the Greenwich Meridian (FAO, 2004). The area has a land mass of about 296,898 Km^2 and a population of 221, 566, 993 million people (NPC, 2006). The population density is estimated at 76 per cent per Km^2 with the rural population constituting about 76 percent of the population in the zone. The major ethnic groups are the Gwari, Tiv, Idoma, Igbira, Angas, Buruba, Bargana, as well as Bassa and Birom.

The population of the study consists of all Maize farmers in North Central Nigeria. A total of four hundred and twenty four (424) respondents were selected as sample size using multistage sampling procedure, involving simple random selection technique. The first stage was a random selection of three states out of the six states in North Central Nigeria. The second stage involved a random selection of two agroclimatic zones out of the three zones in each of the states (the three states have three agroclimatic zones each) giving a total of 6 agroclimatic zones. The third stage involved a random selection of one Local Government Areas from each agroclimatic zone in the state giving a total of 6 Local Government Areas and the fourth stage was a random selection of 3 communities from each of the Local Government Areas giving a total of 18 communities. This was followed by a selection of 0.5 percent of the total population provided by the ADPs in the states of the respective communities giving a total of four hundred and twenty four (424) respondents for the study.

Data were collected from primary source using structured questionnaire. The questionnaire was divided into two sections (A and B). Section A focused on the socioeconomic characteristics of respondents and section B focused on farmers' adaptation strategies to climate change.

The research instruments were validated by passing it through the lecturers in the College of Agricultural Economics and Extension, Federal University of Agriculture Makurdi to ensure that it possessed both face and content validity. Test and retest method was used to ensure reliability of the research instrument. In this method, the research instrument was administered twice to the same group of ten (10) respondents for an interval of two weeks. The data obtain were correlated to confirm the reliability (table 1) of the research instrument. A correlation coefficient (rho) of 0.7 and above was an indication that the instrument was reliable. Data collected were analyzed using descriptive such as percentages and mean.

Table1: Reliability Test Result of Questionnaire

Variables	Test re-test	No. of Item	Mean	Standard Deviation	RXX
Socioeconomic Characteristics	1st	7	14.41	5.12	0.69
	2nd	7	14.52	5.41	
Adaptation Strategies	1st	12	16.01	6.01	0.73
	2nd	12	16.21	6.23	

Small-scale maize farmers' adaption strategies to climate change was measured using a five point Likert-type scale. Respondents were asked to indicate their adaptation strategies to climate change on a five point Likert-type scale of strongly agree (5), agree (4), strongly disagree (3), disagree (2) and undecided (1). The 5 Likert-type scale was summated to obtain mean score of (3.0) as cut-off point. The point for acceptance or rejection of mean score was therefore set at 3.0. Any mean score less than 3.0 was rejected and scores equal to and above 3.0 was accepted.

III. RESULTS AND DISCUSSIONS

The result of data analyzed is as presented below.

Table 2: Socioeconomic characteristics of the respondents (N = 424)

Variable	Frequency (424)	Percentage	Mean	Minimum	Maximum
Age (years)					
20-30	156	36.8			
31-40	158	37.3	36.8	20	67
41-50	60	14.2			
51-60	26	6.1			
61-70	24	5.7			
Sex					
Female	46	10.8			
Male	378	89.2			
Marital Status					
Married	244	57.5			
Single	156	36.8			
Widowed	24	5.7			
Educational Level					
No Formal Education	90	21.2			
Primary School	106	25			
Secondary School	128	30.2			
Tertiary School	100	23.6			
Maize Farmin					

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Experience (year)					
<10	32	7.5			
11-20	168	39.6			
21-30	150	35.4	28.5	6	57
>30	46	10.8			
Farming System					
Subsistence	419	98.8			
Commercial	5	1.2			
Method of Land Acquisition					
Inheritance	331	78.1			
Purchase	53	12.5			
Rent	34	8.0			
Others	6	1.4			

Data in Table 2 indicated that greater (37.3%) percentages of the respondents were aged between 31-40 years, 36.8% were aged 20-30 years. 14.2% were between 41-50 years. 6.1% were aged 51-60 years and 5.7% were aged 61-70 years. The result on socioeconomic characteristics of the respondents in the study area implies that most of the maize farmers were in their youthful and productive age range of 31-40 years. This could be as a result of the unavailability of white collar job opportunities in the country. This finding agrees with Musa, Muhammed and Ado (2020) who reported average age of farmers to be 34.6 years.

Table 2 results on respondent's socioeconomic characteristics indicated that most (89.2%) were males and 10.8% were females. 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.

Results in Table 2 indicated that majority (57.5%) of the respondents were married compared to 36.8% who were single and 5.7% who were widowed. This indicated the importance attached to marriage institution in the study area which showed that most of the respondents who are married have greater responsibility which may encourage them to be more committed towards their farming activities. This finding is similar to the findings of Mbam and Nwibo (2013) and Oghenekohwo (2014) who reported that 64.2% and 67.9% percent of the respondents respectively were married.

Entries in Table 2 indicated that 30.2% of the respondents had secondary education, 25% had primary school education, 23.6% of the respondents had tertiary education training and 21.2% had no formal education. This implies that about 78.8% of the respondents had formal education. This result is similar to that of Ukoku (2012) who reported that 97.2% of the respondents had formal education and Okereke-Ejiogu *et al* (2015) who reported that 97.2% of the respondents had formal education. The acquisition of formal education was expected to better empower farmers to embark on commercial farming.

Table 2 results indicated that most (39.6%) of the respondents had maize farming experience between 11-20 years. 35.4% had maize farming experience between 21-30 years. 10.8% had maize farming experience greater than 30 years and 7.5% had maize farming experience less than 10 years. Hassan and Nhemachena (2008) reported that maize farmers experience of between 21-30 years significantly affects farm management and decision making.

Entries in Table 2 indicated that greater (98.8%) percent of the respondents are subsistence farmers against 1.2% of the respondents who are commercial farmers. This result when compared to the result of 78.8% level of education of respondents is worrisome, especially coupled with 78.1% land inheritance ownership of small scale farmers in the study area. This may call for further investigation on the challenges of maize farmers in the study area.

Table 2 further indicated that 78.1% of the respondents had land acquisition by inheritance, 12.5% had land acquisition by purchase, 8.8% had land acquisition by

rent and 1.4% had land acquisition by other means not mentioned. The high percentage of respondents acquiring land by inheritance may also imply that they are indigene or have lived in the area for long period of time. The result on socio-economic characteristics of the respondents in the study area is as shown in Table 2 below.

Table 3: Distribution of adaptation strategies used by respondents in the study area (N = 424)

Adaptation Strategies	Sum	Mean	Decision
Use of Organic manure	861	2.03	Disagree
Use of inorganic fertilizers	1,208	3.00	Agree
Early planting	1,293	3.05	Agree
Use of improved varieties	1,280	3.02	Agree
Use of irrigation and water storage and conservation	441	1.04	Disagree
Planting of trees	428	1.01	Disagree
Late planting	377	0.89	Disagree
Early harvesting of crops	861	2.03	Disagree
Multiple Cropping	1,336	3.15	Agree
Use of pesticides, herbicides and insecticides	1,217	2.87	Disagree
Prompt and multiple weeding	852	2.01	Disagree
Use of loans, grants and subsidies	1,238	3.00	Agree

Cut-off mean: 3.0

The adaptation strategies used by respondents in the study area are presented in Table 3. The result indicated that small scale farmers in the study area disagree (2.03) with the use of organic manure as a climate change adaptation strategy. The results indicated that small scale farmers use inorganic fertilizers (3.00) as adaptation strategy to climate change in maize farming. Climate change adaptation strategies results in Table 3 indicated that small scale farmers adopt (3.05) early planting of maize as a copying strategy to climate change.

Table 3 results on climate change adaptation strategies of small scale farmers indicated that the farmers also plant improved varieties of maize to cope with climate change in the study area. The result in Table 3 indicated that small scale farmer in the study area disagree with the use of irrigation and water storage and conservation (1.04), planting of trees (1.01), late planting of maize (0.89), early harvesting (2.03), use of pesticides, herbicides (2.87) and prompt and multiple weeding (2.01) as climate change adaptation strategies for maize farming. Table 3 results on climate change adaptation strategies used by small scale farmers in the study area indicated that use of loans, grants and subsidies was used as adaptation strategy in the study area.

Table 3 result on small scale farmers climate change adaptation strategies used include use of organic manure, use of inorganic manure, early planting, use of improved varieties, use of irrigation and water storage and conservation, planting of trees, late planting. Others include early harvesting of crops, multiple cropping, use of pesticides, herbicides and insecticides, prompt and multiple weeding and use of loans, grants and subsidies. Of these adaptation strategies, use of organic manure (3.00), early planting (3.05), use of improved varieties (3.02), multiple cropping (3.15), and use of loans, grants and subsidies (3.00) were agreed as adaptation strategies used by the respondents in the study area. Multiple cropping (3.15), early planting (3.05), improved varieties (3.02) ranked first, second and third, respectively. Mustapha, Salau and Galadima (2013) report that adaptation strategies used in central state Nigeria included agroforestry practices, crop diversification, early maturing and disease/drought resistant varieties.

IV. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

The study concluded that most of the respondents were in their youthful and productive age. Most of the respondents were males and were married. Educationally, most of the respondents had secondary education and had maize farming experience between eleven and twenty years. Greater percent of the respondents are subsistence farmers having land acquisition by inheritance.

Small scale farmers in the study area use inorganic fertilizers, early planting of maize, planting of improved varieties of maize seed, use of loans, grants and subsidies as a climate change adaptation strategy. They do not use organic manure, irrigation and water storage and conservation, planting of trees, late planting of maize, early harvesting, use of pesticides, herbicides, prompt and multiple weeding as a climate change adaptation strategy.

4.2 Recommendation

Based on the findings of this study, the following recommendations were made:

i. Since, most of the farmers are youthful and productive, males, married, educated and experienced, and own their land by inheritance, efforts should be made by Government through extension agents to encourage the farmers to go into commercial farming rather than subsistence farming.
ii. Small scale farmers in north central Nigeria needs to be sensitized on the use of organic manure, irrigation and water storage and conservation, planting of trees, late planting of maize, early harvesting, use of pesticides, herbicides, prompt and multiple weeding as a climate change adaptation strategy.

- Contributions to Knowledge

The study established that farmers in North central Nigeria should be sensitized on the use of organic manure (2.03), irrigation and water storage and conservation (1.04), planting of trees (1.01), late planting (0.89) of maize, early harvesting (2.03), use of pesticides, herbicides (2.87), prompt and multiple weeding (2.01) as a climate change adaptation strategy.

- Suggestion for Further Study

This research was conducted in three out of the seven states in North Central Nigeria. It is suggested that, a similar study be conducted in other states.

There is the need for further study on why small scale farmers in north central Nigeria with the advantage of youthful and productive males, married with land inheritance ownership, farming experience still practice subsistence farming.

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