VOL. 02 NO. 2,
DECEMBER, 2023
E-ISSN 3027-0995
P-ISSN 3026-8265

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Biotechnology and Agricultural Research (JBAR)

Knowledge of the Causes and Impacts of Climate Change among Crop Farmers in Rivers State

*** Nnodim, A. U. & ** Oguzor, I. A., **Oreke, C. I., ***Agege, Jane; & **Iyede, H. O.**

*Department of Vocational & Technology Education, Rivers State University, Port Harcourt, Nigeria **Department of Agricultural Education, Federal College of Education (Technical), Omoku, Rivers State, Nigeria ***Department of Vocational and Technical Education, Ambrose Alli University, Ekpoma, Edo State, Nigeria.
a.oguzor@fcetomoku.edu.ng

Abstract

The paper is a descriptive survey which investigated the knowledge of the causes and impacts of climate change among crop farmers in Rivers State. The population of the study was 1139 crop farmers registered in the Rivers State Agricultural Development Programme, Port Harcourt from the two agricultural designated crop zones. The sample consisted of 470 crop farmers (zone 1=239; zone 3=231) computed using the Taro Yamane sample formula. Multistage sampling technique was adopted for the study. Firstly, purposive sampling technique was used to select the two designated agricultural crop zones and 10 LGAs (five from each crop zone), while random sampling was used to select the 470 respondents. A 24- item structured questionnaire designed in a Likert scale format was developed and validated by three experts. Cronbach alpha reliability test on the questionnaire yielded a high average of 0.87. Descriptive and inferential statistics were used. Result showed that females (zone 1=56.91%; zone 3=56.71%) formed the majority in the crop farming business in the area, with an average of eight years farming experience. The crop farmers were averagely educated (O'level - zone 1=44.35%; zone 3=40.69%) and most of them cultivated an average of less than one-hectare size (zone 1=43.10%; zone 3=61.04%) of farm land. Although, the crop farmers had very low knowledge about the causes of climate change (GM=2.11), the impact of

climate change was observed (GM=4.29) on their agricultural productivity. The crop farmers in the two agricultural zones differed significantly ($p=0.03<0.05$) in their knowledge of the causes of climate change in the area. The paper concludes that crop farming in the area is dominated by female farmers. Most crop farmers have very low knowledge of the causes of climate change. It recommended that crop farmers in the state should be trained through specially designed capacity development programmes to improve their knowledge and advocacies and public enlightenment campaigns should be organized to sensitize crop farmers.

Keywords: Knowledge, Causes and Impact, Climate Change, Crop Farmers, Crop Production

Introduction

Climate change is one of the most serious environmental threats facing mankind worldwide. According to Akinnagbe and Irohibe (2014), climate change is rapidly emerging as a global critical development issue affecting many sectors in the world. The Intergovernmental Panel on Climate Change (IPCC) (2013) defined climate change as statistically significant variations in weather conditions of the earth that persist for an extended period, typically decades or longer. IPCC (2013) also noted that climate change includes shifts in frequency and magnitude of irregular weather events as well as the slow continuous rise in global mean surface temperature. Climate change, in the context of this study, is the persistent changes in the atmospheric conditions of the earth as a result of natural and human factors that have drastically affected the environment, especially agricultural activities vis-à-vis crop production. Climate change events manifest in a variety of ways such as delayed precipitation (rainfall), high temperatures, sea rise, and flooding (Oguzor et al., 2015). Ebele and Emodi (2016) and Haider (2019) corroborated that climate change is evident in increases in temperature, variable rainfall, rise in sea level and flooding; drought and desertification; land degradation, more frequent extreme weather events, and loss of biodiversity. The impact of climatic events is greatly felt in agriculture, especially crop production.

The term climate change is the increase in the average temperature of the earth's atmosphere, mainly due to an increase in the concentration of CO_2 and other greenhouse gases. Greenhouse gases (GHGs) are gases that cause infrared radiation to be retained in the atmosphere, resulting in the warming of the earth's surface and the lower part of the atmosphere (IPCC, 2013). Agriculture is an important contributor to greenhouse gas emissions on a global scale. According to World Economic Forum

(2019), agriculture contributes about half of the global emissions of two of the most potent non-carbon dioxide greenhouse gases: nitrous oxide (N_2O) and methane (CH_4). However, crop production activities rely on operations such as clearing, tillage, application of manure/fertilizer, pesticides, and use of machines and other equipment. These operations are though necessary to achieve the goal of crop production to meet the food needs of Nigerians, but they also contribute substantially to the global stock of GHGs that warm the environment and subsequently lead to climate change (World Bank, 2019).

Agriculture remains the mainstay of the Nigerian economy, contributing over 40% of the country's Gross Domestic Product (GDP) (Chukwuone, 2015). Agriculture is the primary source of food and nutritional security for the welfare of the people as it provides food, feeds, fiber and a whole range of other services (Devendra, 2010). Agriculture is also one of the most vulnerable sectors to the anticipated climate change impact. Despite the technological advances in the 21st century, weather and climate are still key factors in determining agricultural production in most areas of the world, especially, Nigeria. One of the continents of the world that has been acknowledged to be most vulnerable to vagaries of climate change is Africa, particularly West Africa (IPCC, 2013). In Nigeria, over 70% of the population is engaged in agriculture as their primary occupation and means of livelihood (Haider, 2019; Onwutuebe, 2019). Since agricultural production in Nigeria is mostly rain-fed, unpredictable rainfall variation makes it difficult for farmers to plan their operations (Haider, 2019). Higher temperatures, lower rainfall, droughts, and desertification reduce farmlands, lower agricultural productivity and affects crop yield. On the other hand, intensified rainfall in the coastal region, sea-level rise, flooding; and erosion of farmland also lower agricultural production (Ogbuabor & Egwuchukwu, 2017). It follows therefore, that climate change (extreme reactions of weather phenomenon) is bound to impact agricultural production in general and crop farming in particular. Watson (2010) had cautioned that climate variability will have drastic consequences on agricultural production and productivity if efforts are not put to check or mitigate its occurrence. Farauta et al. (2011) highlighted that over 80% of the Nigerian population depends on rain-fed agriculture as their primary occupation leading to a high risk of food production system being adversely affected. This is a potential threat to food security. This was reiterated by the reports of a study conducted by Oguzor (2022) on the impact of climate change on the productivity of crop farmers in Rivers State.

In another submission, Enete et al. (2011) further opined that farmers in Africa face prospects of tragic crop failures, increase in crop yield decline; reduced agricultural productivity, and increased diseases due to the increasing impact of climate change on the agricultural sector. In a report by Chukwuone (2015), an experimental climate response function and fourteen climate predictions conducted in Africa, seven

countries were predicted to suffer the largest average losses in the agricultural sector. The countries in descending order are Nigeria, Sudan, Algeria, Cameroon, South Africa, Morocco, and Zaire. Another report of Food and Agriculture Organization (FAO) (2016) noted that among 53 Sub-Saharan African countries, Nigeria was placed third with 64,239 gigatonnes equivalent (Gt e) of carbon dioxide ($CO_{2)}$ emissions from agriculture, coming behind Sudan (72,517 Gt) and Ethiopia (96,256 Gt). Nigeria was also reported with the highest (599 Gt e) of CO_2 among Sub-Saharan African countries arising from burning crop residues. These reports imply that Nigeria is in grave danger if actions are not taken against the climate change projections. Since scholars have cautioned that Nigeria is highly vulnerable to the whims of climate change because of its long (800km) coastline which is prone to sea-level rise and the risk of fierce storms, incidentally, Rivers State is located along this coastline.

According to Enete (2014), the durations and intensities of rainfalls have increased in the last three decades producing large runoffs and flooding in many places. Federal Government of Nigeria (FGN) (2013) and Haider (2019) also reported that rising sea levels and ocean surges in southern Nigeria have submerged villages in some places in the Niger Delta (including Rivers State). FGN (2013) further lamented about the severe floods in 2010 and 2012 which resulted in unprecedented damage and losses of agricultural lands, farms, crops, and produce. This trend is expected to continue with increased rainfall variability and increase in precipitation by approximately 5 - 20 percent and subsequent flooding in some humid areas of the forest regions in Southern Nigeria (where Rivers State is located) (Oladipo, 2010). The reports of the National Emergency Management Agency (NEMA) (2012) noted that heavy rains between July and October 2012 led to an overflow of rivers, aggravated by a breach of irrigation reservoirs and caused the destruction of farmlands, crop fields, livestock, property, agricultural and other infrastructure as well as other means of livelihood (Chukwuone, 2015; Federal Ministry of Environment (FME), 2011). FME (2014) and Matemilola (2019) also reported that South-south Nigeria (Niger Delta region) where Rivers State is located is the most vulnerable to floods, due to sea-level rise, increased precipitation, coastal erosion of arable lands which have resulted in huge agricultural losses.

Rivers State is one of the 36 states of Nigeria with high agricultural capacity (over 760, 000 hectares of land), particularly in the upland areas, crop, livestock and fish farming activities are also common among the population in Rivers State (Otto & Ukpere, 2014). Rivers State vegetation consists of the tropical rainforest and mangrove swamp where farming is the major occupation of the people. Farmers in Rivers State cultivate and produce several varieties of products that include crops (cassava and its products, potato, yam, oil palm, plantain, banana, cocoyam, fluted pumpkin, okra, pepper, cucumber, etc. (Howard, 2007; Ibemere & Ezeano, 2013; Okezie & Anurigwo, 2016). Crop farmers produce and supply food crops for the teeming population of the

state. Most of these agricultural produce in time past were of high yield, readily available, and affordable cushioning the rising demand by consumers due to the increasing human population with a regular and steady income for farmers. This trend of increased agricultural production has been altered in recent times by the effects of climate change. No wonder Onwutuebe (2019) succinctly opined that reduction in the agricultural production activities that induce climate change would have a significant impact on the livelihood of the population, food security and the Nigerian economy. In the submission of World Economic Forum (2019), reducing tillage, expanding crop rotations, planting cover crops and reintegrating livestock into crop production systems have proven to reduce agriculture's own footprint as well as capture the excess carbon generated by other industries. This captured carbon is then converted into plant material and/or soil organic matter, improving soil health and increasing the ability to produce food on the land in the future. Due to increased level of agricultural production among nations intended to meet the food security needs of the growing population, climate change crisis is becoming more challenging now, hence, threatening food security (Okezie & Anurigwo, 2016). It is on this basis that the paper investigated the knowledge of causes and impact of climate change among crop farmers in Rivers State.

Objectives of the Study

Specifically, the study sought to:

i. describe the demographic characteristics of crop farmers;
ii. ascertain the knowledge of the crop farmers on the causes of climate change;
iii. identify the impact of climate change on the productivity of the crop farmers;

Research Questions

i. What are the demographic characteristics of the crop farmers in Rivers State?
ii. What is the knowledge of the crop farmers on the causes of climate change in Rivers State?
iii. What is the impact of climate change on the productivity of the crop farmers in Rivers State?

The following null hypotheses were designed to guide the study.

1. There is no significant difference between the mean responses of crop farmers in agricultural zones 1 and 3 on their knowledge of the causes of climate change in Rivers State.
2. There is no significant difference between the mean responses of crop farmers in agricultural zones 1 and 3 on the impact of climate change on crop production in Rivers State.

Methodology

This study was carried out in Rivers State, one of the 36 states of Nigeria. Rivers State, a state in Nigeria's Niger Delta region consists of the mangrove swamp, freshwater swamp, and the rain forest vegetation with flat topography and a network of rivers and tributaries. Rivers State lies between latitude 5° North and mid-way between longitude 5° East of the Greenwich Meridian (Oguzor, 2022). There are three agricultural zones according to the agricultural zoning system of Rivers State Agricultural Development Programme (Rivers State ADP Annual Reports cited in Iyagba, 2013). The study adopted a descriptive survey design. In the view of Ezekiel et al. (2017), a descriptive survey design is one that uses a questionnaire to collect data about the characteristics, experiences, knowledge, or opinions of a sample or a population. The population of the study was 1139 crop farmers registered in the Rivers State Agricultural Development Programme, Port Harcourt from the two agricultural designated crop zones. The sample consisted of 470 crop farmers (zone 1 = 239; zone 3 = 231) computed using the Taro Yamane (1967) sample formula.

Multistage sampling technique was adopted for the study. Firstly, purposive sampling technique was used to select the two designated agricultural crop zones and 10 LGAs (five from each crop zone), this was done because Rivers State is structurally partitioned into three agricultural zones, whereas the two chosen zones are designated crop zones. Random sampling was used to select the 470 respondents. A 24 - item structured questionnaire designed in a Likert scale format was developed and validated by three experts. The questionnaire was made up of two parts, section A and section B. Section A elicited information on the demographic characteristics of the crop farmers, while section B presented items that sought answers to research questions two and three relating to farmers knowledge on the causes of climate change and the impact of climate change in River State. Cronbach alpha reliability test on the questionnaire yielded a high average of 0.87. Descriptive statistics was used, any item of the questionnaire with a mean value of 3.0 or above was accepted and those below 3,0 were not accepted. Z-test inferential statistics was also used to determine the significant differences ($p<0.05$) between the opinion of farmers in the two agricultural zones on their knowledge on the causes of climate change and the impact of climate change in River State.

Results and Discussion

Demographic Characteristics of Crop Farmers in Rivers State

Table 1: ***Demographic Characteristics of Crop Farmers in Agricultural Zones 1 and 3 in Rivers State***

Variables	Zone 1 (n_1=239) Frequency	(%)	Mean	Zone 3 (n_2=231) Frequency	(%)	Mean	Grand Mean
Sex							
Male	103	43.10		100	43.29		
Female	136	56.90		131	56.71		

Age (Years)							
Less than 30	20	8.37		10	4.33		
30 – 39	40	16.74		31	13.42		
40 – 49	132		55.23	143	61.90	44years	45 years
50 – 59	46years			31	13.42		
60 – 69	25	10.46		10	4.33		
70 years and above	15	6.48		6	2.60		
	7	2.93					
Marital Status							
Single	40	16.74		28	12.12		
Married	170	71.13		160	69.26		
Widowed	21	8.79		25	10.82		
Divorced	8	3.35		18	7.79		
Educational Attainment							
No Formal Education							
Primary (FSLC)	13	5.44		17	7.36		
Secondary (O Level)	8	3.35		22	9.52		
OND/NCE Certificate	106	44.35		94	40.69		
First Degree	42	17.57		27	11.69		
Masters' Degree	52	21.76		39	16.88		
Doctor of Philosophy	29	12.13		22	9.52		
	8	3.35		10	4.33		
Farming Experience (Years)				26	11.26		
1 – 3	22	9.21		33	14.29		
4 – 6	40	16.74	7years	103	44.59	9years	8 years
7 – 9	120	50.21		52	22.51		
10 – 12	42	14.57		12	5.19		
13 - 15	9	3.77		5	2.16		
15 years and above	6	2.51					
Household Size							
1 – 3	49	20.50		96	41.56		
4 – 6	158	66.11	5 persons	85	36.80	5	5 persons
7 – 9	25	10.46		persons			
10 – 12	4	1.68		40	17.32		
13 - 15	3	1.26		8	3.46		
15 and above	0	0		2	0.87		
				0	0		
Farm Size (Hectare)							
Less than 1ha	103	43.10	<1ha	41	61.04	<1ha	<1ha
2ha	96	38.91		50	21.64		
3ha	21	8.79		19	8.23		

4ha	13	5.44	21	9.09
Above 5ha	6	2.51	0	0

Source: Field Survey (2021)

The results in Table 1 showed that in the two agricultural crop zones, Agricultural Zone 1 designated as crop zone had a sample of 239 crop farmers (50.85%) while Agricultural Zone 3 designated for crops and livestock had a sample of 231 crop farmers (49.15%). The percentage of male and female crop farmers in the area were (43.10) and (56.90) for zone 1, whereas zone 3 had 43.29 and 56.71 percent, respectively, showing that female farmers dominated crop farming business in the area. The table also showed that the grand mean age of crop farmers was 45 years, with the age bracket 40-49 years having 55.33% in zone 1 and 61.90% in zone 3. The results also indicated that majority of the crop farmers were married, 71.13% for zone 1 and 69.26% for zone 3.

The results in Table 1 further showed the educational attainment of the respondents. It showed that in zone 1 those with secondary school certificate (O'level) are more in the crop farming business with 44.35%. Others were first degree (21.76%) and master's degree (12.13%). For agricultural zone 3, majority (40.69%) had secondary school certificate (O'level), followed by first degree (16.88%), and OND/NCE certificate (11.69%). Only 3.35% and 4.33% of the respondents had PhD degree in Zone 1 and Zone 3, respectively. The table also indicated the mean farming experience of 8 years. The responses in zone 1 were 7-9 years (50.21%), 10-12 years (17.74%) and 4-6 years (16.74%). The mean household size of five persons was observed. The result presented in the table also indicated that most of the crop farmers, 43.10% in zone 1 and 61.04% in zone 3 cultivated farm sizes of less than one hectare.

Knowledge of crop farmers on the causes of climate change in Rivers State

Table 2: ***Mean Responses of Crop Farmers in Agricultural Zones 1 and 3 on their Knowledge of the Causes of Climate Change in Rivers State***

S/N	ITEMS	Mean (n_1=239)	SD	Decision	Mean (n_2=231)	SD	Decision	Mean of Zone 1 & Zone 3	Decision
1.	Climate change occurs as a result of clearing forests (deforestation)	4.47	0.67	Agree	4.71	0.49	Agree	4.59	Agree
2.	The cultivation of the land can lead to climate change	1.52	0.60	Disagree	1.17	0.45	Disagree	1.34	Disagree
3.	The making and use of organic manure	1.66	0.92	Disagree	1.61	1.07	Disagree	1.64	Disagree

	can cause climate change								
4.	Climate change can result from burning of cleared vegetation	1.42	0.67	Disagree	2.83	0.27	Disagree	1.63	Disagree
5.	Agrochemicals used by farmers can cause climate change	1.89	1.04	Disagree	1.83	1.27	Disagree	1.58	Disagree
6.	Industrial wastes contribute to climate change	1.82	0.53	Disagree	1.25	0.43	Disagree	1.54	Disagree
7.	Chemicals used at home to kill insects (insecticides) can cause climate change	1.35	0.53	Disagree	1.17	0.45	Disagree	1.26	Disagree
8.	The application and use of inorganic fertilizer can cause climate change	2.89	0.57	Disagree	1.26	0.48	Agree	2.08	Disagree
9.	The cutting down of trees for firewood can lead to climate change	3.99	1.01	Agree	2.61	1.06	Agree	3.30	Agree
10.	Exposing the land during soil tillage operations can lead to climate change	1.69	0.90	Disagree	1.26	0.48	Disagree	1.48	Disagree
11.	Production of smoke from firewood and kitchen stove can lead to climate change	2.47	0.85	Disagree	1.53	0.60	Disagree	2.00	Disagree
	Grand Mean	**2.29**	**0.75**		**1.93**	**0.64**		**2.11**	

Source: Field Survey (2021). Agree = Have Knowledge; Disagree = No Knowledge; Criterion Mean = 3.0

Analysis in Table 2 showed the responses of crop farmers from agricultural zones 1 and 3 on their knowledge on the causes of climate change in Rivers State.The crop farmers only agreed to items 1- deforestation (GM=4.59) and 9- cutting down of trees for firewood (GM=3.30) as causes of climate change. Crop farmers disagreed with the other items as causes of climate change, namely; cultivation of the land (GM=1.34), making and use of organic manure (GM=1.64), burning of cleared vegetation (GM=1.63); use of agrochemicals by farmers (GM=1.58) and application of inorganic manure (GM=2.08). Other items not accepted by the respondents were industrial wastes (GM=1.54), chemicals used at home to kill insects (GM=1.26); exposing the

land during soil tillage (GM=1.48) and the production of smoke from firewood and kitchen stove (GM=2.00). The grand means for zone 1 (2.29) and zone 3 (1.93) were both less than the criterion mean (3.0).

Hypothesis 1: There is no significant difference between the mean responses of crop farmers in agricultural zone 1 and agricultural zone 3 on their knowledge of the causes of climate change in Rivers State.

Table 3: ***Z-test Analysis on Responses of Crop Farmers in Agricultural Zones 1 and 3 on their Knowledge of the Causes of Climate Change in Rivers State***

Variables	N	$\bar{x}$	SD	Df	z-value	p-value	Decision
Zone 1	239	2.29	0.75	468	1.12	0.03*	Reject
Zone 3	231	1.93	0.64				

*p-value = 0.03 < 0.05, there is a significant difference. Source: Field Survey (2021)

In Table 3, the z-test result indicated that there was a significant difference between the mean responses of crop farmers in agricultural zones 1 and 3 in Rivers State. From the table, z (470) = 1.12, p-value (0.03) < α (0.05). Therefore, since p-value (0.03) is less than α (0.05), the null hypothesis of no significant difference was rejected while the alternate was accepted.

Impact of climate change on the productivity of crop farmers in Rivers State

Table 4: ***Mean Responses of Crop Farmers in Agricultural Zones 1 and 3 on the Impact of Climate Change on Productivity in Rivers State***

S/N	ITEMS	Mean (n_1=239)	SD	Decision	Mean (n_2=231)	SD	Decision	Mean of Zone 1 & Zone 3	Decision
1	Climate changes brings about prevalence of pests and diseases of crop plants leading to losses	4.25	0.72	Agree	4.21	0.67	Agree	4.23	Agree
2	Climate change causes a decline in the yield of crops	4.47	0.87	Agree	4.51	0.65	Agree	4.49	Agree
3	There is loss of quality of crops produced in the area	4.55	0.63	Agree	4.03	0.57	Agree	4.29	Agree
4	Climate change brings about regular floods changing the farming season	4.13	0.74	Agree	4.19	0.72	Agree	4.16	Agree
5	High temperature and heat stress lead to wilting and death of cultivated crops	4.47	0.68	Agree	4.52	0.65	Agree	4.50	Agree
6	Drought in the year compels crop farmers to spend more on irrigation	4.54	0.64	Agree	4.60	0.57	Agree	4.57	Agree
7	Climate change leads to shortage of farm produce	4.41	0.70	Agree	4.45	0.66	Agree	4.43	Agree
8	Climate change can lead to scarcity and high cost of seeds and seedlings for planting	4.43	0.80	Agree	4.48	0.77	Agree	4.46	Agree

!	Flooding resulting from climate change leads to erosion of soil and cultivated crops	4.55	0.63	Agree	4.60	0.57	Agree	4.58	Agree
!	Climate change causes farmers to make poor harvests	3.88	1.12	Agree	3.93	1.09	Agree	3.91	Agree
!	Climate change brings about heavy winds and thunder storms that destroy crop farms and structures	4.50	0.61	Agree	4.53	0.57	Agree	4.52	Agree
!	Climate change leads to changes in the cropping season leading to poor yield	4.54	0.75	Agree	4.60	0.57	Agree	4.57	Agree
!	Climate change destroys some arable lands by flood	4.41	1.08	Agree	4.40	0.66	Agree	4.41	Agree
	Grand Mean	**4.39**	**0.77**		**4.39**	**0.67**		**4.39**	

Source: Field Survey (2021). Agree = Have Knowledge; Disagree = No Knowledge; Criterion Mean = 3.0

Analysis in Table 4 showed the responses of crop farmers on the impact of climate change on productivity in agricultural zone 1 and agricultural zone 3 in Rivers State. The respondents agreed to all the items presented as impact of climate change on productivity in the two agricultural zones. Responses for zone 1 include prevalence of pests and diseases (4.25), decline in yield (4.47); loss of quality of crops (4.55), regular floods (4.13), high temperature and heat stress (4.47), shortage of farm produce (4.41), poor harvests (3.88) and drought (4.54) among others.

Hypothesis 2: There is no significant difference between the mean responses of crop farmers in agricultural zones 1 and 3 on the impact of climate change on productivity in Rivers State.

Table 5: ***Z-test Analysis on Responses of Crop Farmers in Agricultural Zones 1 and 3 on the Impact of Climate Change on Productivity in Rivers State***

Variables	N	$\bar{x}$	SD	Df	z-value	p-value	Decision
Zone 1	239	4.39	0.77	468	2.10	0.26	Accept
Zone 3	231	4.39	0.67				

p-value = 0.26 > 0.05, there is no significant difference. Source: Field Survey (2021)

In Table 5, the z-test analysis showed that there is no significant difference between the mean responses of the crop farmers in agricultural zones 1 and 3 on the impact of climate change on productivity in Rivers State. From the table, z (470) = 2.10, p-value (0.26) > α (0.05). Therefore, since the p-value (0.26) in greater than α (0.05), the null hypothesis of no significant difference was retained and accepted.

Demographic Characteristics of Crop Farmers in Rivers State

The demographic characteristics of crop farmers in the study area (Table1) revealed that females formed the majority (zone 1=56.90%; zone 3=56.71%) of crop farmers in the study area. This could mainly because females are more readily disposed to crop production activities. This finding is in consonance with the report of Okoro et al.

(2016) and Oguzor (2022) who observed that the majority (60%) and (57%) of the respondents were females respectively. The study also revealed that the most dominant age bracket in crop farming was 40-49 years with a mean age of 45 years (Table1). This is in consonance with the finding of Osasogie and Omorogbe (2018) who reported that young individuals of between 40-49 years were more (60.37%) in the crop farming business. The findings also indicated that most of the crop farmers are averagely educated with a high percentage of secondary school (O'level) certificate (zone 1=44.35%; zone 3=40.69%). This finding agrees with Nwaiwu et al. (2014) and Oguzor (2022) who investigated climate change trends and mitigation strategies respectively, and observed that crop farmers were characterized with a mean level of education.

Knowledge of Crop Farmers on the Causes of Climate Change in Rivers State

The causes of climate change in Rivers State as revealed in Table 2 are deforestation (GM=4.59), and cutting down of trees for firewood (GM=3.30). These two highlighted causes were identified by crop farmers in the study area as the causes of climate change in Rivers State. These findings showed that the crop farmers have very low knowledge (GM=2.11) on the causes of climate change in the area. These findings agree with Okoro et al. (2016) who reported that less than 40% of the farmers were aware of the occurrence of climate change within their environment. In another submission, the authors posited that in Nigeria, the traditional and predominant methods of clearing farmlands are bush burning; in addition to the use of firewood as a cooking energy source. Enete and Amusa (2010) supported and corroborated that the Nigerian forest is being depleted because of the rising population due mainly to indiscriminate utilization of its resources for firewood among other uses.

The findings of this study in Hypothesis 1 (Table 3) revealed that there is a significant difference between the mean responses of crop farmers in agricultural zones 1 and 3 on their knowledge of the causes of climate change in Rivers State. As shown in the table, the z - test showed a statistically significant difference between the mean responses of crop farmers from agricultural zone 1 and agricultural zone 3, $z(470) = 1.12$, p-value = $0.03 < \alpha = 0.05$. The null hypothesis of no significant difference was rejected while the alternate was accepted. This finding is in agreement with the reports of Okpe and Aye (2015), Iheke and Agodike (2016) and Oduniyi and Tekena (2019) who corroborated in their reports that educational qualification significantly ($p<0.05$) influenced farmers' level of awareness, knowledge, and adoption of measures for the mitigation of climate change.

Impact of Climate Change on Productivity in Rivers State

The impact of climate change on productivity in Rivers State as presented in Table 4, manifests in the prevalence of pests and diseases (GM=4.23), decline in the yield of crops (GM=4.49), loss of quality of crops (GM=4.29), regular floods (GM=4.16), high temperature and heat stress (GM=4.50), and shortage of farm produce (GM=4.43) among others. These findings agree with the works of Iheke and Agodike (2016) who reported that crop production was severely affected by unusual early rains followed by weeks of dryness, incidences of diseases, erratic rainfall patterns, heavy winds; increase in pest problems, loss of forest resources, weed infestation, overflowing rivers and streams among others. In a similar submission, Chukwuone (2015) observed that the main outcomes of climate change were flooding, decline in crop yields, food price increases, and increased number of people at risk of hunger and food insecurity.

The result of Hypothesis 2 as presented in Table 5 showed that there was no significant difference between the mean responses of crop farmers in agricultural zones 1 and 3 on the impact of climate change on productivity in Rivers State. From the table, the z- test did not reveal any statistically significant difference between the mean responses of crop farmers in agricultural zone 1 ($M = 4.39$, $SD = 0.77$) and agricultural zone 3 ($M = 4.39$, $SD = 0.67$), $z(470) = 2.10$, p-value $(0.26) > \alpha\ (0.05)$. Therefore, since the p-value (0.26) in greater than α (0.05), the null hypothesis was retained and accepted.

Conclusion

Based on the findings of the study, it is concluded that crop farming in the area is dominated by female farmers. Most crop farmers have very low knowledge of the causes of climate change, although they could identify the impact of climate change on productivity. The crop farmers generally cultivated an average of less than one hectare of land in the two agricultural zones in Rivers State. More so, the crop farmers in the two agricultural zones differed significantly ($p<0.05$) in their knowledge of the causes of climate change in the area.

Recommendations

The following recommendations were made:

1. Crop farmers in Rivers State should be trained through specially designed capacity development programmes by specialized government agencies to improve their knowledge on the causes of climate change.
2. The state government through its ministries of agriculture, information and other ancillary agencies should carryout advocacies and public enlightenment campaigns on the causes of climate change through regular organization of seminars, and workshops to sensitize crop farmers in the two agricultural zones in Rivers State.

3. The state government through her law-making organ (legislature) can enact laws and make policies on issues and matters pertaining to climate change in the state, especially as it relates to supports in the event of negative climate change propelled disasters in the state.

References

Akinnagbe, O. M., & Irohibe, I. J. (2014). Agricultural adaptation strategies to climate change impacts in Africa: A review. *Bangladesh Journal of Agricultural Research, 39*(3), 407-418.

Alawa, D. A., Asogwa, V. C., &Ikelusi, C. O. (2014). Measures for mitigating the effects of climate change in crop production in Nigeria. *America Journal of Climate Change, 3*,161-168. http://dx.doi.org/10.4236/ajcc.2014.32015.

Chukwuone, N. (2015). Analysis of the impact of climate change on growth and yield of yam and cassava and adaptation strategies by farmers in Southern Nigeria. African Growth and Development Policy Modelling Consortium and International Food Policy Research Institute.

Devendra, C. (2010). Small farms in Asia: Revitalising agricultural production, food security and rural prosperity. Academy of Sciences, Malaysia.

Ebele, N. E., & Emodi, N. V. (2016). Climate change and its impact in Nigerian economy. *Journal of Scientific Research and Reports, 10*(6), 1-13. https//www.journaljsrr.com/index.php/JSSRR/article/view/21917/40737

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.* https://journals.openedition.org/factsreports/678

Enete, A. A., Madu, I. I, Mojekwu, J. C., Onyekuru, A. N., Onwubuya, E. A., & Eze, F. (2011). Indigenous agricultural adaptation to climate change: Study of Southeast Nigeria. Research Paper No. 6. African Technology Policy Studies Network.

Enete, I. C. (2014). Impacts of Climate change on agricultural production in Enugu state, Nigeria. *Journal of Earth Science Climate Change, 5*(9), 234. https://www.comicsonline.org/openaccess/impacts-of-climate-change-on-agricultural-production-in-enugu-state-nigeria-2157-7617.

Ezekiel, P. O., Oguzor, I. A., Onyeukwu, F. O. N., Onwuchekwa, C. A., & China, M. A. H. (2017). *Research techniques in technology education.* Great Stars Publishers.

Farauta, B. K., Egbule, C. L., Idrisa, Y. L., &Agu, V. C. (2011). Climate change and adaptation measures in Northern Nigeria: Empirical situation and policy implications. Working Paper Series No. 62. African Technology Policy Studies Network.

Federal Government of Nigeria. (2013). Nigeria post-disaster needs assessment 2012. Communication. NC 2. https://unfccc.int/sites/default/files/resource/nganc2.pdf

Federal Ministry of Environment. (2014). United Nations climate change Nigeria. National floods. https://.www.gfdrr.org/sites/gfdrr/files/NIGERIA.pdfhttps://www.gfdrr.org/sites/gfdrr/files/NIGERIA_PDNA_PRINT_05_29_2013_WEB.pdf

Food and Agriculture Organization. (2016). The state of food and agriculture: Climate change, agriculture and food security. FAO.

Haider, H. (2019). Climate change in Nigeria: Impacts and responses. Knowledge for Development Helpdesk Report 675. Institute of Development Studies.

Ibemere, I. F., & Ezeano, C. I. (2014). Status of fish farming in Rivers State, Nigeria. *Journal of Fisheries and Aquatic Science, 9, 321-329.* https://www.**doi:** 10.3923/jfas.2014.321.329

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), 213 – 220.

IPCC (2013). Summary for policy makers in climate change 2013: The physical science basis. Contribution of Working Group to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Iyagba, A. G. (2013). Assessing the safety use of herbicides by horticultural farmers in Rivers State, Nigeria. *European Scientific Journal, 9*(15), 98 – 108.

Matemilola, S. (2019). Mainstreaming climate change into the environmental impact assessment process in Nigeria: Perspectives from projects in the Niger Delta region. *Climate, 7*(2), 29. https://doi.org/10.3390/cli7020029.

Nwaiwu, I. U. O., Ohajianya, D. O., Orebiyi, J. S., Ibekwe,U. C., Lemchi, J. I., Onyeagocha, S. U. O., Odoemena, B., Utazi, C. O., Osuagwu, C. O., & Tasie, C. M. (2014). Climate change trend and appropriate mitigation and

adaptation strategies in Southeast Nigeria. *Global Journal of Biology, Agriculture and Health Sciences, 3*(1), 120-125.

Oduniyi, O. S., & Tekana, S. S. (2019). Adoption of agroforestry practices and climate change mitigation strategies in North West province of South Africa. *International Journal of Climate Change Strategies and Management, 11*(5), 716-729. https://doi 10.1108/IJCCSM-02-2019-0009

Ogbuabor, J. E., & Egwuchukwu, E. I. (2017). The impact of climate change on the Nigerian economy. *International Journal of Energy Economics and Policy*, *7*(2), 217-223. https://dergipark.org.tr/en/download/article-file/361739

Oguzor, I. A. (2022). *Strategies for mitigating the impact of climate change on crop production in Rivers State, Nigeria.* Unpublished Doctoral Thesis, Department of Agricultural Science, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt.

Oguzor, I. A., Oguzor, B. G., Amugo, N. M., & Okorie, J. (2015). Advocacy on issues of climate change and food security in Nigeria. *Nigerian Journal of Education, Science and Technology, 3*(1), 7 – 12.

Okezie, C. R., & Anurigwo, E. C. (2016). Fish farmers adaptive capacities to climate change in Port Harcourt riverine areas of Rivers State, Nigeria. *Journal of Agriculture and Earth Science*, *2*(4), 66 - 73. https://www.iiardpub.org.

Okpe, B. E., & Aye, G. C. (2015). Adaptation to climate change by farmers in Makurdi, Nigeria. *Journal of Agriculture and Ecology Research International, 2*(1), 46 - 57.

Oladipo, E. (2010). Towards enhancing the adaptive capacity of Nigeria: A review of the country's state of preparedness for climate change adaptation. https://ng.boell.org/sites/default/files/uploads/2013/10/nigeria

Onwutuebe, C. J. (2019). Patriarchy and women vulnerability to adverse climate change in Nigeria. https://doi.org/10.1177/2158244019825914SAGE

Osasogie, D. I., & Omorogbe, I. (2018). Socioeconomic determinants of farmers adaptation strategies in climate change hazards in Benue State, Nigeria. *Journal of Biodiversity, Bio-prospecting and Development, 5*(1), 21-25. https://doi.10.4172/2376-0214.1000169

Otto, G., & Ukpere, W. I. (2014). Rural development projects in Nigeria: The case of Rivers State. *Mediterranean Journal of Social Sciences, 5*(3), 604 - 612

Watson, D. (2010). Climate change, cropping systems and coping strategies: Impacts of climate change on food security in sub-Saharan Africa. Proceedings of the 14th Annual Symposium of the International Association of Research Scholars and Fellows. International Institute for Tropical Agriculture.

World Bank. (2019). The World Bank Group Action Plan on climate change adaptation and resilience. http://www.steresources.worldbank.org/INTWDR

World Economic Forum. (2019). Agriculture to fight climate change. https://www.weforum.org/agenda/2019/09. Here's how we can use agriculture to fight climate change | World Economic Forum (weforum.org)