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## CLIMATE CHANGE INFORMATION SOURCES AND ADAPTATION STRATEGIES FOR ARABLE CROP PRODUCTION AMONG MALE FARMERS IN SOUTH-EAST, NIGERIA

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### ABSTRACT

*This study assessed climate change adaptation strategies for arable crop production among male farmers in South-East, Nigeria. Specifically it described socio-economic characteristics of male arable crop farmers, identified male arable crop farmers sources of information on adaptation strategies to climate change, identified adaptation strategies to climate change used by male arable crop farmers' and identify constraints that militate against the use of adaptation strategies to climate change by male arable crop farmers. Data for the study were collected through a structured questionnaire from 158 male farmers in arable crop production. Data were analyzed using both descriptive and inferential statistics (multiple regressions). Major results showed that majority (86.71%) of male farmers sourced farm credit from thrift. While majority (98.10%) of male farmers' sourced information on adaptation strategies from fellow farmers, 6.08% of males from extension agents. The male farmers had high utilization of climate change adaptation strategies with mean score of 2.6 for male farmers. The male farmers had high constraints to the use of climate change adaptation strategies with a mean score of 2.4. Results of Multiple regression result showed that coefficients of age for males (0.0554), household size for males (-0.0600), annual income for males (-0.00008), years of farming experience for males (0.4859), number of extension for males (-0.2579), technological attributes for males (2.2909), influenced the use of climate change adaptation strategies. The study recommended formulation of policy that would attract and encourage both you male arable crop farmers for sustained use of climate change adaptation strategies, investment in rural education, increased number of extension contact and sensitization of the inclusiveness of male arable crop farmers in climate change adaptation strategies through trainings and workshops.*

**Keywords:** *Adaptation strategies, climate change, arable crop production, farmers, male.*

### Introduction

Agriculture is the mainstay of the Nigeria's economy. Rich arable land suitable for the production of a wide range of topical crops that is dependent on climate elements such as rainfall, temperature and relative humidity. (Elijah, Osuafor and Anarah, 2018). Nigeria has a land area of about 91 million hectares and 82 million of this total mass is said to be cultivable (Ashagidigbi, Yusuf and Agboola, 2019) arable crops such as cassava and yam are the chief sources of dietary food energy for the majority of the people living in Nigeria. Therefore their production and utilization must be given prime attention in food policy. Climate change refers to as any significant change in measures of climate such as temperature, precipitation or wind lasting for an extended period, decades or longer (Nwaiwu, Ohajianya, Orebiyi, Eze and Ibekwe, 2014).

The Intergovernmental Panel on Climate change 5<sup>th</sup> Assessment Report projected that climate change without adaptation will negatively impact production. The impact vary across crops and region,

with about 10 percent of projections for the period 2030-2049 showing yield gains of more than 10 percent and projections showing yield losses of more than 25 percent compared to the 20<sup>th</sup> century. All aspects of food security are potentially affected by climate change, including access to food, utilization and price stability. These effects are expected to exacerbate poverty in most developing countries (Intergovernmental Panel on Climate change (IPCC) 2014).

Responding to the effect of climate change as manifested through prolonged drought and excessive amount of rainfall, increased incidence of pest, disease and floods (Ajayi, Bamwuye, Owolabi and Alao, 2021) are perhaps some of the most challenging and pressing problems of today's. Since human intervention to reduce the sources or enhance the sinks of green house gases (GHGs), (IPCC, 2014), though an efficient international mitigation policy cannot halt climate change in the next decades, there is a growing consensus to embrace adaptation strategies in order to adjust to changing climate and also to address the food security

concerns that are central to economic growth, sustainable development and poverty reduction agenda (Ogisi, Begho and Alimeke, 2013).

Nigeria like all the countries of sub-Saharan Africa is highly vulnerable to the impacts of climate change. Agricultural production and food security are at stake; as over 95 percent of Africa's agriculture is rain feed (Ifeanyi-obi and Nnadi, 2014)

Adaptation to climate change is the process of adjustment to actual or expected climate and its effects (IPCC, 2014). 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 changing climatic conditions and extreme weather conditions. Climate change affects agriculture in several ways, one of which is its direct impact on arable crop production. It brings additional perspective to the national challenges of increasing agricultural production to keep pace with the rising population, while keeping high standards of environmental protection (Ajayi, Owolabi and Tomori, 2021) Climatic variables affect both male and female farmer's productivity. Both genders do not have the same adaptive capacity. Women are more vulnerable to the impact of climate change despite the fact that they play an active role in adapting to its impact to secure food for the family (Henri-Ukoha, Ugwuaja, Oladejo, Zigakolbari and Onyema, 2018). Gendered roles create opportunities for adaptation. The complementary of male and female knowledge and skills is key for designing and implementing effective and sustainable adaptation initiatives, ensuring to their specific needs and that both benefit equally from the development process (Ali, Awade and Abdoulaye, 2020)

Therefore, in climate change adaptation, taking male and female into consideration in decision making will provide better guidance to build adaptive responses and effective policies. Men and women perform different functions and roles in yam and cassava production. These roles vary and are in many instances determined by culture and tradition (Ezeibe *et al.*, 2015). Men select site for yam and cassava production, suggesting that the responsibility lies with men, the land tenure system vests ownership and authority of land on men, Land clearing rests mainly on men with women and youths playing lesser role (Udemezue and Onwuneme, 2017). Tillage is a heavy energy task, hence men inherent physic do most of the job (Onyeneke *et al.*, 2019). The women and to a much lesser extent men do most of cassava planting operation, while the planting of yam is done by the men (Atser, Dixon, Ekeleme, Chikoye, Dashiell, Kanmi, Hauser, Agada, Okirusi, Adekoya (2017). Herbicide application was mainly the prerogative of men. Harvesting was carried out by all (men and women),

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national challenges of increasing agricultural production to keep pace with the rising population, while keeping high standards of environmental protection (Ajayi, Owolabi and Tomori, 2021)

#### **Methodology**

The study was conducted in Southeast, Nigeria. The South East is located within latitudes 5°N, to 6°N of the Equator and Longitude 6°E to 8°E, f the Greenwich Meridian (NPC, 2006). South East zone of Nigeria is made up of Abia, Anambra, Ebonyi, Enugu and Imo states. The total land mass for this zone is 10,952,400 hectares of land with a population of about 16,381,729 people (NPC, 2006). This Zone has two peculiar seasons known as the dry and rainy seasons. The dry season occurs between November and March. The rainy season occurs between April and October but climatologically changes has affected these seasons so much that there are various variation in these season (NPC, 2006). The Zone has average temperature of 27°C, rainfall of 1800mm, relative humidity of about 72%, number of rain days is about 142days and hours of sunshine per day of 4.4 hours (NPC, 2006). South-East, Nigeria is the homeland of the Igbo people. Its population consist of diverse Igbo culture and the speakers of diverse Igbo languages.

Purposive, multi-stage, simple random and proportionate sampling technique was used for the study. Abia, Imo and Ebonyi states among other South-East States in Nigeria was purposively selected for the study because they are the major yam and cassava producing states in south—East Nigeria and they are prone to the menace of climate change. Multi-stage sampling technique was used in selecting the farmers, bearing in mind the agricultural delineation of the study areas into zones, blocks cells and sub-circles. The sample frame for the study was obtained from the Abia, Owerri and Ebonyi states agricultural development programme (ADPs). Two agricultural zones were randomly selected from the three states for the study. This gave a total of six zones. Two blocks was randomly selected from each of six agricultural zones in the three states. This gave a total of 12 blocks. Four circles were randomly selected from each block to give a total of 48 circles. Proportionate sampling technique was used considering the uneven distribution of the sub-circles at 11.5 percent proportion. This gave a total of 34 sub-circles. A total of 158 male arable crop farmers were interviewed, Descriptive statistics such as frequency, percentages and mean scores were used to realize the objectives of the study while the hypothesis was tested with multiple regression analysis.

Identify male arable crop farmers' sources of information on climate change adaptation strategies. To achieve this, farmers were asked to indicate their sources from a list of information sources provided. This was realized using descriptive statistics such as

frequency and percentages. To identify adaption strategies to climate change used by male arable crop farmers was measured using a Four point type scale, which was based on the question options of always = 4, often = 3 seldom = 2 and never = 1. For the purpose of decision making an upper limit was established. A benchmark of 2.5 would be taken as the decision rule for acceptance or rejection. As such the means scores of 2.5 are above as always, 2.0 – 2.4 as often, 1.5-1.9 as seldom, and below 1.5 as never.

There is no significant relationship between socio-economic characteristics of arable crop male farmers and their use of climate change adaptation strategies in the South-East Nigeria. This was tested using ordinary least squares regression.

This was analyzed using ordinary least squares regression. The multiple regression model is expressed as follows;

The four functional forms are expressed as follows:

**Linear Function**

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e_i \dots\dots\dots (1)$$

**Semi – log function**

$$Y = L_n \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + e_i \dots\dots\dots (2)$$

**Exponential function**

$$L_n Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e_i \dots\dots\dots (3)$$

**Cobb Douglas Function**

$$L_n Y = L_n \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + e_i \dots\dots\dots (4)$$

Where;

- Y = Male arable crop adaptation strategies used to climate change adaptation strategies (mean scores).
- X<sub>1</sub> = Age (years)
- X<sub>2</sub> = marital status married =1, single =0
- X<sub>3</sub> = household size (number of persons)
- X<sub>4</sub> = annual income (in naira)
- X<sub>5</sub> = educational Attainment (number of years)
- X<sub>6</sub> = type of cropping system sole /cropping = 0, mixed cropping = 1
- X<sub>7</sub> = farming experience (in years)
- X<sub>8</sub> = number of extension visits (One month)
- X<sub>9</sub> = technology attributes (mean scores).
- E<sub>i</sub> = error term

**Results and Discussion**

**Socio-Economic Characteristics of Respondents in the Study Area**

The distribution of arable crop farmers according to age is shown in Table 4.2. The result indicates that a good proportion (54.43%) of the males fell between 50 – 59 years. However, 20.25% for males fell between 40 – 50 years while. Again the male farmers (10.6%) had between 20 -29 years, while the male farmers (10.76%) fell between 20 – 30 years. The mean ages of both male arable crop farmers were 46.0 years. The result implied that the respondents were young, active and capable of undertaking activities involved in arable crop production. The result is in agreement with Okon, and Edeme, (2021) and Okoro, Okwu-Delunzu, and Ofordu, (2020) as they affirmed that farmers who fall within these ages constitute the major agricultural productive workforce.

The distribution of male arable crop farmers according to farming experience is shown in Table 1. The result indicates that 50.63% of the males had farming experience of between 6-30 years Also 29.75% of the Males had 1 – 15 years farming experience.

The mean farming experience of male farmers was 22 years. Experience gained by farmers in agricultural production activities helps them to bear the risk and uncertainty in adapting to climate change effect and resilience. The result is in consonance with the findings of Olorunfemi, Olorunfemi, Oladele and Malomo, (2021), Adzawala, Azumah, Anan and Donkoh, (2019), Onyekwuru and Marchant, (2017) as they reported that indigenous knowledge and farming experience of farmer’s aid in bearing risks involved in farming especially mitigating the effect of climate change.

The distribution of male arable crop farmers according to household size is shown in Table 1. The result shows that 47.47% of the male farmers had household sizes of between 4-6 persons. However, 35.44% of Males had household size of between persons 7-9, while 15.83% of Males had between 1-3 persons, 1.27% of Males that had between 10 – 15 persons as their household sizes. The mean household size for the male farmers was 6 persons.. Household size has shown to be a supplier of farm labour in any farming activity that involves application of climate change adaptation strategies. This result is in tandem with the findings of Subedi, Bhatta, Udas, Agrawal and Panday, (2019) as they inferred that size of the household supplements farm labour thereby reducing cost of materials used in the control of climate change effect. Henri-Ukoha and Walison, (2018) in their study found that household labour influences supply management for on-farm cassava enterprise.

The distribution of male arable crop farmers according to farm size is shown in Table 1. Result revealed that 37.34% of male farmers had farm size ranging between 0.25 – 1.0 hectares, 36.08% of male farmers had farm sizes of between 1.25 – 2.0 hectares while, 25.95% of male farmers had farm

sizes of between 2.25 – 3.0 hectares. The male (0.63%) also cultivated on farms ranging between 3.25 – 4.0 hectares. The mean farm size of male farmers was 1.5 hectares. This result suggests that the farmers were small scale farmers due to the size of farmland used in the production of arable crops. This result agrees with the findings of Arifin and Nirawal (2018) who reported that majority of farmers in south east Nigeria are small scale farmers, on the average cultivate less than 2.0 hectares of land. In support of this, Alhassan, Kwakwa and Adzawa, (2019) reported that the size of the farm determines the best alternative or choice employed by farmers in using any available climate change adaptation measure.

The distribution of arable crop farmers according to number of extension contact is shown in Table 1. The result indicates that a good proportion (51.7%) of male farmers had monthly extension contact, a moderate proportion (38.61%) of Males had fortnightly contact, while 10.13% of Males had no

contact with extension. The result suggests that extension contact on climate change adaptation strategies were not encouraging. According to Olorunfemi, Olorunfemi and Oladele, (2020), effective agricultural extension service encompasses the provision of timely information to farmers. The availability of such apt information will allow farmers to immediately respond to problems faced on their farms such as the inimical effect caused by climate change. Thus, it is the responsibility of agricultural extension to disseminate best practices and innovations developed to enhance the adaptive capacity and increased resilience of farming communities to the effect of climate change Hida, Oyedeji and Ginini, (2022), Izuogu, Onyeneke, Njoku, Azuamairo, and Atasi, (2021) in their study reported that extension delivery should incorporate the building of climate change resilience to help farmers cope with its effect on crop production in Nigeria.

**Table 1: Socio-Economic Characteristics of Respondents in the Study Area**

States	Abia (n=32)		Ebonyi (n=37)		Imo (n=89)		S.E pooled (n= 158)	
Age/(years)	Freq.	%	Males		Freq.	%	Freq.	%
			Freq.	%				
20-29	2	6.25	0.0	0.0	15	16.85	17	10.76
30-39	9	28.13	3	8.11	11	12.36	23	14.56
40-49	8	25.00	13	35.14	11	12.36	32	20.25
50-59	13	40.62	21	56.75	52	58.43	86	54.43
<b>Mean (<math>\bar{X}</math>)</b>	<b>45</b>		<b>49</b>		<b>46</b>		<b>46</b>	
<b>Marital status</b>								
Single	3	9.38	0.0	0.0	13	14.61	16	10.13
Married	27	84.37	37	100.0	73	82.02	137	86.71
Divorced	2	6.25	0	0	0	0	2	1.27
Widowed	0	6.25	0	0	3	3.37	3	1.89
<b>Education</b>								
No formal	2	6.25	0	0	2	2.25	4	2.53
Primary	12	37.50	2	5.41	16	17.98	30	18.99
Secondary	11	34.38	9	24.32	35	39.33	55	34.81
Tertiary	7	21.88	26	96.77	36	40.45	69	42.67
<b>Farming Experience (years)</b>								
1-15	13	40.63	5	13.51	29	32.58	47	29.75
16-30	10	31.24	31	83.79	39	43.82	80	50.63
31-45	9	28.13	1	2.70	21	23.60	31	19.62
<b>Mean (<math>\bar{X}</math>)</b>	<b>21</b>		<b>21</b>		<b>22</b>		<b>22</b>	
<b>Household size (numbers)</b>								
4-6	19	59.37	21	56.76	35	39.33	75	47.47
7-9	9	28.13	13	35.13	34	38.20	56	35.44
10-12	1	3.12	0	0	1	1.12	2	1.27
<b>Mean (<math>\bar{X}</math>)</b>	<b>6</b>		<b>5</b>		<b>5</b>		<b>6</b>	
<b>Farm Size (hectares)</b>								
0.25-1.00	6	18.75	3	8.11	50	56.18	59	37.34
1.25-2.00	10	31.25	22	59.46	25	28.09	57	36.08
2.25-3.00	16	50.00	12	32.43	13	14.61	41	25.95
3.25-4.00	0.0	0.0	0.0	0.0	1	1.12	1	0.63
<b>Mean (<math>\bar{X}</math>)</b>	<b>6</b>	<b>18.75</b>	<b>3</b>	<b>8.11</b>	<b>50</b>	<b>56.18</b>	<b>59</b>	<b>37.34</b>
<b>Extension contact</b>								
Monthly	19	59.38	22	59.46	40	44.94	81	51.26
Fortnightly	12	37.50	15	40.54	34	38.20	61	38.61
No contact	1	3.12	0	0	15	16.86	16	10.13

The result showed that majority (98.10%) of male farmers sourced information on adaptation strategies from fellow farmers and 86.08% (males) from extension agents and 84.18% (males) from friends/relations and 79.11% (male) farmers sourced information on adaptation strategies from radio programme. Again, half (50.0%) of the male farmers sourced adaptation strategies from television programmes, 46.20% (males) and from extension bulletins 36.68% (males) from farmers' cooperative 30.38% (males) farmers sourced from information from internet. However 26.58% male farmers

sourced information on adaptation strategies from weather station while 17.72% (males) sourced from research institutes.

The result suggests that farm groups sourced information on adaptation strategies from fellow farmers, friends/relations and radio programmes. Horamo, this result corroborates with the findings of Manzoor, Haqal, Baloch (2021), Mairura, Musafiri, Kiboi, Macharia, Ng'etich, Shisanya, Okeyo, Mugendi, Okwuosa and Ngetich, (2021) as they obtained a similar result among arable crop farmers in sub-Saharan Africa.

**Table 2: Distribution of Respondents According to Sources of Information on Adaptation Strategies**

Sources of information	Abia (n=32)		Ebonyi (n=37)		Imo (n=89)		S.E pooled (n=158)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Extension agents	31	96.9	33	89.2	72	80.9	136	86.08
Research institution	6	18.8	2	5.4	20	22.5	28	17.72
Fellow farmers	31	96.9	36	97.3	88	98.9	155	98.10
Friends/relations	29	90.6	25	67.6	79	88.8	133	84.18
Farmers' cooperative	19	59.4	2	5.4	33	37.1	57	36.08
Extension bulletins	22	68.8	23	62.2	28	31.5	73	46.20
Radio	30	93.8	37	100	58	65.2	125	79.11
Television programme	30	93.8	4	10.8	45	50.6	79	50.00
Internet	29	90.6	1	2.7	18	20.2	48	30.38
Weather station	26	81.3	1	2.7	15	16.9	42	26.58

Source: (field survey) 2022

\*Multiple Responses Recorded

#### Extent of Use of Adaptation Strategies to Climate Change among Male Farmers

Result in Table 2 showed that the male farmers in Abia averred that they cultivated early maturing crops and crop rotation with mean scores of 3.4 each, changes in planting and harvesting dates with mean ratings of 3.2 each, irrigation practices ( $\bar{X}=3.1$ ), application of pesticides ( $\bar{X}=3.0$ ), mulching/cover crops, diversified livelihood with mean ratings of 2.9 each as adaptation strategies to climate change. Again the farmers used terracing, planting deeper and shallower usual depths, crop replacement, shortened bush fallow, dam construction and riverside/bank cultivation with mean scores of 2.8 each, diversifying from farm to non-farm activities, increased use of organic manure, family labour, tree planting and joining of cooperative society with mean scores of 2.7 each as adaptation strategies. Liming/acidification, land rotation, use of weather forecast and cultivation of marginal lands with mean ratings of 2.6 each and use of herbicides ( $\bar{X}=2.5$ ) were also used as adaptation strategies. The farmers had high utilization ( $\bar{X}=2.9$ ) of the adaptation strategies to climate change in Abia State. However, Ebonyi farmers used planting of pest and disease resistant varieties ( $\bar{X}=3.8$ ), crop rotation ( $\bar{X}=3.3$ ), use of herbicides ( $\bar{X}=2.9$ ), changes in planting and harvesting dates ( $\bar{X}=2.7$ ), and terracing ( $\bar{X}=2.6$ ) as adaptation strategies to climate change. Ebonyi State farmers had moderate utilization ( $\bar{X}=2.3$ ) of the adaptation strategies to climate change.

Furthermore, Imo farmers used changes in planting and harvesting dates ( $\bar{X}=3.6$ ), intensive organic

manure changes in planting and harvesting dates ( $\bar{X}=3.5$ ), frequent weeding and cultivate land expansion with mean ratings of 3.3 each, planting of pest and disease resistant varieties, planting deep and shallow and processing of crops with mean scores of 3.2 each as adaptation strategies to climate change. Also, crop replacement ( $\bar{X}=3.0$ ), cultivation of marginal lands ( $\bar{X}=2.9$ ), intensive use of organic manure ( $\bar{X}=2.8$ ), weather forecast and shortened bush fallow with mean ratings of 2.7, diversified livelihood ( $\bar{X}=2.6$ ) and application of pesticides ( $\bar{X}=2.5$ ) were adaptation strategies to climate change used farmers. Imo State farmers had high utilization ( $\bar{X}=2.6$ ) of the adaptation strategies to climate change. The pooled mean of male farmers in the Southeast was 2.6, indicating that they had high utilization of strategies to climate change in the study area.

This result infers that smallholder farmers are faced with complex decisions either not to adopt or adopt a single or combination of technologies for climate change mitigation and adaptation. On the other hand, research shows that appropriate adaptation strategies can enhance the resilience and sustainability of agricultural systems. This finding is in consonance with studies of Collins, Musafiri, MilkaKiboi, Joseph, Onesmus, Ng'etich, David, Kosgei, Betty Mulianga, Michael Okoti Felix, Ngetich, (2022), Murithi and Mogaka, (2021), Belachew, Mekuria and Nachimuthu, (2020) as they reported that smallholder farmers adopt these strategies to cope with climate change shocks. The adoption of these strategies are mainly driven by expected utility, where a farmer could adopt a practice if the pay-off

is better than not adopting. The adoption of a specific practice could be conditioned to another.

The result indicated that male farmers in Abia revealed that inadequate farm land and lack of access to meteorological report with mean scores of 2.4 each, high cost of labour, poor capacity building and high cost of improved cassava varieties with mean ratings of 2.3 each, scarcity of improved yam and cassava varieties and inadequate funding with mean scores of 2.2 each, inadequate availability of climate change information and high cost irrigation facilities with mean scores of 2.1 each and poor service delivery ( $\bar{X}=2.0$ ) were constraints to use of climate change adaptation strategies. Abia State farmers had high constraints ( $\bar{X}=2.7$ ) to the use adaptation strategies to climate change.

Ebonyi farmers averred that high cost of labour ( $\bar{X}=3.2$ ), scarcity of improved yam and cassava varieties and lack of knowledge on different adaptation strategies with mean values of 3.0 each, high cost of cassava varieties and poor agricultural extension service delivery with mean scores of 2.9, inadequate land ( $\bar{X}=2.8$ ) were also a constraint. The farmers identified inadequate funding, poor capacity building to climate change and lack of access to meteorological data with mean values of 2.6 each and inadequate availability of climate change information ( $\bar{X}=2.4$ ) as a constraint to the use of climate change adaptation strategies. Ebony State farmers had high constraints ( $\bar{X}=2.5$ ) to the use adaptation strategies to climate change.

For Imo farmers, they affirmed that high cost of improved cassava varieties and inadequate farm land with mean ratings of 2.9, lack of access to meteorological data ( $\bar{X}=2.8$ ), high cost of labour and inadequate early information on climate change with mean scores of 2.7, scarcity of improved yam/cassava varieties and poor capacity building on climate change with mean scores of 2.6, inadequate availability of climate change information ( $\bar{X}=2.5$ ), inadequate funding ( $\bar{X}=2.2$ ), poor extension service delivery ( $\bar{X}=2.1$ ) and high cost of irrigation facilities ( $\bar{X}=2.0$ ) were constraints to use of climate change adaptation strategies. Imo farmers had high constraints ( $\bar{X}=2.5$ ) to use of climate change adaptation strategies. The pooled mean of male farmers in the Southeast was 2.4, indicating that they had high constraints to the use of climate change adaptation strategies to in the study area.

Mogaka, Bett, and Ng'ang'a, (2021), Mwaura, Kiboi, Bett, Mugwe, Muriuki, Nicolay and Ngetich, (2021), affirmed that vulnerability to climate change comes from both located in the tropics, and from various socioeconomic, demographic, and policy trends limiting its capacity to adapt to change. Kanyenji, Oluoch-Kosura, Onyango and KaranjaNg'ang'a, (2020), reported that low capacity to adapt to climate change due to low levels of awareness, human and financial resources and institutional and technological capabilities were serious constraints to use of strategies to climate change.



**Table 3: Extent of Use of Adaptation Strategies to Climate Change among Male Farmers**

States Adaptation Strategies	Abia (n=32)					Ebonyi (n=37)					Imo (n=89)				
	Al ways	Often	Seldo m	Neve r	Mean	Always	Often	Seldo m	Neve r	Mean	Always	Often	Seldo m	Never	Mean
Irrigation practices	18(72)	4(12)	9(18)	1(1)	<b>3.2</b>	4(16)	1(3)	12(24)	20(20)	<b>1.7</b>	2(8)	11(33)	26(52)	50(50)	<b>1.6</b>
Use of pest and disease resistant varieties	11(44)	9(27)	11(22)	1(1)	<b>2.9</b>	32(128)	2(6)	2(4)	1(1)	<b>3.8</b>	30(120)	43(129)	16(32)	0(0)	<b>3.2</b>
Crop rotation	15(60)	15(45)	2(4)	0(0)	<b>3.4</b>	10(40)	27(81)	0(0)	0(0)	<b>3.3</b>	8(32)	25(75)	46(92)	10(10)	<b>2.3</b>
Changes in planting and harvesting date	14(56)	13(39)	5(10)	0(0)	<b>3.3</b>	0(0)	26(78)	10(20)	1(1)	<b>2.7</b>	57(228)	28(84)	4(8)	0(0)	<b>3.6</b>
Mulching / cover cropping	9(36)	16(48)	7(14)	0(0)	<b>3.1</b>	0(0)	3(9)	28(56)	6(6)	<b>1.9</b>	2(8)	25(75)	49(98)	13(13)	<b>2.2</b>
Construction of drainages	3(12)	18(54)	9(18)	2(2)	<b>2.7</b>	0(0)	0(0)	33(66)	4(4)	<b>1.9</b>	2(8)	41(123)	41(82)	5(5)	<b>2.4</b>
Liming/acidification	1(4)	17(51)	13(26)	1(1)	<b>2.6</b>	0(0)	6(18)	30(60)	1(1)	<b>2.1</b>	0(0)	6(18)	19(38)	64(64)	<b>1.3</b>
Diversifying from farm to non-farm activities	6(24)	13(39)	11(22)	2(2)	<b>2.7</b>	0(0)	22(66)	14(28)	1(1)	<b>2.6</b>	33(132)	47(141)	9(18)	0(0)	<b>3.3</b>
Increased use of family labour	8(32)	11(33)	9(18)	4(4)	<b>2.7</b>	0(0)	6(18)	24(48)	7(7)	<b>2.0</b>	35(140)	49(147)	5(10)	0(0)	<b>3.3</b>
Intensive use of organic manure	9(36)	10(30)	8(16)	5(5)	<b>2.7</b>	1(4)	5(15)	27(54)	4(4)	<b>2.1</b>	26(104)	21(63)	39(78)	3(3)	<b>2.8</b>
Land rotation	7(28)	11(33)	9(18)	5(5)	<b>2.6</b>	6(24)	20(60)	9(18)	2(2)	<b>2.8</b>	59(236)	22(66)	4(8)	4(4)	<b>3.5</b>
Crop diversification	9(36)	13(39)	8(16)	2(2)	<b>2.9</b>	19(76)	14(42)	4(8)	0(0)	<b>3.4</b>	57(228)	28(84)	0(0)	4(4)	<b>3.6</b>
Terracing	5(20)	14(42)	13(26)	0(0)	<b>2.8</b>	9(36)	6(18)	22(44)	0(0)	<b>2.6</b>	1(4)	6(18)	26(52)	56(56)	<b>1.5</b>
Contouring	7(28)	10(30)	14(28)	1(1)	<b>2.7</b>	1(4)	7(21)	27(54)	2(2)	<b>2.2</b>	0(0)	6(18)	9(18)	74(74)	<b>1.2</b>
Use of different tillage system	6(24)	10(30)	16(32)	0(0)	<b>2.7</b>	2(8)	10(30)	23(46)	2(2)	<b>2.3</b>	21(84)	44(132)	11(22)	13(13)	<b>2.8</b>
Tree planting	7(28)	9(27)	16(32)	0(0)	<b>2.7</b>	1(4)	10(30)	8(16)	18(18)	<b>1.8</b>	1(4)	16(48)	53(106)	19(19)	<b>2.0</b>
More frequent weeding	8(32)	11(33)	12(24)	1(1)	<b>2.8</b>	0(0)	22(66)	8(16)	7(7)	<b>2.4</b>	44(176)	35(105)	6(12)	4(4)	<b>3.3</b>
Changes in timing of land preparation activities	6(24)	16(48)	9(18)	1(1)	<b>2.8</b>	1(4)	28(56)	3(6)	5(5)	<b>1.9</b>	35(140)	47(141)	7(14)	0(0)	<b>3.3</b>
Use of herbicides	4(16)	12(36)	13(26)	3(3)	<b>2.5</b>	4(16)	26(78)	5(10)	2(2)	<b>2.9</b>	8(32)	31(93)	43(86)	7(7)	<b>2.4</b>
Water storage in ponds	10(40)	12(36)	10(20)	0(0)	<b>3.0</b>	0(0)	14(42)	5(10)	18(18)	<b>1.9</b>	4(16)	9(27)	28(56)	48(48)	<b>1.6</b>
Planting deeper or shallower than usual planting depth	3(12)	19(57)	9(18)	1(1)	<b>2.8</b>	0(0)	13(39)	2(4)	22(27)	<b>1.9</b>	30(120)	47(141)	8(16)	4(4)	<b>3.2</b>
Application of pesticides	7(28)	17(51)	8(16)	0(0)	<b>3.0</b>	2(8)	24(72)	1(2)	10(10)	<b>2.5</b>	12(48)	29(87)	43(86)	5(5)	<b>2.5</b>

Processing of crops to minimize post-harvest losses	8(32)	15(45)	9(18)	0(0)	<b>3.0</b>	4(16)	13(39)	13(26)	7(7)	<b>2.4</b>	28(112)	47(141)	14(28)	0(0)	<b>3.2</b>
Crop replacement	5(20)	14(42)	13(26)	0(0)	<b>2.8</b>	1(4)	8(24)	24(48)	4(4)	<b>2.2</b>	20(80)	46(138)	23(46)	0(0)	<b>3.0</b>
Use of weather forecast	5(20)	12(36)	13(26)	2(2)	<b>2.6</b>	0(0)	15(45)	16(32)	6(6)	<b>2.2</b>	18(72)	36(108)	25(50)	10(10)	<b>2.7</b>
Shortened bush fallow	8(32)	12(36)	10(20)	2(2)	<b>2.8</b>	2(8)	10(30)	13(26)	12(12)	<b>2.1</b>	22(88)	24(72)	37(74)	6(6)	<b>2.7</b>
Cultivated land expansion	7(28)	14(47)	11(22)	0(0)	<b>2.9</b>	1(4)	8(24)	12(24)	16(16)	<b>1.8</b>	38(152)	38(114)	10(20)	3(3)	<b>3.3</b>
Cultivation of marginal lands	5(20)	12(36)	13(26)	2(2)	<b>2.6</b>	0(0)	8(24)	12(24)	17(17)	<b>1.8</b>	19(76)	44(132)	22(44)	4(4)	<b>2.9</b>
Joining of co-operative society	4(16)	16(48)	11(22)	1(1)	<b>2.7</b>	0(0)	4(12)	15(30)	18(18)	<b>1.6</b>	6(24)	23(69)	40(80)	20(20)	<b>2.2</b>
Dam construction	6(24)	14(42)	10(20)	2(2)	<b>2.8</b>	1(4)	4(12)	10(20)	22(22)	<b>1.6</b>	10(40)	24(72)	18(36)	37(37)	<b>2.1</b>
Riverside / bank cultivation	7(28)	12(36)	11(22)	2(2)	<b>2.8</b>	0(0)	11(33)	8(16)	18(18)	<b>1.8</b>	7(28)	27(81)	25(50)	30(30)	<b>2.1</b>
Diversified livelihoods	11(44)	13(39)	7(14)	1(1)	<b>3.1</b>	1(4)	19(57)	2(4)	15(15)	<b>2.2</b>	22(88)	27(81)	25(50)	15(15)	<b>2.6</b>
Cultivation of early maturing crops	16(64)	13(39)	2(4)	1(1)	<b>3.4</b>	0(0)	27(81)	2(4)	8(8)	<b>2.5</b>	50(200)	30(90)	9(18)	0(0)	<b>3.5</b>
<b>Grand mean</b>					<b>2.9</b>					<b>2.3</b>					<b>2.6</b>
<b>S.E pooled mean</b>										<b>s</b>					<b>2.6</b>

Source: *Field Survey 2022*

### CONSTRAINTS TO THE USE OF ADAPTATION STRATEGIES TO CLIMATE CHANGE

Constraints to the Use of Adaptation Strategies to Climate Change among male Farmers. The distribution of respondents according to constraints to use of adaptation strategies to climate change among male farmers is shown in Table 3.

Table 3: Distribution of Males farmers According to Constraints to the use of Adaptation Strategies to Climate Change

States Constraints	Abia (n=32)			Ebonyi (n=37)					Imo (n=89)						
	VS	MS	NS	Total	Mean	VS	MS	NS	Total	Mean	VS	MS	NS	Total	Mean
Scarcity of improved yam cassava varieties	10(30)	19(32)	3(3)	71	2.2	37(111)	0(0)	0(0)	111	3.0	57(171)	30(60)	2(2)	233	2.6
High cost of labour	13(39)	15(30)	4(4)	73	2.3	16(48)	16(32)	5(5)	85	3.2	61(183)	28(56)	0(0)	239	2.7
High cost of improved cassava varieties	15(45)	11(22)	6(6)	73	2.3	34(102)	3(6)	0(0)	108	2.9	82(246)	6(12)	1(1)	259	2.9
Poor agricultural extension	3(9)	16(32)	13(13)	54	1.7	34(102)	3(6)	0(0)	108	2.9	11(33)	38(76)	40(40)	149	1.7
Poor services delivery	10(30)	12(24)	10(10)	64	2.0	36(108)	0(0)	1(1)	109	2.9	14(42)	72(144)	3(3)	189	2.1
Lack of knowledge on different adaptation strategies	5(15)	17(28)	10(10)	53	1.7	37(111)	0(0)	0(0)	111	3.0	67(201)	19(38)	3(3)	242	2.7
Inadequate farm land	17(51)	10(20)	5(0)	76	2.4	31(93)	6(12)	0(0)	105	2.8	82(246)	3(6)	4(4)	256	2.9
Inadequate funding	12(36)	13(26)	7(7)	69	2.2	21(63)	16(32)	0(0)	95	2.6	20(60)	67(134)	2(2)	196	2.2
Poor capacity building on climate change	15(45)	11(22)	6(6)	73	2.3	24(72)	11(22)	2(2)	96	2.6	50(150)	38(76)	1(1)	227	2.6
Inadequate availability of Climate Change Information	11(33)	12(24)	9(9)	66	2.1	17(51)	18(36)	2(2)	89	2.4	50(150)	33(66)	6(6)	222	2.5
Lack of access to metrological report	18(54)	9(18)	5(5)	77	2.4	27(81)	6(12)	4(4)	97	2.6	77(23)	10(20)	2(2)	253	2.8
High cost of irrigation facilities	10(30)	16(32)	6(6)	68	2.1	11(33)	3(6)	23(23)	62	1.8	29(87)	33(66)	27(27)	180	2.0
Inadequate early warning information on climate change	7(21)	10(20)	15(15)	56	1.8	13(39)	11(22)	13(13)	74	2.0	60(180)	28(56)	1(1)	237	2.7
Grand mean					2.7					2.5					2.5
S.E pooled															2.4

Source: Field Survey, 2022 Key: VS = Very Serious, MS = Moderately Serious, NS = Not Serious

Note:  $\leq 1.5$  never serious constraint,  $\geq 1.5$  to  $2.4$  moderate serious constraints,  $\geq 2.5$  and above very serious constraint

The result from Table 3 indicated that male farmers in Abia revealed that inadequate farm land and lack of access to meteorological report with mean scores of 2.4 each, high cost of labour, poor capacity building and high cost of improved cassava varieties with mean ratings of 2.3 each, scarcity of improved yam and cassava varieties and inadequate funding with mean scores of 2.2 each, inadequate availability of climate change information and high cost irrigation facilities with

mean scores of 2.1 each and poor service delivery ( $\bar{X}=2.0$ ) were constraints to use of climate change adaptation strategies. Abia State farmers had high constraints ( $\bar{X}=2.7$ ) to the use adaptation strategies to climate change.

Ebonyi farmers averred that high cost of labour ( $\bar{X}=3.2$ ), scarcity of improved ym and cassava varieties and lack of knowledge on different adaptation strategies with

mean values of 3.0 each, high cost of cassava varieties and poor agricultural extension service delivery with mean scores of 2.9, inadequate land ( $\bar{X}=2.8$ ) were also a constraint. The farmers identified inadequate funding, poor capacity building to climate change and lack of access to meteorological data with mean values of 2.6 each and inadequate availability of climate change information ( $\bar{X}=2.4$ ) as a constraint to the use of climate change adaptation strategies. Ebony State farmers had high constraints ( $\bar{X}=2.5$ ) to the use adaptation strategies to climate change.

For Imo farmers, they affirmed that high cost of improved cassava varieties and inadequate farm land with mean ratings of 2.9, lack of access to meteorological data ( $\bar{X}=2.8$ ), high cost of labour and inadequate early information on climate change with mean scores of 2.7, scarcity of improved yam/cassava varieties and poor capacity building on climate change with mean scores of 2.6, inadequate availability of climate change information ( $\bar{X}=2.5$ ), inadequate funding ( $\bar{X}=2.2$ ), poor extension service delivery ( $\bar{X}=2.1$ ) and high cost of irrigation facilities ( $\bar{X}=2.0$ ) were constraints to use of climate change adaptation strategies. Imo farmers had high constraints ( $\bar{X}=2.5$ ) to use of climate change adaptation strategies. The pooled mean of male farmers in the Southeast was 2.4, indicating that they had high constraints to the use of climate change adaptation strategies to in the study area.

Mogaka, Bett, and Ng'ang'a, (2021), Mwaura, Kiboi, Bett, Mugwe, Muriuki, Nicolay and Ngetich, (2021), affirmed that vulnerability to climate change comes both from being located in the tropics, and from various socioeconomic, demographic, and policy trends limiting its capacity to adapt to change. Kanyenji, Oluoch-Kosura, Onyango and KaranjaNg'ang'a, (2020), reported that little capacity to adapt to climate change due to low levels of awareness, human and financial resources and institutional and technological capabilities were serious constraints to use of strategies to climate change.

#### Multiple Regression estimates of the relationship between socioeconomic characteristics of male arable crop farmers and their use of climate change adaptation strategies in South- East Nigeria

The results in Table 4 shows the regression estimates of relationship between socioeconomic characteristics of male arable crop farmers and their use of climate change adaptation strategies in South-East Nigeria. Among the four functional forms estimated, the linear form was chosen as the lead equation based on a high  $R^2$  value, number of significant factors and agreement with a priori expectations. The F-value was highly significant at 1.0% level indicating a regression of best fit. The  $R^2$  value of 0.5106 showed that 51.06% of the variability in level of adaptation was explained by the independent variable and the remaining 48.94% is due to error.

The result shows that the coefficient of age (0.0554) was positively signed and significant at 5.0% level of probability. This implies that any increase in age will lead to increase in climate change adaptation strategies for arable crop production among rural male in the study area.

The coefficient for annual income (-0.00008) was negatively signed and significant at 5.0% level of probability. This indicates that any reduction in annual income of the male farmers will lead to increase in climate change adaptation strategies for arable crop production Murithi and Mogaka, (2021),

The coefficient for farming experience (0.4859) was significant at 5.0% and positively related with climate change adaptation strategies for arable crop production among rural male in the study area. This implies that those male farmers with more years of farming experience will adapt climate change adaptation strategies faster than their counterparts with few years of experience, Similar by Nenna (2014) agreed that considerable experience in farming, could serve as an advantage in day to day running of farming activities.

**Table 4: Multiple Regression estimates of the relationship between socioeconomic characteristics of male arable crop farmers and their use of climate change adaptation strategies in South- East Nigeria**

Variables	Parameter	±Linear	Exponential	Double Log	Semi-Log+
Constant	$\beta_0$	65.8381 (9.76)***	4.2128 (52.99)***	4.2698 (9.51)**	73.2208 (1.92)*
Age	$\beta_1$	0.0554 (2.75)**	0.0005 (0.47)	0.0070 (0.13)	0.9119 (0.21)
Marital status	$\beta_2$	-0.6617 (-0.21)	-0.0094 (-0.26)	-0.0041 (-0.11)	-0.2031 (-0.06)
Household size	$\beta_3$	-0.0600 (-0.15)	-0.0004 (-0.09)	0.0037 (0.16)	0.2511 (0.13)
Annual income	$\beta_4$	-0.00008 (-3.09)**	-1.01e-06 (2.76)**	-0.4539 (-1.79)*	-4.2617 (-2.12)*
Education	$\beta_5$	0.04634 (-0.25)	-0.0007 (-0.33)	-0.0013 (-0.60)	-0.9501 (-0.53)
Type of cropping	$\beta_6$	-1.3006	-0.0171	-0.0119	-0.8581

system		(-0.70)	(-0.78)	()-0.54	(-0.46)
Farming experience	$\beta_7$	0.4859 (2.69)**	0.0010 (2.56)**	0.1770 (1.94)	1.4314 (2.29)*
Number of Extension visit	$\beta_8$	-0.2579 (-0.25)	-0.00185 (-0.15)	-0.00133 (-0.11)	-0.2079 (-0.20)
F-calculated		7.41	7.13	6.75	7.00
R-squared		0.5106	0.5023	0.4911	0.4986
Adjusted R-squared		0.4687	0.4599	0.4480	0.4559

Source: STATA Result, 2022

\*  $p \leq 0.10$ , \*\*  $p \leq 0.05$  and \*\*\* $p \leq 0.01$

+ = lead equation

### CONCLUSION

The study has shown that male arable crop farmers sourced information on climate from fellow farmers, friends and relatives and high utilization of climate change adaptation strategies. Multiple regression result revealed that age, household size, education, number of extension visit, and technological attributes influenced male farmers' use of climate change adaptation strategies in the study area.

### RECOMMENDATIONS

Policy should focus on ways to attract and encourage both young and old arable male farmers who are still agile and strong to remain in the business. This group of farmers would be able to put in a lot of effort at raising the current level of efficiency since they have been in the business and thus, are knowledgeable about the climate change adaption strategies

The study calls on the investment in rural education which is indispensable if climate change adaptation strategies should be adopted especially among the male arable farmers. Education is an important policy tool with potential to improve productivity of rural farmers.

Moreover, programmes aimed at sensitizing male arable crop farmers inclusive on climate change adaptation strategies through series of trainings and workshops must be encouraged by the Government to enhance their technological attributes. This can also be done through governmental support for research and the spread of suitable technologies to enable farmers adapt to climate change.

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