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SOCIO-ECONOMIC DETERMINANTS OF ARABLE CROP FARMERS' ADAPTATION TO CLIMATE CHANGE IN EDO STATE, NIGERIA

J. Ahmadu[1] and S.U. Ewansiha[2]

[1]Department of Agricultural Economics and Extension Services, Faculty of Agriculture, University of Benin, Benin City, Nigeria.

[2]Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City, Nigeria.

[1]Corresponding author

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ABSTRACT

This study examined the socio-economic determinants of arable crop farmers' adaptation to climate change in Edo State, Nigeria. Primary data for the study were collected using structured questionnaire administered to 192 respondents randomly sampled from the study area. Data analysis was done using descriptive statistics, multiple regression and information from Likert-type scale. Results of the study showed that the climate change adaptation practices highly employed by the farmers include mixed cropping, inter-cropping, adjusting the timing of land preparations in accordance with weather variations, adjusting the planting dates, crop rotation, application of inorganic fertilizer, processing of farm produce to reduce post-harvest losses, changing the quantity of fertilizer used and changing the quantity of herbicides/pesticides used. Extension contact and farm size of the farmers were found to be the significant ($P<0.01$) determinants of the farmers' adaptation to climate change. Serious constraints faced by the farmers in adapting to climate change include inadequate finance, inadequate information on climate change, lack of support from government and other institutions, and inadequate infrastructural facilities. The farmers would employ more practices to adapt to climate change if they are empowered through education, training and provision of timely and accessible credit.

Keywords: Determinants, Arable Crop, Adaptation, Climate Change, Nigeria

1.0 INTRODUCTION

Climate change is presenting unprecedented challenges for the developing world especially the Africa countries, including Nigeria, in terms of meeting its sustainable development objectives. Climate change refers to the variation in the global or regional average or typical weather conditions observed over a long period of time. According to Intergovernmental Panel on Climate Change (1), climate change is a statistically significant variation in the climate that persists for decade or longer, caused by human (anthropogenic) and non-human (natural) activities. The natural processes (biogeographical) include astronomical factors (changes in the eccentricity of the earth orbit, obliquity of the plane of ecliptic and orbital procession) and extra-terrestrial factors (solar radiation quantity and quality). The anthropogenic factors are human activities that either emit large amount of greenhouse gases into the atmosphere that depletes the ozone layer or activities that reduce the amount of carbons absorbed from the atmosphere (2). The human activities that emit large amount of greenhouse gases include burning of fossil fuels, gas flaring, urbanization (emissions from cars, trucks, ships and domestic heating) and agricultural activities such as bush burning. In addition, land clearing has reduced the ability of the earth to absorb excess carbon dioxide (CO_2) from the atmosphere as there is less plant life to assist in natural regulation. These activities have led to a large increase in concentration of greenhouse gases in the atmosphere.

The human factors have been proven to be responsible for the ongoing climate change popularly referred to as global warming – the warming that results when the atmosphere traps heat radiating from the earth towards space (2, 3).

Indeed, the effect of climate change is already evidenced in the eroding of decades of hard-won national and international development gains in the developing countries. This challenge has further aggravated poverty in Africa as rising temperature and sea level result in undue flooding, droughts and salinization in low lying areas such as the deltas in the southern region of Nigeria. Findings revealed that the sectors of the economy that are most likely to be affected by climate change in Africa, including Nigeria are agriculture, water and biodiversity. These sectors are considered as the most critical because they have direct effect on rural livelihood (4). Incidentally, agriculture is the mainstay of the economies of many Africa countries, including Nigeria and arable crop in particular is the major source of staple food for the populace, income for majority of the smallholder farmers and feeds for livestock.

The threat posed by climate change on arable crop production in particular and agriculture in general requires urgent attention to avert unbearable catastrophic consequences in the near future. Concerted efforts to address the challenge of climate change have been to increase adaptation to the climate change as well as mitigate against it. Adaptation is the process of

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responding or adjusting to actual and potential impacts of changing climate conditions in ways that moderate harm or take advantage of any positive opportunities that it may afford. It essentially aims at reducing the damages from climate change that cannot be avoided. Mitigation, on the other hand, deals with the measures employed to reduce the rate and magnitude of climate change. Adaptation remains the most popular option to manage the impacts of climate change on agriculture in the world today (4).

There is, therefore, the need to strengthen the adaptive capacity of arable crop farmers to climate change by improving the socio-economic factors that influence the adaptation. This can only be possible when the socio-economic factors are known. A search through the literature revealed that there is no comprehensive and adequate information as regards the socio-economic determinants of arable crop farmers' adaptation to climate change, especially in Edo State of Nigeria. Although a number of studies on the subject have been carried out (4, 5, 6, 7, 8, 9, 10, 11, 12), most of them either do not focus on arable crops or do not have wide scope in terms of the adaptation practices and socio-economic variables covered. Thus, this study is expected to throw more light on the socio-economic determinants of arable crop farmers' adaptation to climate change.

The specific objectives of the study are to describe the socio-economic characteristics of the arable crop farmers in Edo State, Nigeria; examine the perceived effect of climate change on arable crop production in the study area; examine the climate change adaptation practices employed by arable crop farmers; examine the socio-economic factors influencing arable crop farmers' adaptation to climate change; and identify the constraints to the farmers' adaptation to climate change in the study area.

2.0 METHODOLOGY

2.1 Study Area

The study was carried out in Edo State of Nigeria. Edo State which is situated between latitude $4^0\ 44^'$ and $7^0\ 34^'$ N and longitude 5^0 and $6^0\ 45^'$ E occupies land area of 19,794 km^2 and has the population of 4,116,863 people (13). The State which comprises 18 Local Government Areas (LGAs) is divided into three agricultural zones as delineated by Edo State Agricultural Development Project, ADP (Edo North, Edo Central and Edo South). It has equatorial climate. Rainfall is the key climatic variable, and there is a marked alternation of wet and dry seasons. The wet season is from April to October while the dry season is between November and March. The rainfall and relative humidity are substantial, being high in the South and decline Northwards. Temperature is also high. There is varied vegetation cover across the State, ranging from forest zone in the South to Derived Savanna in the North.

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The major occupation of the inhabitants of the State is agriculture, with majority of the work force being smallholder farmers. Some of the major arable crops produced in the State include maize, rice, cassava, yam and cocoyam while tree crops include cocoa, oil palm and rubber. Livestock production including cattle, sheep, goats, pigs and other small ruminants are also carried out in the area. Fishing and aquaculture are also practiced in the State. The study area is also rich in crude oil deposits, resulting in some level of oil exploration activities.

2.2 Sampling Procedure and Data Collection

A multi-stage sampling procedure was employed to select respondents for the study. First, a random sampling technique was employed to select two LGAs from each of the three agricultural zones of the State. Second, a random sampling technique was also applied to select four communities from each LGA. This summed up to 24 communities. The third and last stage of this procedure involved a random selection of 8 arable crop farmers from each village giving rise to a total sample size of 192 respondents. The rationale for the application of random sampling technique at all stages of the sampling procedure is to give every element of the population a chance of being represented. The primary dataused for the study were collected using a structured questionnaire administered to the respondents. This was complemented with personal interview. There was a 100% response rate for the 192 copies of the questionnaire administered. This is because, enumerators personally administered the questionnaire and ensured proper monitoring of the process.

2.3 Measurement of Variables

i. Awareness of climate change was measured using the responses, Aware = 1 and Not aware = 0
ii. **Perceived effect of climate change on farmers' production:**A 5-point likert scale ofVery serious = 5, Serious = 4, Undecided = 3, Not serious = 2 and Not very serious = 1 was used. These gave a bench mark of 3.0 on which decision was based.
iii. **Climate Change Adaptation Practices Employed by Arable Crop Farmers:** A 3-point likert-type scale was employed for this measurement with the following rating:Very high = 3, High = 2, and Low = 1. Mean score ≥ 2.0 was considered to be high.
iv. **Constraintsto adaptation:** These were measured using 5-point likert scale of Very serious = 5, Serious = 4, Undecided = 3, Not serious = 2, Not very serious = 1. A mean score of 3.0 and above indicated serious constraint.

2.4 Data Analysis

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Data analysis was done using both descriptive statistics and quantitative technique. The descriptive statistics used were means, frequency counts and percentages while the quantitative technique involved the use of Ordinary Least Squared (OLS) multiple regression model.

2.4.1 Multiple Regression Model

The multiple regression of the OLS was employed to examine the socio-economic determinants of the farmers' adaptation to climate change. The model is implicitly given as:

$X = f(Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8, Z_9, Z_{10}, Z_{11}, U_i)$ …………….. (1)

Where:

X = Number of climate change adaptation practices employed

Z_1 =Age of respondents (in years)

Z_2 = Sex of farmers (male = 1, female = 0)

Z_3 = Marital status of respondents (married = 1, otherwise = 0)

Z_4 = Household size (number of persons)

Z_5 = Farmers' level of educational (years)

Z_6 = Occupation of farmers (farming = 1, otherwise = 0)

Z_7 = Farming experience (years)

Z_8 = Income of farmers (in naira)

Z_9 = Extension contact (number of times)

Z_{10} = Awareness of climate change (aware = 1, not aware = 0)

Z_{11} = Farm size of respondents (ha)

U_i = Random error term

The choice of the variables, Z_1 - Z_{11} in the regression model was guided by literature (10, 11, 12) that these variables could influence farmers' adaptation to climate change. The regression model was fitted using three functional forms including: Linear, Semi-log and Double-log functions in line with Olayemi (14). The best function (Semi-log) was selected based on the criteria for the selection of the lead equation given by Koutsoyiannis (15).

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3.0 RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Arable Crop Farmers

Table 1 shows the socio-economic characteristics of arable crop farmers in Edo State. The socio-economic characteristics under consideration include sex, age, marital status, household size, level of education, farming experience, occupation and income level of the farmers.

On sex, the results showed that 74% of the respondents were males while 26% were females. This indicates that arable crop production in Edo State was dominated by males, confirming the findings of Alufohai and Ahmadu (16) who reported dominance of males in arable crop production in Edo State. The ageof the respondents ranged from 25-68 years with the highest number of respondents (60%) within age group 40-54 years. The mean age was 48 years. This shows that the population of people involved in arable crop farming in the study area is aging. The average age of arable crop farmers in Edo State in 2012 as reported by Egbodion and Ahmadu (17) is 42 years, confirming that the population of the arable crop farmers in the study area is aging. This shows a negative prospect for the development of agriculture in the State in particular and the country at large.

The distribution of the farmers according to their marital status indicated that most (87.50%) of them were married while the single, widow/widower and divorced/separated were few. Married people are saddled with the responsibility of catering for their families, hence their high involvement in arable crop production. The number of persons per family of the respondents ranged from 1-16. The range of 1-5 persons per family had the greatest number of respondents, accounting for 82.81% of the total sample. The average household size was 8 persons. Large household size of the farmers might negatively affect their farm production except there is high contribution from family labour to their farming activities (18).

The educational level of the respondents which was divided into five categories include: no formal education, primary education, secondary education, NCE/OND and B.Sc/HND. About 88.02% of the respondents were literate and a higher proportion of those educated was at the secondary school level, accounting for about 44.79% of the sample. Level of literacy is very vital in enhancing the managerial ability of the farmers in their production. The higher the level of education of farmers, the higher their ability to efficiently manage their farms, leading to increased productivity, *ceteris paribus* (19). On farming experience, highest proportion (43.23%) of the respondents was in category14-23 years, followed by 24-33 years with 30.21% of the respondents. The average years of farming experience was about 21 years. It is expected that the farmers would have mastery of their production operations given their high level of farming experience.

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The major occupation of the respondents was farming (63.02%). Those engaged in civil service, trading, teaching (private) and artisan were few. Having farming as the major occupation would enable the farmers to pay attention to their production operations and adapt to practices that would reduce the adverse effect of climate change on their production so as to increase their crop productivity, all things being equal. The farmers' annual income ranged from ₦80,000.00 - ₦5,000,000.00 with majority (74.48%) of them having the annual income of between ₦80,000.00 and ₦2,079,999. Their average annual income was estimated at ₦1,532,786.00. Finance is required in the employment of some climate change adaptation practices. Income, thus, plays a vital role of enabling the farmers to employ those adaptation practices. This means that the higher the income of a farmer, the higher his/her ability to adapt the practices.

Table 1: Socio-economic Characteristics of Arable Crop Farmers in Edo State

Variable	Frequency (192)	Percentage (100%)
Sex		
Male	143	74.48
Female	49	25.52
Age (years)		
25-39	26	13.54
40-54	116	60.42
55-69	50	26.04
Minimum	25	
Maximum	68	
Mean	48	
Marital status		
Single	5	2.60
Married	168	87.50
Widow/Widower	18	9.38
Divorced/separated	1	0.52
Household size (no of persons)		
1-5	159	82.81
6-10	27	14.06
11-15	5	2.60
16-20	1	0.52
Minimum	1	
Maximum	16	
Mean	8	
Level of education		

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No formal education	23	11.98
Primary education	18	9.37
Secondary education	86	44.79
NCE/OND	32	16.67
B.Sc/HND	33	17.19
Farming experience (years}		
4-13	38	19.79
14-23	83	43.23
24-33	58	30.21
34-43	13	6.77
Minimum	4	
Maximum	40	
Mean	20.90	
Major occupation		
Farming	121	63.02
Trading	21	10.94
Civil Service	23	11.98
Teaching (private)	12	6.25
Artisan	15	7.81
Annual income*		
80,000-1,079,999	83	43.23
1,080,000-2,079,999	60	31.25
2,080,000-3,079,999	41	21.36
3,080,000-4,079,999	5	2.60
4,080,000-5,079,999	3	1.56
Minimum	80,000.00	
Maximum	5,000,000.00	
Mean	1,532,786.00	

Source: Field data, 2022

*Income from both arable crop production and other sources

3.2 Type of Arable Crop grown, Farm Size and Source of Finance of Arable Crop Farmers

The major arable crops cultivated by the farmers in the study area were cassava, maize, yam and rice, accounting for 96.88%, 68.75%, 52.08% and 20.31% of the respondents respectively. This implies that these are the main staple food crops produced by the farmers in the study area to cater for their family food need, besides the surplus for market. Minor crops grown, in descending order of importance, were cocoyam, pepper, leafy vegetables, sesame, tomatoes,

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water melon and groundnut (Table 2).Both the major and minor crops cultivated by the farmers are similar to those reported by Alufohai *et al.* (20) exception is in the order of their importance and few other minor crops such as sweet potatoes, okra, garden egg and cowpea they reported which are not grown by farmers in this study.

The farm size of the arable crop farmers in the study area is also presented in Table 2. This is the total farm size for the different major arable crops cultivated in different holdings by the farmers. As shown in the table, majority (91.15%) of the respondents had farm size between the range of0.1 and 10 hectares. This was followed by the farm size range of 10.1 - 20 hectares which accounted for 7.81% of the respondents. The maximum farm size was 32ha and only two respondents (1.04%) had farm size greater than 20ha. The average farm size was 5.53ha, indicating that the respondents were small-scale farmers. Given that the average farm size of 5.53ha was for the four major arable crops (cassava, maize, yam and rice) cultivated by the farmers, it means each crop covered an average of 1.38ha. This compares favourably with the farm size of 1.87ha, 1.4ha, 1.83ha and 2.38ha reported for cassava, maize, yam and rice by Ahmadu and Owati (9), Ahmadu and Edeoghon (18), Ariyo *et al*. (21) and Egbodion and Ahmadu (22) respectively.

The sources of finance available to the respondents were personal savings and credit. While personal savings accounted for the highest proportion of the sampled farmers (98.44%), credit accounted for only 27.08% of them, corroborating the finding of Alufohai and Ahmadu (16) who found that personal savings ranked top among the sources of finance to arable crop farmers in Edo and Delta States, accounting for 61.87% of the respondents. According to Ahmadu and Edeoghon (18), personal savings of small-scale farmers is inadequate in financing their production. Institutional loans are very vital to provide the required capacity for the acquisition of inputs, especially improved inputs, to increase production.

Table 2: Arable Crop Production Information

Variable	Frequency (192)	Percentage (100%)
Type of arable crop grown*		
Cassava	186	96.88
Maize	132	68.75
Yam	100	52.08
Rice	39	20.31
Cocoyam	12	6.25
Pepper	11	5.73
Leafy vegetable	10	5.21
Sesame	5	2.60

Tomato	3	1.56
Water melon	2	1.04
Groundnut	1	0.52
Farm size		
0.1-10	175	91.15
10.1-20	15	7.81
20.1-30	1	0.52
30.1-40	1	0.52
Minimum	0.11	
Maximum	32	
Mean	5.53	
Source of finance*		
Personal savings	189	98.44
Credit	52	27.08

Source: Field data, 2022

*Multiple responses

3.3 Awareness of Climate Change

Awareness of climate change by farmers is very vital as it increases their enthusiasm and stimulate them for mobilization and action towards the employment of adaptation of practices to combat climate change effects on their production. No farmer can employ climate change adaptation practices if he or she is not aware of climate change. Table 3 shows that about 96% of the respondents were aware of climate change which could have effect on their production. Only few (4%) of them were not aware. This implies that the farmers were in a position to act towards combating the effect of climate change on their production. This result agrees with the finding of Balogun *et al*. (23) who reported that 97% of the respondents were aware of climate change.

Table 3: Awareness of Climate Change by Arable Crop Farmers in Edo State

Category	Frequency	Percentage
Aware	184	95.83
Not aware	8	4.17
Total	192	100

Source: Field data, 2022

3.4 Perceived Effect of Climate Change on Arable Crop Production

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There are numerous effects of climate change on arable crop production in the study area as perceived by the respondents (Table 4). All the perceived effects of the climate change under consideration were ranked to be serious with their mean scores greater than the bench mark (3.0). The most serious of these effects in decreasing order of seriousness were increased flood (mean = 4.484), increased soil erosion (mean = 4.453), increased temperature (mean = 4.359), increased weed problem (mean = 4.333), increased pests/diseases infestation (mean = 4.208), declining crop yields (mean = 4.193), decreased soil fertility (mean = 4.099), and increased vulnerability of crops to pests/diseases attacks (mean = 4.052), among others. In the study by Balogun *et al.* (23), some of the effects of climate change reported by majority of the respondents include increasing temperature (74.8%), increased erosion (70.5%), increased flooding (55.8%) and quick spoilage of agricultural produce (79.3%). These effects hamper adequate arable crop production, thus, widening the already existing demand-supply food gap in the study area.

Table 4: Perceived effect of climate change on arable crop production in Edo State

Effect	Mean
Increased flood	4.484
Increased soil erosion	4.453
Increased temperature	4.359
Increased weed problem	4.333
Increased pests/diseases infestation	4.208
Declining crop yields	4.193
Decreased soil fertility	4.099
Increased vulnerability of crops to pests/diseases attacks	4.052
Unequal distribution of rainfall	3.995
Wilting of crops	3.927
Poor soil drainage	3.896
Increased post-harvest losses	3.875
Poor quality of crop yields	3.823
Crop failure	3.531
Reduction of water level in fadama areas	3.312
Reduced farm size	3.182
Poor soil aeration	3.135
Frequent and prolonged drought	3.114
Increased wind storm which destroys crops	3.068
Decrease in soil moisture	3.047

Source: Computed from field data, 2022

Mean ≥ 3.0 is considered serious.

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3.5 Climate Change Adaptation Practices Employed by Arable Crop Farmers

Table 5 shows the climate change adaptation practices employed by arable crop farmers in Edo State. A mean score greater than zero means that at least a farmer employed such a practice while the higher the mean value, the higher the extent of its application, with the mean score ≥ 2.0 considered to be high. According to the results, all the adaptation practices under consideration were employed by at least a farmer as indicated by all the mean scores that are greater than zero. Of out the 28 adaptation practices considered, only nine were highly employed by the farmers. These include mixed cropping (mean = 3.141), inter-cropping (mean = 2.630), adjusting the timing of land preparations in accordance with weather variations (mean = 2.479), adjusting the planting dates (mean = 2.166), crop rotation (mean = 2.161) and application of inorganic fertilizer (2.161). Others are processing of farm produce to reduce post-harvest losses (mean = 2.333), changing the quantity of fertilizer used (mean = 2.250) and changing the quantity of herbicides/pesticides used (mean = 2.245).

The extent of application of all other adaptation practices employed was low because majority of them were expensive to adopt given the poor financial base of the small-scale arable crop farmers; majority of them had no access to credit but financed their production from personal savings (Table 2). Besides, they required some level of technical know-how for application. This corroborates the finding of Ogbonna *et al*. (11) where irrigation was cited as an example of how most farmers did not adopt it as climate variability adaptation measure due to high cost and inadequate access to the irrigation facilities.

Table 5: Climate Change Adaptation Practices Employed by Arable Crop Farmers in Edo State

S/N	Adaptation practice	Mean
1	Mixed farming	0.359
2	Mixed cropping	3.141*
3	Inter-cropping	2.630*
4	Crop rotation	2.161*
5	Contour cropping	0.094
6	Relay cropping	0.057
7	Use of cover crops	0.180
8	Mulching	1.745
9	Adjusting the timing of land preparations in accordance with weather variations	2.479*
10	Adjusting the planting dates	2.166*
11	Changing plant spacing	0.177

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12	Altering harvesting dates	0.401
13	Changing planting depth	0.099
14	Changing fallow length	0.068
15	Use of irrigation schemes	0.026
16	Construction of drainage systems	0.026
17	Construction of ponds	0.026
18	Ground water harvesting	0.026
19	Controlled flooding	0.484
20	Use of improved crop varieties	1.188
21	Using organic fertilizer	0.474
22	Application of inorganic fertilizer	2.161*
23	Increasing farm size under cultivation	1.240
24	Processing of farm produce to reduce post-harvest losses	2.333*
25	Changing crops	0.094
26	Changing crop varieties	0.505
27	Changing the quantity of fertilizer used	2.250*
28	Changing the quantity of herbicides/pesticides used	2.245*

Source: Computed from field data, 2022

*Mean ≥ 2.0 is considered to be high.

3.6 Socioeconomic Determinants of Arable Crop Farmers' Adaptation to Climate Change

Table 6 shows the results of the three (3) functional forms of regression model (Linear, Semi-log and Double-log functions) fitted to examine the relationship between socioeconomic factors and arable crop farmers' adaptation to climate change. The dependent variable for this relationship was the number of adaptation practices employed by the arable crop farmers while the socioeconomic factors which are the explanatory variables were age of the respondents, sex, marital status, household size, educational level, occupation, farming experience, income level, extension contact, awareness of climate change, and farm size of the farmers. Based on the criteria for the selection of the function with the best fit given by Koutsoyiannis (15),Semi-log function was selected. Thus, further discussion is based on the Semi-log function.

The adjusted R^2 of the Semi-log function indicated that about 36.8% of the variation in the number of adaptation practices employed by the farmers was significantly influenced by the variation in the explanatory variables under consideration. Of all the explanatory variables, only extension contact and farm size of the farmers were significant ($P<0.01$), indicating that they were the determinants of the farmers' adaptation to climate change. They were both positively

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signed, implying that their increase led to employment of more adaptation practices by the respondents.

Increase in the number of extension contact increased the number of adaptation practices the farmers employed because of the enlightenment the farmers received from the extension agents on climate change and how to combat its effect on their production. This supports the findings of Nicholas and Nnaji (24) where farmers identified numerous roles of extension in cushioning the effects of climate change on their production to be effective. Some of these roles include: dissemination of innovations on best practices and building resilience capacities of vulnerable farmers in climate risk management, use of demonstration methods in teaching farmers the measures used to mitigate or adapt to the effects of climate change, setting up of emergency management units by extension agencies that will attend to victims of climate risks, organizing seminars, workshops, and field days to sensitize farmers and the public on climate risk management, use of farmer-to-farmer extension strategy to promote awareness and adoption of best practices in climate risk management, formation of Young Farmers Club in schools to educate and encourage young farmers in learning about climate change issues with a view to reducing human causes and improving adaptation options, and use of farmer field schools to promote faster learning by farmers on the measures used to mitigate and adapt to the effects of climate change. The higher the farm size, the higher the number of adaptation practices employed. This was expected because farmers with high farm size are more commercially oriented and tend to adopt technology that increase productivity faster than their counterparts with low farm size whose production is mainly for subsistence. This agrees with Chete (25) and Olagunju (12) who reported significant correlation between farm size and farmers' adaptation techniques, noting that large farm sizes provides farmers with room to implement more adaption techniques.

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Table 6: Socio-economic Determinants of Arable Crop Farmers' Adaptation to Climate Change in Edo State

	Linear			Semi-log			Double-log		
Variable	**Coefficient**	**t-ratio**	**Sig.**	**Coefficient**	**t-ratio**	**Sig.**	**Coefficient**	**t-ratio**	**Sig.**
(Constant)	6.968	1.318	0.189	0.538	1.124	0.263	0.331	0.672	0.503
Age of respondents	-0.161	-1.416	0.158	-0.092	-1.393	0.165	-0.038	-0.393	0.695
Sex of farmers	-0.069	-0.777	0.438	0.037	0.519	0.605	0.021	0.248	0.804
Marital status of respondents	-0.029	-0.388	0.698						
Household size	-0.065	-0.744	0.458	-0.079	-1.181	0.239	0.105	1.226	0.222
Farmers' level of educational	-0.023	-0.277	0.782	-0.005	-0.082	0.935	0.009	0.123	0.902
Occupation of farmers	0.007	0.094	0.925	0.054	0.862	0.390	-0.020	-0.252	0.802
Farming experience	0.101	0.920	0.359	0.036	0.506	0.613	0.082	0.903	0.367
Income of farmers	0.036	0.412	0.681	0.002	0.032	0.975	-0.082	-1.022	0.308
Extension contact	0.153**	1.971	0.050	0.212***	3.259	0.001	-0.068	-0.884	0.378
Awareness of climate change	-0.064	-0.874	0.383	-0.027	-0.451	0.653	0.145*	1.930	0.055
Farm size of respondents (ha)	0.190**	2.011	0.046	0.525***	7.205	0.000	-0.132*	-1.736	0.084
	R Square = 0.114			R Square = 0.401			R Square = 0.055		
	Adjusted R Square = 0.059			Adjusted R Square = 0.368			Adjusted R Square = 0.002		

Source: Computed from field data, 2022

***Significant at 1%, **Significant at 5%, *Significant at 10%

Best fit function: Semi-log

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3.7 Constraints Militating against Arable Crop Farmers' Adaptation to Climate Change

The respondents were confronted with many constraints that militated against their adaptation to climate change (Table 7). These include financial constraint, inadequate information on climate change, lack of support from government, lack of support from Non-Governmental Organizations (NGOs), private organizations and financial institutions, and inadequate infrastructural facilities. With the exception of poor health condition to work, all the constraints experienced were rated to be serious.

Thus, for arable crop farmers to make more significant progress in their adaptation to climate change, these constraints must be combated. This means that the farmers need to be empowered through more sensitization on climate change and its effect on crop production and training on wide range of adaptation practices to employ, as well as through timely and accessible credit to break their financial limitation to adapt to climate change. Studies have shown that to achieve these, it has to be the collective effort of all the three tiers of government in the country (Federal, State, and Local Government), financial institutions, as well as private and Non-Governmental Organizations, playing their various roles to create awareness on climate change and its effects on agriculture, provide training, credits and infrastructural facilities to the farmers, and send more extension officers to the field to disseminate more information on climate change adaptation strategies to the farmers (12). Ultimately, the farmers would be empowered with knowledge and facilities to effectively employ the required adaptation measures to cushion the effects of climate change on their production.

Table 7: Constraints Militating against Arable Crop Farmers' Adaptation to Climate Change in Edo State

Constraint	Mean
Inadequate finance	4.578
Inadequate information on climate change	3.568
Lack of support from Government	4.781
Lack of support from NGOs, private organizations and financial institutions	4.671
Poor health condition to work	2.765
Inadequate infrastructural facilities	4.557

Source: Computed from field data, 2022

Mean $\geq$ 3.0 is considered serious.

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4.0 CONCLUSION

The study has established that climate change had enormous negative effects on arable crop production in Edo State. The most serious of these effects in decreasing order of seriousness were increased flood, increased soil erosion, increased temperature, increased weed problem, increased pests/diseases infestation, declining crop yields, decreased soil fertility, and increased vulnerability of crops to pests/diseases attacks. Consequently, farmers employed many adaptation practices to combat the effect of the climate change. Practices highly employed by the farmers were mixed cropping, inter-cropping, adjusting the timing of land preparations in accordance with weather variations, adjusting the planting dates, crop rotation, application of inorganic fertilizer, processing of farm produce to reduce post-harvest losses, and changing the quantity of fertilizer and herbicides/pesticides used. Extension contact and farm size of the farmers were found to be the significant determinants of the farmers' adaptation to climate change while serious constraints that militated against the farmers' ability to employ climate change adaptation practices include inadequate finance, inadequate information on climate change, lack of support from government and other institutions, and inadequate infrastructural facilities.

Thus, if the arable crop farmers are empowered through education on climate change and its effect on crop production and training on wide range of adaptation practices to employ, as well as through timely and accessible credit to break their financial limitation to adapt to climate change, they would perform more significantly in combating the effect of climate change on their production by adaptation.

5.0 RECOMMENDATIONS

Based on the findings of the study, it is hereby recommended that the government, both at the Federal, State and Local levels should partner with financial institutions, and private and non-governmental organizations to raise funds mainly for the purpose of organizing campaign and capacity building workshop for arable crop farmers to intensify sensitization on climate change and its effect on crop production and training them on wide range of adaptation practices to employ. Also, Bank of Agriculture and Microfinance Banks should provide timely and accessible credit to arable crop farmers to empower them and break their financial limitation to adapt to climate change.

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