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Climate Change Adaptation Strategies among Cassava-based Farmers in Akwa Ibom State, Nigeria.

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ABSTRACT

This study analyzed Climate Change Adaptation Strategies and their Barriers among Cassava-based farmers in Akwa Ibom State, Nigeria. Specifically, the study identified the respondents' perceived effect of climate change; examined the prevalent climate change adaptation strategies and identified the barriers militating against these strategies. Data were obtained from three hundred and forty six (346) cassava farmers selected through a multi-stage random sampling technique with a structured questionnaire and personal interviews, while secondary data were sourced from journals and text books. Descriptive statistics such as frequency means, percentages, means and ranking with Likert measuring scale and Principal Component Analysis (PCA) were employed in analyzing the data. Results showed that the respondents' perceived effect of weather changes on cassava were, increase in pest and disease outbreaks ($\bar{\chi}$=2.69); flooding of the farms ($\bar{\chi}$=2.61); loss of cassava plants ($\bar{\chi}$=2.42); decline in crop yield ($\bar{\chi}$=2.37) among others. The adaptation strategies identified were; application of farm yard manure (0.779), plant cover crops (0.752), minimum tillage operations (0.762), lengthened fallow periods (0.672) and use of zero tillage (0.785), among others. The barriers militating against adaptation were inadequate knowledge on how to build resilience on climate change (0.755), poor access to improved cassava varieties (0.757), poor yield (0.792) and intense weed growth due to minimum tillage (0.786) and lack of access to weather forecast technologies(0.770) among others. It was recommended that the determining factors of adaptation and barriers should be inputted into climate change related policies and projects/programmes, necessary logistics and workshops for extension workers on climate change issues and flexible terms of agricultural credit should be made accessible to farmers, also policies which incorporate institutional, infrastructural support system and metrological information/training to create more awareness on the impact of climate delivery be developed and actually implemented.

Keywords: Adaptation, climate change, cassava farmers, barriers.

Introduction: Cassava (*Manihot esculenta*), after rice and maize, is the third-most significant source of calories in Africa's tropical and subtropical regions. It is commonly grown in several Sub-Saharan African nations. Currently, half of the cassava consumed worldwide is produced in Africa (FAO, 2020). Over 90% of Nigeria's rural families routinely consume cassava. Cassava production in Nigeria has been under the threat of climate change-related events influencing agriculture. Changing climate predisposes rain-fed agriculture to danger since it depends on favourable climate conditions to be productive (Lenis, Liverpool-Tasie, Holly, Justice, Tambo, and Olubukola, 2020). In Nigeria, climate change has disrupted cassava yields, outputs and quality, causing food shortages and reduced supply. Reduced cassava productivity, for instance, is typically caused by changes in extreme weather events, such as temperature increase, change in precipitation pattern, change in relative humidity, windstorm, etc (Kemi and Olusegun, 2020). Presently, negative seasonal variations and changes brought on by climate change pose a threat to cassava output. Cassava production is being impacted by climate change on a global, regional, and local scale (FAO, 2022).

Climate change and weather variability are a challenge to agricultural production and management resources because they increase risks and uncertainties. Climatic fluctuations are putting Nigeria's agricultural system under serious threat and stress. This implies that rural sustenance and food security in Nigeria is under serious threat as crop production takes significant aspects of agricultural activities in Nigeria (Ayinde and Ibrahim, 2017). The income and profitability of farmers are impacted by the rapid deterioration of the cassava tubers on the farmland and after harvest (Ekundayo, Olutumise and Akinrinola, 2021).

Responding to climate change through mitigation will take time and even with reduction in greenhouse gases emission, global temperatures are expected to increase and sea level will continue to rise. Hence, development and use of adaptation strategies to deal with these effects are regarded as a necessary complement to mitigating actions (IPCC, 2010). Adaptation to climate change refers to adjustments in natural or human systems in response to actual or expected climate stimuli or their effects which moderate harm or exploits beneficial opportunities. Adaptation is a necessary and fundamental element of climate change policy (IPCC, 2010). Adaptation strategies are vital components in response to climate change because it helps farmers achieve their food, income and livelihood objectives in the face of the changing climatic conditions and extreme weather conditions (Chigavezira, 2012). It has been determined that with adaptation strategies to climate change, economic losses and vulnerability could be reduced (IPCC, 2010). Many countries are already making appreciable efforts to adapt to climate change but unfortunately a lot of constraints have and are still militating against these efforts. As reported by Mendelsohn *et al.* (2006) and IPCC (2007) "failure to address the issue of climate change may lead to a situation where Nigeria and other West African countries incur agricultural losses of up to 4% of GDP mainly due to climate change and parts of the country that experience soil erosion and operate rain-fed agriculture could have decline in agricultural yield of up to 50 % within 2000-2020 due to increasing impact of climate change". The importance of climate change adaptation strategies to agriculture and to the people of Nigeria and her economy at large cannot be over emphasized. Agriculture is the single largest contributor to the wellbeing of the rural poor in Nigeria, sustaining about 86% of rural households in the country and a major source of domestic food consumed (Food & Agricultural Organization, 2020).

Despite advances in agricultural technology, cassava production remains uncertain and average crop yield is still low (Henry and Westby, 2001). Most studies on climate change and agriculture in Nigeria and Africa in general have tended to concentrate on actual and projected impacts as well as farmers' coping/adaptation strategies (Adejuwon, 2004; Apata, Ogunyinka, Sanusi, & Ogunwande, 2010; Ajetomobi and Abiodun, 2010). Also, Enete and Amusa (2010) examined the challenges of agricultural adaptation to climate change in Nigeria. In Akwa Ibom State, cassava is widely cultivated and consumed as a major staple crop. Despite this, there is paucity of information on challenges faced by these farmers in using the adaptation and mitigation strategies to boost their productivity. However, a few studies on cassava tend to concentrate on profitability and economic analysis; Ebukiba (2010); Ifeanyi-obi (2013) and Ajayi (2016)). It is on this basis, that the current study seeks to fill this gap.

Climate change poses a threat to the sustainability of food production among small-scale rural communities in Sub-Saharan Africa, Nigeria and Akwa Ibom State in particular, that are dependent on rain-fed agriculture. Thus, understanding farmers adaptation strategies and their barriers is crucial in designing realistic strategies and policies for agricultural development and food security, hence the study, Climate Change Adaptation Strategies and their Barriers among Cassava-based Farmers in Akwa Ibom State, Nigeria.

This study is guided by the following objectives; To identify the farmers' perceived effects of weather changes on cassava production in the study area; To examine the prevailing climate change adaptation strategies used in the study area.To determine the barriers militating against the use of the climate change adaptation strategies in the study area.

Methodology Study area: Akwa Ibom State is the study area and one of the thirty-six states of the federation of Nigeria. It has its administrative capital at Uyo and located at latitudes 4^0 32' and 5^0 32' North and Longitudes 7^0 25' and $8^0$25' East of the equator. It is bordered by Rivers State in the West, Abia and Imo States in the North, Cross River State in the East and the Atlantic Ocean in the South. The state has thirty-one Local Government Areas (LGAs). These LGAs are further classified into 6 Agricultural Zones (Uyo, Ikot Ekpene, Abak, Etinan, Eket, and Oron zones) as delineated Akwa Ibom State Agricultural Development Programme.

It covers an area of 8,412 square kilometers with a population of 3.9 million based on the national census figure of 2006 and an average population density of 350 inhabitants per square kilometer. It has 3 distinguishable vegetation; saline, fresh and rain forest. It has a mean annual rainfall of 2200mm and 3500mm with sunshine of between 1400 to 1500 hours per year, and its average temperature ranges from 23^0C to 31^0C. The following crops are widely grown in the State: cassava, yam, cocoyam, maize, rice, cowpea, melon, oil palm, coconut, rubber, cocoa, raffia palm, gmelina, kolanut, plantain, banana, pineapple, pawpaw, mango and African pears. Vegetable crops include; leafy vegetable, okro, pepper and tomatoes. About 80 % of the work forces are into Agricultural production (Akwa Ibom State Year Book, 2011).

Sampling procedure and size: The study was carried out across the Six (6) Agricultural Zones of the State (Uyo, Ikot Ekpene, Abak, Etinan, Eket, and Oron zones) as delineated by Akwa Ibom State Agricultural Development Program. To ensure proportionate representativeness, even spread, effective data gathering and credibility in generalization of results from research findings, all the zones and the blocks were represented and a multi-stage sampling technique was adopted. In stage 1, fifty per cent (50%) of the total number of cells from each of the blocks were randomly selected across the zones (Kothari and Garg, 1986). In the second stage, the list of registered farmers in the cells was obtained and three respondents from each of the chosen cells in stage 1 were randomly chosen, making a total of 423 respondents across the state and were used as the sample size. At the end of the field work, 350 questionnaires were properly completed and returned, (Table 1).

Table 1: Sampled number of cells and respondents

Zone	Blocks	Total cells	Selected cells (50%)	Respondents/ cell	Total respondents /zone
Uyo	8	84	42	3	126
Ikot Ekpene	8	58	29	3	87
Abak	7	46	23	3	69
Etinan	4	40	20	3	60
Eket	7	36	18	3	54
Oron	4	24	12	3	36
Total					432

Method of Data Analysis: Descriptive statistics such as frequency, means, percentages, means and ranking with Likert measuring scale and Principal Component Analysis (PCA) were employed in analyzing the data.

Model Specification: Means and Ranking with Likert measuring scale. Objective 1, which was aimed at ascertaining the farmers' perceived effect of climate change was analyzed using a Likert measuring scale to rank the means. A 3 point likert scale specified as serious effect (SE) = 3, mild effect (ME) = 2 and no effect (NE) = 1, was applied. The likert scaling measuring instrument is represented by the formula;

$$X = \frac{\sum Fx}{N} \quad \text{(i)}$$

Where X is mean score, ∑ = summation sign, F = frequency. N = number of respondents, x = number of nominal value of each response category.

The assigned values on the three scale were added to obtain six (6), which was divided by three (3) to obtain a mean score of 2.0. Hence variables with mean score of 2.00 and above were regarded as major/ significant effects while a mean score of less than 2.0 were regarded as minor and of non-significant effects.

Principal Component Analysis (PCA): Objectives two (2) and three (3) which were aimed at examining and determining the prevalent climate change adaptation strategies and barriers militating against their adaptation were analyzed using PCA. PCA is a technique of removing relevant variables from a wide set of variables present in a data set. The principal components may now be utilized as criterion variables in further analyses. A principal component is a translational mix of peak-weighted identified variables. The general form of the principal component analysis is as contained in this equation.

$$C_1 = b_{11}(X_1) + b_{12}(X_2) + ... + b_{1n}(Xp) \quad \text{(ii)}$$
$$C_2 = b_{21}(X_1) + b_{22}(X_2) + ... + b_{2n}(Xp) \quad \text{(iii)}$$
$$C_3 = b_{31}(X_1) + b_{32}(X_2) + ... + b_{3n}(Xp) \quad \text{(iv)}$$
$$* = * + * + *$$
$$* = * + * + *$$
$$C_1 = b_{n1}(X_1) + b_{n2}(X_2) + ... + b_{nn}(Xp) \quad \text{(v)}$$

Where,

C_1 = subject's score on principal component 1 (the first component extracted)

b_{1p} = regression coefficient (or weight) for seen variable p

X_p = subject's score on observed variable p.

Its interpretation relies on finding which variables are most strongly related with each component. It needs to be determined at what extent the relationship is of significant. For the purpose of this study a correlation above 0.5 is deemed important.

Results and Discussion: Farmers' perceived effects of weather changes on cassava production

The result is presented in Table 2. The perceived effects of weather changes on cassava as reported by farmers were as follows; increase in pest and disease outbreak ($\bar{\chi}$=2.69) ; flooding of the farm ($\bar{\chi}$=2.61) , loss of cassava plant/planting materials ($\bar{\chi}$=2.42), decline in crop yield ($\bar{\chi}$=2.37), increased cost of production ($\bar{\chi}$=2.30), frequent weed infestation ($\bar{\chi}$=2.14), stunted growth ($\bar{\chi}$=2.12) , soil depletion/ leaching ($\bar{\chi}$=2.11), poor tuber formation ($\bar{\chi}$=2.03). The less severe effect were erosion hazard ($\bar{\chi}$=1.96) and late maturity ($\bar{\chi}$=1.84). The findings agree with Fadina and Barjolle (2018) who revealed that increased crop /livestock pests and diseases, land degradation, decreased crop yield and increased food cost were the significant effects of climate change. Similarly, Okringbo and Ominikari (2017) reported that "poor crop yield (2.75); washing away of soil surface applied with fertilizer (2.60), frequent leaching of nutrient, (1.70), disease incidence (1.85), frequent pest attack (2.10), damage/breaking of plants due to windstorm (2.58), high labour demand on the farm (1.96), increase in cost of production (2.77), post-harvest losses (2.52) and loss of improved planting materials (2.53) were perceived effects of climate change on arable crop production". Similarly, Kim, Elisha, Lawrence, and Moses (2017) reported the following perceived significant effects; low rainfall, stunted growth, premature rice ripening, high rate of weed growth, low crop yield, and incidence of flooding. . Iheke and Agodike (2016) identified "unusual early rains followed by weeks of dryness, high temperature, incidence of diseases, heavy rainfall, decrease in soil fertility, increase in pest problems, erratic rainfall pattern, loss of forest resources, flooding, soil erosion, heavy winds, thunderstorms, heavy and long period of rainfall, weed infestation, overflowing of rivers and streams, and extinction of some crop species are some of the major effects or manifestations of climate change". Ajokporise (2011) reported flooding of farmlands yearly, windy and heavy rain falls.

Table 2: Farmers' perceived effects of weather changes on cassava production.

S/N	Effect	SE	ME	NE	CUM	Mean	Rank
1.	Stunted growth	91(273)	209(418)	50(50)	741	**2.12**	7th
2.	Frequent weed infestation	131(393)	138(276)	81(81)	750	**2.14**	6th
3.	Poor tuber formation	105(315)	149(296)	96(96)	709	**2.03**	9th
4.	Flooding of the farm	81(243)	141(282)	128(128)	653	**2.61**	**2nd**
5.	Late maturity	43(129)	208(416)	99(99)	644	1.84	11th
6.	Soil depletion/leaching	139(417)	110(220)	101(101)	738	**2.11**	8th
7.	increase in pest and disease outbreak	70(210)	183(366)	97(97)	673	**2.69**	**1st**
8.	Increased cost of production	167(501)	120(240)	63(63)	804	**2.30**	5th
9.	Decline in yield	177(531)	125(250)	48(48)	829	**2.37**	4th
10.	Erosion hazard	103(309)	137(274)	110(110)	693	1.96	10th
11.	Loss of plants/ planting materials	202(606)	92(184)	56(56)	846	**2.42**	**3rd**

Note: Weighted mean= 2.00 ($X \geq 2.00$ = serious effect, $X < 2.00$ = less severe effect); SE = serious effect, ME= mild effect and NE = No effect : Source: Field survey data (2023)

Prevalent Climate Change Adaptation Strategies: The estimate of Principal Component Analysis (PCA) is shown in Table 3. It revealed that only six mutually exclusive and major strategies were identified by the factor analytic procedure. Kaiser criterion (1960) was adopted for choosing underlying factors. Only variables with factor loadings of 0.500 and above were deemed significant and therefore prevalent. The major dimensions were named as follows: The first PCA - Fac_1, strongly related with two original variables - Application of farm yard manure (0.779) and planting cover crops (0.752). Fac.1 increases with increasing application of farm yard manure and plant cover crops. Application of farm yard manure is the most prevalent adaptation strategy followed by planting cover crops. The second component - Fac_2, Minimum tillage operation (0.762) was most prevalent strategy, followed by lengthened fallow period (0.672) and crop rotation (0.625). The third component - Fac_3, Use of zero tillage (0.785) was the most prevalent strategy, followed by planting of early maturing cassava (0.597) and use of heavy mounds (0.536). The fourth component - Fac_4, Changes in harvesting dates (0.663) was the most prevalent strategy, followed by movement to different site (0.651) and Mulching (0.524). Change in planting periods (0.656), was the only significant and prevalent strategy in the fifth component - Fac_5. Diversification into non-farm activities 0.634) was most prevalent strategy, followed by use of weather forecasts (0.519) in the sixth component - Fac_6.

These results agree with the study of Kolleh and Jones (2018) who reported that "changing planting dates, using different crop varieties, planting tree crops, irrigation, and soil conservation were the major adaptation methods in their study area, out of which, farmers' use of different crop varieties was the most common adaptation method, while irrigation was the least common". Similarly, Fadina and Barjolle (2018) reported that about 85.0% of their respondents used different adaptation strategies which include: "crop–livestock diversification and other good practices (mulching, organic fertilizer), use of improved varieties, chemical fertilizers and pesticides, Agroforestry and perennial plantation (oil palm, orchard, tree species) and diversification of income-generating activities. Most of the respondents (24.2%) used these strategies in combination for effective adaptation".

Kim *et al*. (2017) reported use of climate tolerant varieties, early planting, diversification into non-farm activities and mulching. Weli and Bajie (2017) revealed the following prevalent climate change adaptation strategies; "delay in planting period, crop diversification, cultivation of early maturing crops such as maize, vegetables intercropped with the root crops and changes in the time of farm operations, change in planting period to avoid crop failure and changing their farm location".

Barriers militating against adaptation strategies in the study area: The result of the principal component analysis presented in Table 4 shows that twenty seven identified barriers militating against the adaptation patterns were sufficiently and adequately tenable to measure the extent of the barriers militating against the adaptation patterns. Out of the twenty seven, only nine mutually exclusive and major patterns were identified by the factor analytic procedure as follows:

Fac_1: Inadequate knowledge of how to cope or build resilience to climate change, non-availability of storage facilities and inadequate finance to cope with the changing climate. Fac_2: poor access to improved varieties of cassava, lack of cassava varieties that are adaptable to excess/ low rainfall and poor access to disease and pest resistant varieties of cassava. Fac_3: poor yield due to minimum tillage and intense weed growth due to minimum tillage operation. Fac_4: lack of access to weather forecast technologies, poor agricultural extension services delivery,

Table 3: Prevalent climate change adaptation strategies

Adaptation strategies	Fac_1	Fac_2	Fac_3	Fac_4	Fac_5	Fac_6
Plant cover crops	**.752**	-.081	-.193	.050	-.183	.172
Mulching	.155	-.287	-.109	**.524**	-.336	.210
Mixed farming	-.194	-.076	.069	-.088	.223	-.718
Movement to different site	-.231	.026	.225	**.651**	.124	-.082
Planting of early maturing cassava	-.001	.098	**.597**	-.035	-.104	.190
Crop rotation	.050	**.625**	.251	.024	.032	-.321
Application of farm yard manure	**.779**	-.088	.134	-.172	.059	-.204
Increased/reduced load size cultivated	-.154	-.106	.097	.129	.118	-.095
Change in planting periods	.493	.258	-.129	.129	**.656**	.074
Diversification into non-farm activities	-.083	-.135	.400	.132	.034	**.634**
Changes in harvesting dates	.191	.382	-.006	**.663**	.160	.086
Planting of trees	-.339	.238	-.308	.498	.028	.326

Lengthened fallow period	-.110	**.672**	.043	.001	.296	.012
Minimum tillage operation	-.047	**.762**	.005	.127	-.211	.203
Use of weather forecasts	-.186	.028	.212	-.104	.287	**.519**
Use of zero tillage	-.088	.064	**.785**	.044	.138	.003
Use of heavy mounds	.463	.126	**.536**	.324	-.085	.024
Use of resistance varieties	.083	-.277	.236	.438	-.536	-.144

Bold values = significant prevalent strategies.: Source: Field survey data (2023)

untimely supply of essential inputs for farming (e.g fertilizers) and illiteracy of farmers and lack of knowledge on adaptation options. Fac_5: Inadequate organic manure for impairing the soil fertilities Fac_6: poor water harvesting technology, inability of extension personnel to build residence capacity of famers on climate change and pest and disease infestation due to minimum tillage operation. Fac_7: Inherited system of land ownership, commercial system of land ownership and high cost of farmland. Fac_8: Non-availability of credit facilities. Fac_9: Government, non-government attitude towards climate change issues and non-availability of processing facilities.

Majority of these barriers were found to be similar to those by other researchers. Kim *et al.* (2017) reported that the most commonly identified barriers that constituted major hindrances to adaptation practices were: "scarcity of improved varieties, insufficient credit facilities, poor economic status of farmers, inadequate extension services and poor information on climate change". Adeoti, Coster, and Akanni (2016) reported lack of information and shortage of labor. Begmi and Bhandari (2013) studied climate change barriers in Nepal and revealed that barriers of available technology, knowledge and institutional frameworks. Antwi-Agyei, Dougill and Stringer (2013) identified key challenges to climate change adaptations as "lack of financial resources (97%), lack of information on climate change characteristics (65%), lack of institutional capacity to facilitate agricultural adaptation (33%), social-cultural barriers (26%), technological barriers (28%) and a lack of infrastructural development (7%)". Kragt *et al.* (2013 found that the following broad factors were militating against adaptation; Biophysical factor, economic factor, social factor, Institutional and technological factor. Ayoade (2012) outlined lack of storage facilities, lack of subsidies and credit facilities and land tenure system as major barriers to adaptation

Table 4: Barriers militating against the adaptation strategies in the study area.

Barriers	Fac_1	Fac_2	Fac_3	Fac_4	Fac_5	Fac_6	Fac_7	Fac_8	Fac_9
poor access to improved varieties of cassava	0.097	**0.757**	0.006	-0.254	0.076	0.237	0.086	0.060	-0.011
poor access to disease and pest resistant varieties of cassava	-0.260	**0.630**	-0.177	0.051	0.075	0.268	0.153	-0.256	0.271
lack of cassava varieties that are adaptable to low rainfall	-0.031	**0.685**	-0.065	0.262	-0.283	-0.048	-0.022	-0.149	0.262
intense weed growth due to minimum tillage operation	0.284	-0.198	**0.786**	0.090	0.037	0.048	0.012	0.097	0.003
poor yield due to minimum tillage	-0.137	**0.080**	**0.792**	0.093	-0.195	0.248	0.086	-0.122	-0002

pest and disease infestation due to minimum tillage operation	-0.148	0.069	0.399	0.003	0.346	**0.501**	0.197	-0.312	0.179
limited availability of farmland for farming	0.370	0.090	0.106	-0.003	0.426	-0.245	0.376	-0.059	0.167
high cost of farmland	0.444	-0.062	-0.028	-0.197	-0.058	-0.342	**0.541**	0.252	-0.057
inherited system of land ownership	-0.012	0.039	0.172	-0.014	-0.105	0.125	**0.824**	-0.107	-0.013
commercial system of land ownership	0.014	0.342	-0.152	-0.090	0.241	0.060	**0.554**	0.305	0.159
poor access to information services	0.142	0.484	0.431	0.216	0.001	-0.259	0.035	0.010	0.003
Non-availability of credit facilities	**-0.053**	-0,092	-0.058	0.032	0.050	-0.008	0.037	**0.839**	0.042
lack of access to weather forecast technologies	**0.021**	0.046	0.042	**0.770**	-0.024	0.050	-0.044	-0.029	0.142
government, non-government attitude towards climate change issues	0.097	0.229	0.184	0.063	0.033	0.019	0.063	0.267	**0.671**
non availability of processing facilities	0.267	0.144	-0.125	0.187	0.183	0.149	0.014	-0.117	**0.665**

Bold values = significant prevalent barriers: Source: Field survey data (2023)

Table 5: Barriers militating against the adaptation strategies (Continuation)

Barriers	Fac_1	Fac_2	Fac_3	Fac_4	Fac_5	Fac_6	Fac_7	Fac_8	Fac_9
non availability of storage facilities	**0.742**	-0.017	0.079	0.244	0.040	0.023	0.191	-0.058	0.154
inadequate finance to cope with the changing climate	**0.646**	-0.007	-0.226	0.238	0.102	0.182	0.061	0.178	0.112
inadequate knowledge of how to cope or build resilience to climate change	**0.755**	0.012	0.216	-0.150	0.021	0.061	-0.135	-0.126	0.020
non-availability of farm labour	0.487	0.380	0.116	-0.126	0.168	0.053	-0.192	0.268	0.368
traditional belief/practices	0.168	0.259	0.009	0.115	0.447	0.353	0.223	0.308	0.045
poor agricultural extension services delivery	0.058	-0.101	0.258	**0.605**	0.000	0.010	-0.131	0.430	0.135
inability of extension personnel to build resilience capacity of famers on climate change	0.131	0.098	0.259	-0.072	0.027	**0.579**	-0.379	0.181	-0.137
illiteracy of farmers and lack of knowledge on adaptation options	0.036	0.213	0.242	**0.545**	0.226	0.064	-0.088	0.124	-0.495
untimely supply of essential inputs for farming(e.g fertilizers)	0.398	-0.102	-0.089	**0.546**	0.296	0.201	0.167	-0..252	-0.153

poor water harvesting technology	0.159	0.107	0.053	0.165	-0.108	**0.766**	0.106	-0.036	0.138
inadequate organic manure for impairing the soil fertilities	0.394	-0.296	0.139	0.351	**0.654**	0.087	-0.044	0.043	0.036
lack of drought resistant cassava varieties	-0.025	-0.060	0.299	0.099	-0.755	0.115	0.109	-0.080	-0.060

Bold values = significant prevalent barriers Source: Field survey data (2023)

Conclusion and Recommendations: If farmers could overcome the barriers militating against their adaptation patterns and consistently use the adaptation strategies in combination, it will go a long way to enhance effective adaptation and boost cassava productivity in the area. The following were recommended based on the findings of this study; Policies which incorporate institutional and infrastructural support system should be developed and actually implemented through extension channel. These should include metrological information/training to create more awareness on the impact of climate. Also there is need for government and NGOs to assist farmers overcome those key barriers militating against their adaptation patterns like, lack of access to weather forecast technologies, untimely supply of essential inputs, non-availability of credit facilities etc, through timely, intensive and effective extension intervention. The identified prevailing adaptation strategies should be packaged and used by the extension agents in training contact farmers on the appropriate adaptation strategies to adopt. The government and developing partners should mainstream the barriers to adaptation into climate change related policies and projects/programs. Flexible terms of agricultural credits should be made accessible to farmers so that they can meet the financial demand of adaptation.

References

Adejuwon SA (2004). Impacts of climate variability and climate change on crop yield in Nigeria. Paper presented at the stakeholders' workshop on assessment of impacts and adaptation to climate change (AIACC), Conference centre, Obafemi Awolowo University, Ile-Ife, 271-279.

Adeoti, A.I., Coster, A.S. & Akanni, T.A. (2016). Analysis of farmers' vulnerability, perception and adaptation to climate change in kwara state, Nigeria. *International Journal of Climate Research,. 1: 1-16.*

Ajayi, J. O. (2015). Effects of climate change on production and profitability of cassava in the Niger Delta region of Nigeria. *Agris on-line Papers in Economics and Informatics.* 7 (2)

Ajetomobi, J. & Abiodun, A. (2010). Climate change impacts and food production in Ibadan, Nigeria. African crop science conference proceedings 8:1423-14

Antwi-Agyei, P., Dougill, A. J. & Stringer, L.C. (2013) Barriers to climate change adaptation in sub Saharan Africa: evidence from northeast Ghana & systematic literature review. Centre for Climate Change Economics and Policy Working Paper No. 154 Sustainability Research Institute Paper No. 52

Apata, T.G., Ogunyinka, A. Sanusi, R.A. & Ogunwande, S. (2010). Effects of global climate change on Nigerian agriculture: An empirical analysis. Paper presented at the 84th Annual Conference of Agricultural Economics Society, Edinburgh, Scotland, 29-31 March. 345-351.

Ayoade, A.R. (2012). Determinants of change on cassava production in Oyo State, Nigeria. *Global Journal of Science Frontier Research Agriculture & Biology 12(3) March 2012*

Chigovazirea, B. M. (2012). Assessing Vulnerability of Rural Communities to Climate Change. *International Journal of Climate Change Strategies and Management* Doi: 10,1108/JCCSM-04-2016-0044.

Ebukiba, E. (2010). Economic analysis of cassava production (farming) in Akwa Ibom State *Agriculture and biology journal of North America ISSN Print: 2151-7517, ISSN Online: 2151-7525 © 2010.*

Ekundayo, B.P., Olutumise, A.I., Akinrinola, O.O. (2021). A time series analysis of the nexus between climate change and cassava production in Southwest Nigeria. In: Leal Filho, W., Luetz, J., Ayal, D. (eds) Handbook of Climate Change Management. Springer, Cham. https://doi.org/10.1007/978-3-030-22759-3312-1

Enete, A. A. & Amusa, T. A. (2010). Challenges of agricultural adaptation to climate change in Nigeria: A synthesis from the literature. Field Actions Science Reports 4.

Fadina, A. & Barjolle, D. (2018). Farmers' adaptation strategies to climate change and their implications in the Zou Department of South Benin. *Environments 2018, 5, 15; www.mdpi.com/journal/environments*

Food and Agriculture Organisation, (2020). Climate change and agricultural production in Nigeria. Food and Agriculture Organisation of the United Nations, Rome Italy.

Food and Agriculture Organisation, (2022). Crop prospects and seasonal variations in Nigeria. Food and Agriculture Organisation of the United Nations, Rome Italy.

Ifeanyi-Obi, C.C & Issa, F.O. (2013b). Barriers faced by cassava farmers in adapting to climate change in Oron agricultural zone of Akwa Ibom State. *IORS Journal of Agriculture and Veterinary Science. 4(6) 19 – 26, India.*

Iheke, O. R. & Agodike, W. C (2016). Analysis of factors influencing the adoption of climate change mitigating measures by smallholder farmers in Imo State, Nigeria. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development 16(1), 2016.*

IPCC (2007). Summary for Policymakers. In Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.) Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

Kemi, A. A. and Olusegun, A. J. (2020). Climate Change impact on cassava agriculture in Nigeria. Journal of Xi'an Shiyou University, Natural Science Edition, 17(05), 22-31.

Kim, I., Elisha, I., Lawrence, E. & Moses, M. (2017). Farmers adaptation Strategies to the effect of climate variation on Rice Production: Insight from Benue State, Nigeria. *Environment and Ecology Research 5(4): 289-301, 2017.*

Kolleh, J.B. & Jones, M.T. (2018). Rice farmers' perception of climate change and adaptation strategies in the Ketu North District, Volta Region of Ghana. *African Journal of Agricultural Research 13(15): 782-791, 12 April, 2018*

Kragt, M.E., Robson, B.J. & Macleod, C.J.A. (2013). Modellers' roles in guiding integrative research projects. *Environmental Modelling & Software. 39(1), 322-330.*

Lenis, S.O., Liverpool-Tasie, A., Holly, P., Justice, A., Tambo, B., Laura, S. O. C. and Olubukola, O. (2020). Perceptions and exposure to climate events along agricultural value chains: Evidence from Nigeria, Journal of Environmental Management, 21, 34-39. https://doi.org/10.1016/j.jenvman.2020.110430

Mendelsohn, R., Dinar, A., & Williams, L., (2006). *The Distributional Impact of Climate Change on Rich and Poor Countries. Environment and Development Economics11: 1-20.*

Okringbo, J. I. & Ominikari, A. G. (2017). Effect of climate change on arable crop production in Bayelsa State, Nigeria. *Journal of Community and Communication Research. www.jccr.org.ng Vol. 2 No. 1*

Weli,V. E. & Bajie, S. (2017) Adaptation of root crop farming system to climate change in Ikwerre Local Government Area of Rivers State, Nigeria. *American Journal of Climate Change, 2017, 6, 40-51 http://www.scirp.org/journal/ajcc ISSN Online: 2167-9509*