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Climate change adaptation practices of smallholder arable crop farmers in Kwara State, Nigeria

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Abstract Findings of the study indicated that majority of the respondents had formal education with average of 7 years of farming experience. The leading impacts of climate change were poor farm planning ($\bar{x}$=4.79), loss of farm crops ($\bar{x}$=4.82) and food insecurity ($\bar{x}$=4.80). The main adaptation measures used by farmers include organic agriculture ($\bar{x}$=3.59), afforestation ($\bar{x}$=3.52) and crop rotation ($\bar{x}$=3.53). Severe problems that hindered effective usage of adaptation practices of the farmers were inadequate extension visit ($\bar{x}$=4.85), insufficient government interventions ($\bar{x}$=4.71) and inadequate access to inputs needed for adaptation ($\bar{x}$=4.69). Pearson correlation analysis indicated that increase years of formal education significantly leads to increase use of adaptation practices among farmers. In conclusion, this study found that crop rotation, afforestation and organic agriculture practices were the main adaptation practices used by the smallscale farmers. Consequently, more agricultural extension officers should be recruited to provide adequate dissemination of smart practices to adapt the effects change in climate on arable crops among farmers.

Keywords: Climate change, Adaptation practices, Farm plaining, Extension visit

Introduction

Nigeria, like other developing countries in the world, has a predominantly agricultural economy. Higher population of the people living in the rural communities were engaged in farming at smallscale, which means they farm fewer than 10 hectares (Komolafe *et al*., 2022). The farmers reside in rural areas and grow mostly arable crops includind sorghum, cowpea, millet, rice, maize, etc. Farming problems encountered by the farmers include poor access to farm inputs, inadequate extension services, inadequate access to farm loan, irregular intervention programmes for farmers, poor funding for agricultural research as well as the adverse impacts of climate change (Hamidu, 2021).Greenhouse gases released into the atmosphere have had a significant impact on the frequency of

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rainfall, the amount of sunlight, and the temperature needed for crops to grow (Adeagbo *et al*., 2021).

Climate change is the alteration of climate patterns. The only cause of the change in the climate is the emission of greenhouse gases (GHGs) that trap heat and contribute to global warming. Human activities and natural systems are the main contributors to greenhouse gas escape into the atmosphere. Wetlands, earthquakes, forest seas and permafrost are examples of natural events, while man-made GHG emissions include land use changes, industrial processes and the process of energy production (Yue and Gao, 2018). Change in the climate negatively influence development in the agricultural sector by changing the average amount of rainfall, the amount of sunlight and temperature required for efficient cultivation of arable crops. Furthermore, change in climate has fluntuate the level of ground-level ozone, carbon dioxide in the atmosphere, and the nutritional content of foods (Macdiarmid and Whybrow, 2019).

Adaptation and mitigation measures against greenhouse gas emissions have been taken by people all over the world in order to mitigate the effects of climate change. People around the world have adopted adaptation and mitigation measures against greenhouse gas emissions in order to address the adverse effects of climate change on most human needs.

Mitigation refers to actions to reduce and reduce emissions of greenhouse gases, while adaptation refers to measures to reduce vulnerability to threats that may result from changes in climate. In recent years, many measures have been implemented by Nigerian farmers in the agricultural sector to mitigate the effects of climate change. In the Southern and Western regions of Nigeria, a number of authors have listed a number of native and climate smart adaptation strategies that farmers use when growing arable crops. Some of these practices include drought tolerant seed planting, fadama irrigation system, afforestation, and organic practices such as manure application, timely crop harvesting planting date adjustment, mulching and fallowing (Adeagbo, Ojo and Adetoro, 2021; Oyelere *et al.,* 2020). Unfortunately, the implementation of climate mitigation measures has been put at risk due to lack of technical know-how, high illiteracy of farmers, insufficient funding, poor understanding of weather forecast and low awareness of climate change impacts among farmers (Hamidu, 2021).

The topic of climate change has been discussed for a long time, and there is no denying that it is having a negative impact on agricultural development in Kwara State, particularly in the crop production sector. The majority of farmers in Nigeria are smallholders with limited financial resources and limited capacity to implement costly agricultural practices. Extreme weather events (climate change) like strong floods, winds, heavy rains, and thunderstorms pose serious risks to crop production, animals and people. The effects of changes in climate

are typically marked by a decrease in the number of crops grown on land, an increase in disease and pest infestations (Bolarin, Adebayo and Komolafe, 2022).

However, there are a few adaptation strategies that are more cost-effective and less stressful. These strategies should be implemented by small-scale arable crop growers while some of these mitigation strategies have already been implemented by farmers, empirical research is required to understand the major climate adaptation strategies implemented by farmers cultivating arable crops to mitigate climate change in Kwara State.

The main objetive was to examine climate change adaptation practices among smallscale arable crop farmers in Kwara State. The specifically investigation was evaluated the effects of climate change on arable crops, examined the adaptation practices employed against the effects of climate change in cultivating arable crops, and determined the problems faced by farmers in using the adaptation practices in Kwara State. Null hypothesis (H0) assessed the relationship between the socio-economic characteristics and adaptation practices measures applied against climate change effects of arable crops of farmers.

Materials and methods

Study area

Kwara state is the location of the study. Kwara State is positioned between parallels 8Â° and 10Â° north latitudes and 3Â° and 6Â° east longitudes. Kwara State consists of sixteen Local Government Areas (LGAs) namely: Moro, Asa, Ifelodun, Irepodun, Pategi, Ekiti, Baruten, Kaiama, Ilorin South, Oke-Ero, Ilorin East, Ilorin West, Isin, Edu, Oyun, and Offa.

Sampling size and sampling produce

Population of the study consists of all arable crop farmers in Moro LGA. Multistage sampling procedure was employed to choose sample size for the stusy. The first stage entailed a random selection of two districts. The selected districts were Gaa-Alamu and Malete. Secondly, random selection was performed to select 15 farming villages per districts selected. Thirdly, a random selection was performed to select 4 arable crop farmers in each selected village. In all, the study selected a total sample size of 120 respondents.

Data collection and analysis

A structured questionnaire was used to collect primary data. Data collected were analysed and presented using percentage, frequency, mean and standard deviation. Hypothesis of the study was tested by Pearson Moment Correlation (PPMC) statistical tool. Perceived effects of climate change was measured using the scale and scored as 5-Strongly agree, 4-agree, 3-undecided, 2-disagree, 1-strongly disagree. Adaptation practices against the effects of climate change was measured using the scale scored as 4-always used, 3-sometimes used, 2-rarely used, 1-never used. Problems to use of adaptation practices was measured as 5=highly severe, 4-severe, 3-undecided, 2-not severe, 1-not a constraints.

Results

Socio-economic characteristics of respondents

Presentation of result in Table 1 shows that majority (78.3%) of the respondents were males and the average age of the farmers was 43 years. Most (75.0%) of the respondents were married and the average household size was 5 people. Regarding education, majority of the respondents had formal education with at least secondary education (60.0%) while the remaining few had primary education (15.0%), tertiary education (9.2%) and arabic education (13.3%). The respondents also had long (14 years) of experience in the cultivation of arable crops.

Table 1. Socio economic characteristics of respondents (n=120)

Variables	Frequency	Percent	Mean
Age			43 years
Household size			5 people
Farming experience			7 years
Sex:			
Female	26	21.7	
Male	94	78.3	
Marital status:			
Married	90	75.0	
Unmarried	30	25.0	
Education:			
Tertiary	11	9.2	
Secondary	72	60.0	
Primary	18	15.0	
Arabic	16	13.3	
No formal	3	2.5	

Source: Field survey, 2021

Perceived effects of climate change on arable crop farmers

Information on the effects of climate change on arable crops as presented in Table 2 shows that the leading effects was brought about loss of crops ($\bar{x}$=4.82) which ranked first. Adverse effects of climate change causing food insecurity ($\bar{x}$=4.80) was ranked second position. Inability of the farmers to effectively make future plan ($\bar{x}$=4.79) was ranked third position. The practice of crop diversification ($\bar{x}$=4.00) was revealed as the effect of climate change indicated by respondents.

Table 2. Effect of climate change on arable crop farming

Statements on effects	Mean	Standard Deviation	Rank
It reduces profit	4.69	0.562	4th
It reduces crop yield	4.25	1.343	7th
It hinders the farmers to plan ahead	4.79	0.517	3rd
Increases rural-urban migration	4.17	1.056	8th
It reduces efficiency	4.68	0.521	5th
It brings about loss to the farmers	4.82	0.389	1st
It discourages the farmers from planting	4.62	0.568	6th
It causes food insecurity	4.80	0.402	2nd
It brings about livelihood diversification	4.00	1.177	9th

Source: Field Survey (2021)

Adaptation practices use by farmers

Findings on adaptation practices employed against the effects of climate change were presented in Table 3. The leading practice use was organic agricultural practices ($\bar{x}$=3.59) which ranked first position. Adapatation practice that ranked second position in use was crop rotation ($\bar{x}$=3.53). Another practice on afforestation/reforestation ($\bar{x}$=3.52) was ranked third position and the use of weed management practice ($\bar{x}$=3.45) was ranked fourth position. The least practices used were the use of improved seeds ($\bar{x}$=3.09) and shifting cultivation ($\bar{x}$=2.97).

Challenges to use of climate change adaptation practices

The results presented in Table 4 indicate that the leading problem militating against the adoption of adaptation practices by farmers is associated with inadequate extension visit ($\bar{x}$=4.85). The second problem based on indication of severity was inadequate agricultural intervention programmes initiated by government ($\bar{x}$=4.71). The third on the list of problems was inadequate access to production inputs ($\bar{x}$=4.69) while and inadequate access to fund ($\bar{x}$=4.62) was

ranked fourth position. The least problems indicated by arable crop farmers were inadequated access to climate related information ($\bar{x}$=3.71) and long time implementation of some adaptation practices ($\bar{x}$=3.69) which were ranked tenth position as the least challenge facing smallscale arable crop farmers.

Table 3. Use of climate change adaptation practices

Climate change adaptation practices	Mean	Standard Deviation	Rank
Altering of planting date	3.31	0.893	7th
Crop rotation	3.53	0.774	2nd
Shifting cultivation	2.97	1.000	12th
Weed management	3.45	0.873	4th
Use of improved seed varieties	3.09	0.923	11th
Water management	3.27	1.016	9th
Cultivation of improved crops	3.34	0.792	6th
Afforestation and reforestation	3.52	0.797	3rd
Alley cropping	3.29	0.739	8th
Organic farming	3.59	0.571	1st
Planting of cover crops	3.40	0.887	5th
Nutrient management	3.13	1.092	10th

Source: Field survey (2021)

Table 4. Challenges to use of climate change adaptation practices

Challenges	Mean	Standard Deviation	Rank
Inadequate extension visit	4.85	0.633	1st
Inadequate awareness of farmers on climate change variability	3.89	1.067	8th
Inadequate awareness of farmers on climate change adaptation practices	4.54	1.090	5th
Inadequate intervention programmes by government	4.71	0.640	2nd
Poor access to formal credits	4.62	0.611	4th
Inadequate required production inputs (e.g land, seeds, fertilizer etc)	4.69	0.562	3rd
Time consuming practices	3.69	0.814	10th
Irregular visit of extension agents	4.25	1.063	7th
Poor access to information on climate change	3.71	1.402	9th
Insufficient land	4.54	0.815	5th

Source: Field survey (2021)

Hypothesis of the study

Results indicated by PPMC analysis as presented in Table 5 reveal that there is significant relationship exist between educational level and the use of climate change adaptation practices by arable crop farmers (r= 0.01<0.05). This indicates that additional years of schooling will lead to increase in the use of adaptation measures to manage the effects of changes in weather on arable crops.

Table 5. PPMC analysis showing the significant influence of education on the adoption of climate change adaptation practices among farmers

		Educational status	Adaptation practices
Educational status	Correlation (Pearson)	1	0.316**
	Probability		0.001
	N	120	106
Adaptation practices	Correlation (Pearson)	0.316**	1
	Probability	0.001	
	N	106	106

**Significant at p<0.01level

Discussion

According to findings of this study, the average age suggests that the arable crop farmers at the time of this study were young and within the working age. This is in line with the findings of Olaniyan and Govender (2023), which found that smallscale farmers in the study area tend to be relatively young and prone to high levels of stress in crop production. The literacy level of farmers could also have a progressive effect on farmers' adoption and implementation of the climate smart innovation strategies implemented by extension agents. This observation is in line with the findings of the report by Aderinoye-Abdulwahab and Abdulbaki (2021) who found that individual farmers with educational background are most likely to be early adopters of innovation. Findings of this study further show that most of the arable farmers in Kwara State had long years of farming arable crops. This attribute must have equipped the farmers with appreciable knowledge about the effects and adaptation practices against the detrimental effects of weather variability on arable crop production.

One of the biggest impacts of climate change on the agriculture of arable crops was the loss of crops to farmers. Crop loss may be attributed to retarded growth and damages caused by adverse impacts of climate change which consequently lead to loss of crops. The next effect of change in climate in crop production found in this study was that it caused food insecurity. Crop production is essential for maintaining food security throughout the year, so a slight shift in climate can lead to a decrease in arable crop production, ultimately leading to food shortage in Nigeria. The third way that global warming affects crop cultivation is by making it more difficult for farmers to make long-term plans. This may be attributed to farmers' fear of sudden changes in weather conditions that could cause severe damage to their crops, so they are hesitant to plan ahead. Crop diversification is the least impact of climate change. The average score is also high at 4.00 on the 5-point scale used by Likert, but this is the least significant effect of climate change on crop production. Another impact of

climate change is a decrease in profits and productivity. It also discourages farmers from crop production, lower crop yields, and encourages rural-urban out-migration. This is in line with Bolarin et al. (2022) findings that climate change causes farmers to lose income, food insecurity and discourage them from farming.

Organic farming was the most prominent form of mitigation, which suggests that the application of organic materials was the primary form of adaptation practiced by farmers. The use of improved varieties and the practice of shifting cultivation are two of the least-used mitigation practices. This means that extension agents must work more closely with arable cop farmers to enhance seed varieties that can be a very effective way to mitigate climate change impacts. Other adaptation measures are the cultivation of improved crop varieties, alley cropping, changing of plant date, planted cover crops, management of nutrient and water. This observation is in line with Kaye and Quemada (2017), who argued that organic agriculture and cover crop planting are mitigation strategies for climate change.

The biggest issue preventing farmers from using mitigation methods is the inadequate extension visit to farmers. The report found that more needs to be done by extension agents to educate farmers growing arable crops about adaptation practices. Most farmers did not use the improved seed varieties. The second constraint according to their severity is poorly supported by the government. The low level of government support means that the government should increase its support for arable crop growers, particularly in the main area involved in feeding the nation. Additional key constraints were inadequate access to farm credit and production inputs while shortage of access to climate information and excessive time taken to perform some climate change adaptation practices were the least to hinder the farmers. Other constraints faced by the farmers were inadequate access to farmland and knowledge on climate change. This confirms the findings of the report by Solomon and Edet (2018), which found that poor extension contact, and a lack of government attention were the core problems faced by farmers cultivating crops following the usage of adaptaion practices aimed to reduce the impacts of change in the climate. Direct and positive significant relationship exists between education status and climate change mitigation measures among farmers growing crops. This suggests that an additional year of formal schooling would lead to an increase the use adaptation meansures againsts climate change effects in the study area.

The study demonstrated that crop loss in Kwara State, Nigeria, was a result of climate change's impact on crop cultivation. Farmers mostly use radio and neighbors to obtain information about climate change in order to control its impacts. The study also found that the biggest obstacle preventing farmers from

growing arable crops that require climate change adaptation practices is a lack of extension contact. Therefore, more extension agents are needed in Kwara State to demonstrate climate change adaptation practices in the field for farmers to learn. To lessen the consequences of climate changes, a government-funded project is needed to provide access to agricultural inputs like cutting-edge seed types. Kwara State farmers need to be made more knowledgeable of adaption strategies against the threat of changes in the climate.

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