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PERCEIVED EFFECTS OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTIVITY IN IGBO-ETITI LOCAL GOVERNMENT AREA OF ENUGU STATE, NIGERIA

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ABSTRACT

Climate change has been adduced to negatively affect agricultural productivity in agrarian communities. This study examined the effects of climate change on agricultural productivity in agrarian communities of Igbo-Etiti Local Government Area of Enugu State, Nigeria. Data were collected through the use of mixed and complementary methods such as observation, questionnaire survey and key informant interviews. The data generated were analyzed using descriptive statistics. Results reveal that majority (54.4%) of the respondents were female with farming the primary source of livelihood for majority (56.5%). Majority (59.1%) of the farmers were aged between 35 and 54 years, and majority (53%) had more than years farming experience. The results also revealed climate change as the major factor affecting agricultural productivity in the study area. The findings show that farmers in the study were highly vulnerable to the adverse effects of climate change largely because they depend on rain-fed agriculture. Agricultural productivity was found to have decreased due to the influence of climate change as manifested in rainfall decline, delayed onset of rain, increased temperature, dryness of soil and prolonged dry season. However, the reduced agricultural productivity had led to farmers engaging in other secondary occupation such as trading. Farmers empowerment through loans and grants, Climate Smart Agriculture, subsidies in the areas of improved climate change-resistant plants, among others were recommended to improve agricultural productivity, food security and cushion the effects of climate change, thereby enhancing resilience.

Keywords: Climate Change, Agricultural Productivity, Igbo-Etiti, Enugu State, Nigeria

INTRODUCTION

Climate is the general weather conditions in an area over a long period and one of the major influential factors in agriculture (Ani et al., 2022). It influences the type of crops cultivated at any specific location on earth, livestock farming and determines what types of land use are possible. Precipitation, temperature and sunlight have been noted as some influential climate factors that have direct effect on plants and animals farming and determine the spread of pests and diseases among other effects (Agbola and Fayiga, 2016; Osuji et al, 2023). Thus, climate is critical in agricultural crop cultivation and productivity.

Climate change is defined as a change in climate that is attributable directly or indirectly to human activities, that alters the atmospheric composition of the earth which leads to global warming (Ngigi, 2009; Adishi and Oluka, 2018; Malhi et al., 2021). Climate change has emerged as a major challenge to agricultural development in Africa. There has been an increasingly unpredictable and erratic weather systems in the continent with resultant negative effects on food security and rural livelihoods (Muringai et al., 2020). For instance, the recent wide spread destruction of homes and farms by floods in Nigeria, and the prolonged drought in Ethiopia, demonstrate the extent of the threat posed by climate change in Africa (Oyinloye et al., 2018). Consequently, the effects of climate change on agriculture has been noted to be dependent on the rate of the change severity, and the adaptation capacity of farmers (Nze and Eboh, 2011; Oyewole et al., 2022).

Nonetheless, agriculture is very sensitive to weather and climate and depends heavily on water, land, and other natural resources affected by climate (Gowda et al., 2018; Anabaraonye et al., 2022). Climate change has both positive and negative effects. For instance while it could lengthen the growing season or encourage multiple cropping in some regions due to increase in rainfall, it could also make agricultural practices more difficult in others due to high temperatures (Odenkule, 2014; Adamaagashi et al, 2023). Thus, a significant cost of the damage caused by climate change impacts is mostly felt in the areas of agriculture. According to Mba et al. (2020), the combined effect of food crisis and the global financial downturn has forestalled progress in rural development as a result, leading to high hunger and malnutrition trends.

However, 24% people in Sub-Saharan Africa (SSA) are recently malnourished (Beyene, 2023), although the World Bank has predicted that by 2080, SSA would be the most food insecure region (surpassing Asia) in the world with 40-50% of undernourished people living in this region. In addition, by the 2080, portions of arable land suitable for agricultural production are predicted to decline by 9-20% (Berhanu and Wolde, 2019), thereby confirming that there exists a significant relationship

between climate and agriculture; agriculture is dependent on climate (Omotosho et al., 2023)

Notably, Nigeria is one of the sub-Saharan African countries identified as vulnerable to changing climate (Ughaelu, 2017; Ani et al., 2022). Several studies have noted that food productivity have declined due to have found that recurring environmental disasters experienced in various parts of the country (Ayinde et al. 2011; Ikem, 2018; Ughaelu, 2017; Ani et al., 2022; Gbenga et al., 2020). Moreover, in 2012, Nigeria experienced the most devastating floods surpassing all the severe flooding recorded in the last forty years, which led loss of lives and livestock, displacement of people, destruction of farmlands and invariably food insecurity (Ogbuchi, 2020). Other severe floods occurred in 2015, 2017, 2018 and 2019, though not as severe as the floods of 2012 with milder ones occurring in 2014 and 2016 (Umar and Gray, 2023). However, the changes in environmental conditions resulting from climate change has differently impacted on the six vegetative zones of Nigeria (Okoye, 2016; Tajudeen et al, 2022).

The impacts of climate change vary across regions. For instance, on the one hand, in the semi-arid Sudan and arid Sahel Savannah region, reduced rainfall, drought and desertification are the noticed manifestations of climate change while in the Northern and Southern Guinea savannah belt, changes in rainfall pattern especially late onset of rainfall and prolonged dry season are noticed. It also has caused areas along the shorelines to experience devastating flooding during the rainy season (Agba et al., 2017)). On the other hand, in the Rain Forest zone, the impacts of climate change are seen in the areas of delays in the onset of rainfall, longer dry season, heat waves and intense flooding along the coastal lines while in the Mangrove Swamp, the impacts are flooding in usually dry plains and persistent sea level rise with associated risk to farming activities, and rise in water temperature which negatively affects fishing (Berhanu and Wolde, 2019).

Studies have revealed that high rainfall, desertification and flooding are extreme climatic conditions that adversely affect food production (Eneji et al., 2020; Onyeneke et al., 2020; Enize and Agala, 2023). In addition, productive agriculture is important to feed the increasing population and for sustainability of modern civilization, but it has been affected by climate change. Thus, climate affects agriculture, and what distinguishes between the annual bountiful harvest and economic ruin of farmers are variations in precipitation and temperature. The realization of these effects, therefore, calls for an in-depth study on the effects of climate change on agricultural productivity in Igbo-Etiti Local Government Area of Enugu State, Nigeria. The pertinent questions to ask therefore are: At what level has changes in temperature and rainfall affected farm yield in the study area? What have they done to adapt to these changes in order to improve agricultural productivity. This paper focuses on providing answers to these questions. The findings of this research will be of benefit to the study area and also to other governmental and non-governmental institution considering that decline in agricultural productivity has a significant effect in our society generally. Thus, the greater demand for food justifies the need for the increase in farm yield. Finally, this research is aimed at investigating the effect of change in the rate of temperature and rainfall on agricultural productivity of the study area. To achieve this aim, the following objectives were achieved; (a) To describe the socio-economic characteristics of the respondents. (b) To examine the changes in rainfall over time (c) To examine the effects of climate change on agricultural productivity in the study area and (d) To suggest possible solutions to improve agricultural productivity.

MATERIALS AND METHODS

The study area

The study area is Igbo-Etiti Local Government Area (LGA) of Enugu State, Nigeria with Ogbede as its headquarters. The area is located between latitude 6^0 36^1N and 6^0 47^1N and longitude 7^0 15^1E to 7^0 32^1 E. It is bounded to the north by Nsukka LGA, to the north east by Udi LGA, to the north west by Uzo-Uwani LGA, in the south east by Udi LGA and in the south west by at Enugu East LGA, (Figure 1). The communities that make up the study area are Ohodo, Ozalla, Ukehe, Ekwebge, Aku, Ochima, Ohebe-dim, Umunko, Diogbe, Udeme, and Ikolo umuna (Figure 2). It has an area of about 351.29 km² and a population of 209,248 (NPC, 2006) and a current population of 343,983 persons as projected to 2023.

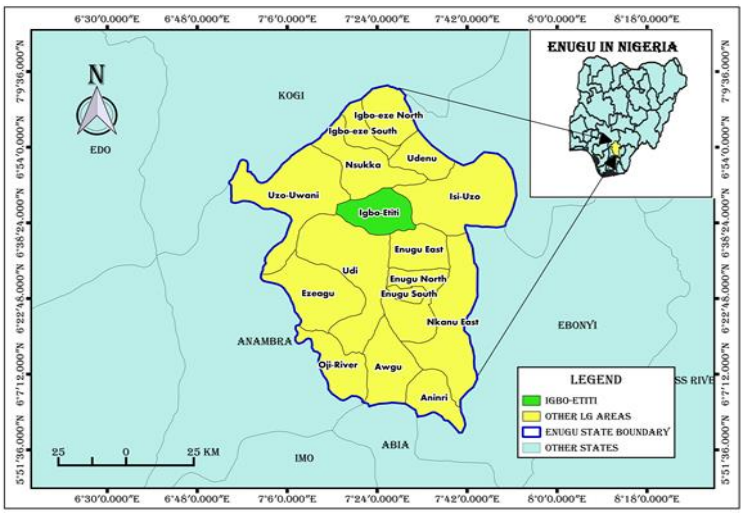

Figure 1: Enugu state showing the study area

Source: Department of Geography, University of Nigeria, Nsukka, 2021

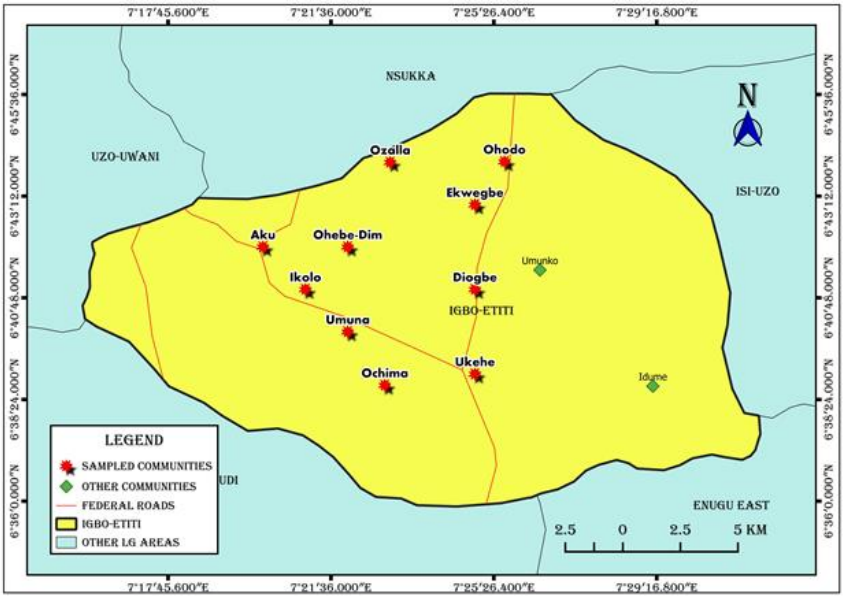

Figure 2: Igbo-Etiti showing the sampled communities

Source: Department of Geography, University of Nigeria, Nsukka, 2021

Anyadike (2002) described the climate of Igbo-Etiti LGA as tropical wet and dry climate which falls into koppen's Aw climate region, characterized by low annual total rainfall ranging from 2000-3000mm. The area experiences an average annual temperature of 27°C, with a high insolation and uniform temperature in most part of the year. Topography of the area is undulating and has no natural surface drainage, but has a network of dry valleys that suggest that they existed under water conditions when the regional water table was near the ground surface (Ofomata,1978).

The soil of Igbo-Etiti falls under two classes, there are the clayey loam soils formed over shale and the ferralitic brownish sand loams formed on the sandstone. Local condition of poor drainage creates hydromorphic soil in the area as a result of seasonal water logging which is caused by the underling impervious shale (Ofomata 1975). The hydromorphic soil is suitable for the growth of crops such as yam, Maize and cassava. Phil-Eze (2000), described the vegetation of the study area as a guinea-savanna sub climax mosaic.

The major economic activity in the area is agriculture. Predominantly, the farmers cultivate cassava, maize,

yam, banana, plantain among others including other vegetables and fruit and rearing of livestock and ruminants such as goat, sheep, local cow and guinea fowl. The agricultural products are produced in large quantities while livestock is in medium scale.

Sampling and Sample Size

The target population is made up of farmers in Igbo-Etiti Local Government Area and copies of questionnaire were administered in their farms and homes. A purposive sampling technique was employed in selecting 10 communities in the study area, which were the areas with high agricultural activities. In order to determine the sample population, the population of the Local Government Area was projected from 2006 to 2023 using annual growth rate of 2.8 per cent (NPC, 2010), using the equation below

$$P_2 = P_1 (1+r)^n \ldots(1)$$

Where; P_2 is the projected population, P_1 is the known population (2006 in this case), r is the rate of natural increase (2.8%), n is the number of years between P_1 and P_2 (interval) and its 18 years in our case.

$P_2 = 209{,}248\ (1+0.028)^{18} = 343{,}983$ persons

Consequently, the total number of the respondents interviewed was derived from the population of each of the selected communities.

The Yamane (1967) formula for finite population was used to statistically determine the sample size for the study thus::

$$n = N \div \left(1 + N\,(e^2)\right) \ldots 2$$

Where; n= sample size, N= population, e= level of significance.

$n = 343{,}983 / (1+343{,}983\ (0.05)^2)$

$n = 343{,}983 / (1+343{,}983\ (0.0025))$

$n = 399.5$

n= 400 copies of questionnaire/respondents

Since population figures were not published at the community level by the National Population Commission, and the study area is largely agrarian, 40 farmers were purposively selected from each community for equal representation as well as to reduce bias. Thus, a total of 400 copies of questionnaire were distributed in the 10 communities with a 94.75% return of the filled copies of questionnaire (Table 1). The questionnaire survey captured farmer's socio-economic characteristics, the perception of climate as well as perceived effects of climate change on agricultural productivity in the study area.

Table 1: Sampled number of households and distributed number of questionnaire

S/N	Name of communities	Number of questionnaire distributed	Number of questionnaire filled
1	Ohodo	40	39
2	Ozzala	40	38
3	Ochima	40	37
4	Aku	40	40
5	Ukehe	40	39
6	Ikolo	40	31
7	Ohebe-dim	40	39
8	Diogbe	40	39
9	Ekwegbe	40	40
10	Umuna	40	37
	Total	400	379
	Total No. of Questionnaires returned Unfilled	_	7
	Total No. Of Questionnaires not returned	_	14
	Grand Total	400	400

Source: Fieldwork, 2023

Data Collection and Analysis

Data were collected through oral interview and questionnaire. However, secondary data such as rainfall data were collected from Nigerian Meteorological Agency (NiMET), for a climatic year (1987-2021).

There was little or no record of yearly crop yield by the farmers as most of them are subsistence farmers. Therefore, to determine whether climate change has affected or not affected agricultural productivity in the study area, the farmers were asked to indicate if their crop yield had either increased or decreased or remained the same over the last ten years. Agricultural productivity as used in this study is synonymous with crop productivity. The data were analyzed using descriptive technique presented in tables, charts and graphs.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

Majority (54.4%) of the farmers are female while male farmers are 45.6% (Table 2). This shows that in Igbo-Etiti LGA, more women are involved in farming than men. This is in agreement with the findings of Amusan et al., (2022) where it was revealed that women contribute significantly in agriculture and that the overall labour burden of rural women exceed that of men.

Table 2 also reveals that farming is the primary occupation of majority (56.5%) of the respondents while Figure 3 reveals that they also engage in other secondary occupations such as trading, civil services and studying. A substantial percentage (88.2%) of the respondents had reported that they have other sources of income, though farming is regarded as their primary livelihood source (Fig. 3). The reasons given by majority of the farmers for engaging in other secondary occupation include; decreasing farm yield due to climate variability, reduced land holding and inadequate capital to either expand their land holding or purchase seedlings.

The age distribution of the respondents is shown in Table 2, and it was revealed that the lowest proportion (7.4%) of farmers were between the ages of 15 and 24 years while majority of them fall within the age brackets of 45-54 years (32.5%), followed by those between 35 and 44 years (26.6%) of age. Thus, a substantial number (59.1%) of farmers fall within the ages of 35-54 in study area indicating that they are active farmers.

In addition, our findings revealed that majority (49.9%) of the respondents earn between 10,000-19,000 Naira monthly while the remaining 50.1% earn between 20,000 to 60,000 Naira and above monthly (Table 2). The low monthly income implies that the farmers are poor, despite their effort put into farming yearly. The farmers noted the use of traditional farming implements, low capital and the changing climate as contributors to their low income.

However, the results also revealed that the literacy rate in the study area was high (Table 2) as only 6.6% of the farmers did not have any form of education while 93.4% had formal education with majority completing either primary school (39.3%) or secondary school (38%).

In terms of farming experience, majority of the farmers (85.5%) had ten or more years of farming experience (Table 2) which indicates that the study area is highly agrarian. The long years of farming experience shows that majority of the farmers are experienced and knowledgeable, hence their ability to give account of the effects of climate change on crop productivity is not questionable.

Table 2: Social and economic characteristics of respondents

Characteristic	Component	Frequency	Percent (%)
Sex	Male	173	45.6
	Female	206	54.4
	Total	379	100
Primary sources of livelihoods	Farming	214	56.5
	Civil servant	45	11.9
	Trading/Business	83	21.9
	Students	11	2.9
	Others	26	6.9
	Total	379	100
Age	15-24Years	28	7.4
	25-34Years	48	12.6
	35-44Years	101	26.6
	45-54Years	123	32.5
	55-64Years	29	7.7
	65 Years & above	50	13.2
	Total	379	100
Monthly Income	10,000-19,000 Naira	189	49.9
	20,000-29,000 Naira	80	21.1
	30,000-39,000 Naira	42	11.1
	40,000-49,000 Naira	26	6.9
	50,000-59,000 Naira	19	5.0
	60,000 Naira and above	23	6.0
	Total	379	100
Years of farming experience	1-5 Years	55	14.5
	6- 10Years	123	32.5
	Above 10 Years	201	53.0
	Total	379	100
Educational qualification of respondents	Non formal	25	6.6
	FSLC/Primary School	149	39.3
	SSCE/Secondary School	144	38.0
	NCE/OND	44	11.6
	B.Sc or equivalent	17	4.5
	Total	379	100

Source: Authors' computation, 2023

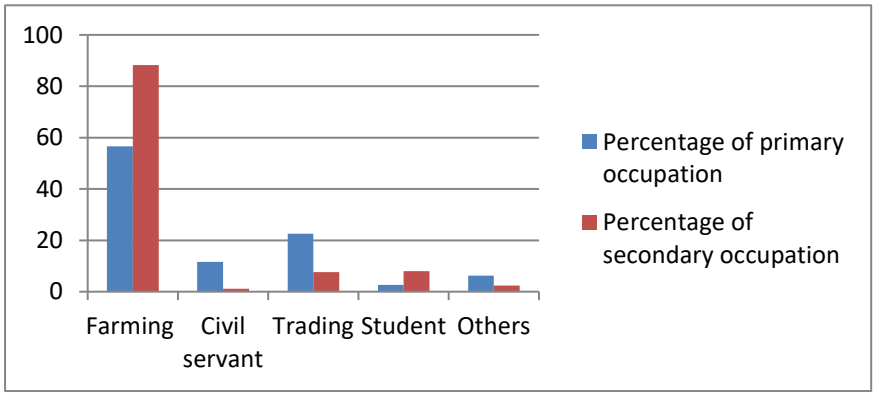

Figure 3: Occupation of the respondents in the study area
Source: Authors' computation, 2023

Changes in rainfall in the study area

The line graph in Figure 4 shows that the annual rainfall amounts over the study area were not evenly distributed. A decadal analysis of the 35 years annual rainfall data of the study area shows that, 1987-1996 has the maximum annual rainfall amount of 25310.1 mm with 1997-2006 being the second, recording 23277.9 mm annual rainfall, and 2007-2016 with annual rainfall of 22345 mm being the third. The observed decline in decadal rainfall shows a decrease in rainfall which have been attributed to climate change by the respondents. The highest annual rainfall amount for the period under study was 2909.1 mm, recorded in the year 2009 while the lowest rainfall amount was 1352.8 mm, recorded in 2016. The annual rainfall amount distribution has a range of about 1556.3 mm (Fig. 4).

The line graph in Figure 5 shows a normal distribution of monthly rainfall in the 35 year of study. The monthly rainfall is lowest in December but steadily increased through January to July-the peak and then decreased gradually from August to November. The 35 year mean monthly rainfall amount distribution showed in Figure 5 reveals that the monthly rainfall characteristic is mono-modal with the peak in July. This is not in agreement with the results of Eruola et al., (2021) that noted that States near the southern guinea savanna usually have double rainfall maxima because they receive rainfall from tropical maritime air mass (MT) originating from the Atlantic Ocean. The result is also in contrast with the findings of Ibebuchi and Abu (2023) that found rainfall pattern below latitude 10°N to be bi-modal, having a major peak in June-July and another peak in September with little dry season in August as a result of absence of Africa Easterly Jet. This finding implies that the study area experienced no little dry season (August break). Apparently the volume of rainfall received in August is little above the preceding months (Fig. 5). The rainy season months of March to November accounted for 97% of rainfall while the dry season months of December to February accounted for just 3% of the total rainfall during the study period.

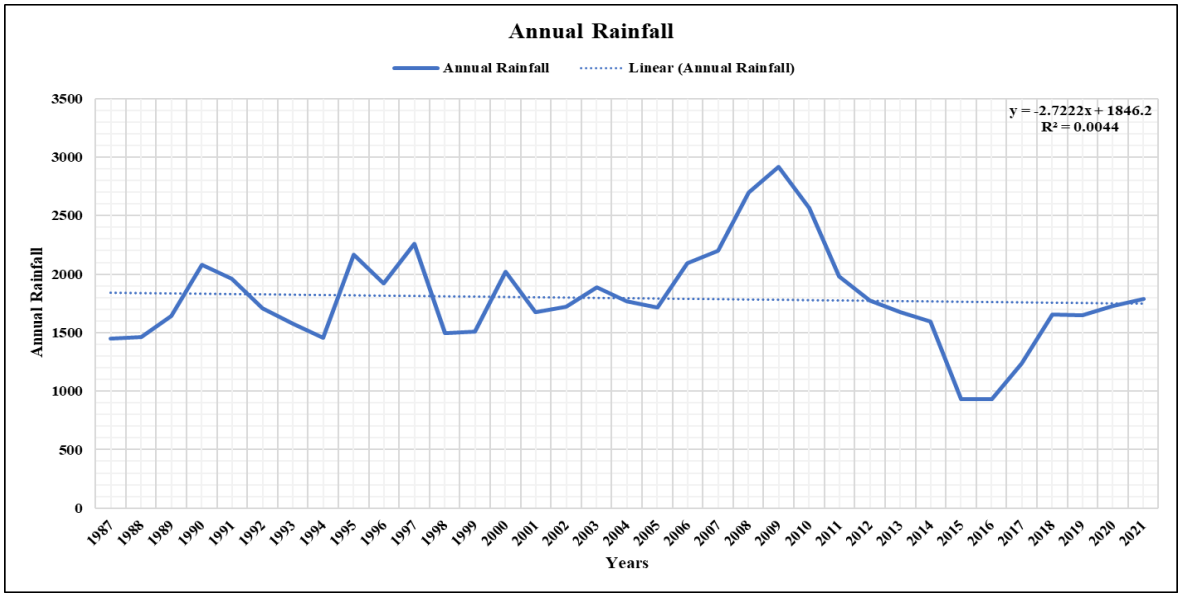

Figure 4: **Annual change in rainfall pattern**

Source: NiMET (2021)

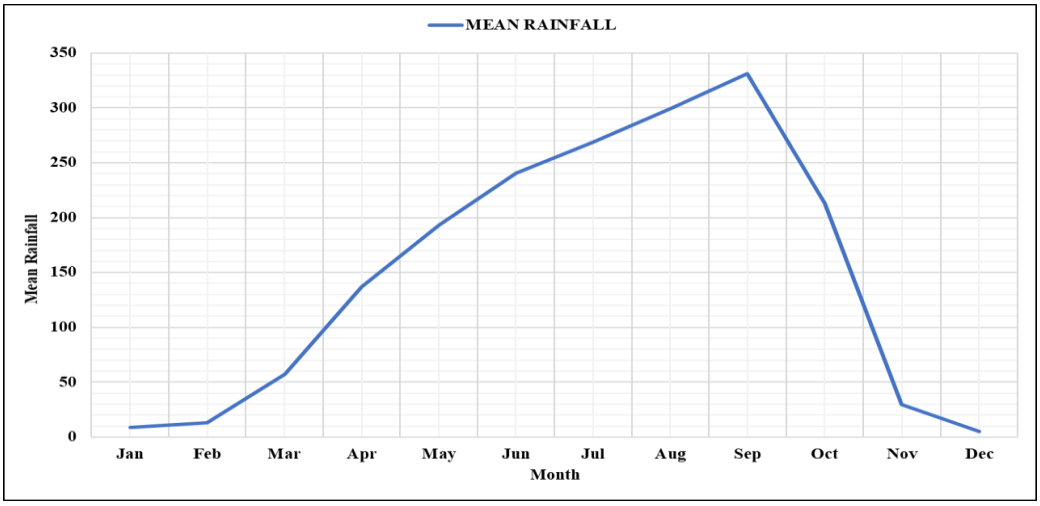

Figure 5: Mean monthly rainfall trend analysis

Majority of the respondents affirmed that rainfall has decreased over the years (Table 3) and this corresponds with the scientific evidence shown in Figure 4. This ddecrease in rainfall has been mostly attributed to climate change by the farmers, and has greatly affected crop productivity in Igbo-Etiti LGA as discussed subsequently. The sampled communities have the climatic factor (e.g. rainfall) as their major determinant of planting seasons since they practise mainly rain-fed agriculture. Over the years in the study area, there have been changes in pattern of rainfall where in most years, the rainy season delays beyond the usual period of occurrence. The reduction in rainfall pattern across the three decades as shown in Figures 4 and 5 has stretched the period of dry season beyond usual. As reported by the respondents, there have been several years of crop failure owing to the fluctuation of rainfall pattern. The sampled farmers further stated that drought (absence of rainfall) is one of the factors that have crippled crop productivity. Generally, there has been recurrence of crop failure resulting from change in rainfall pattern as indicated by the farmers.

Table 3: Perceived change in rainfall

Change in rainfall	Frequency	Percent
Increasing	155	40.9
Decreasing	224	59.1
Total	379	100

Source: Authors' computation, 2023

Perceived change in agricultural productivity

It was found that most farmers in the study area did not keep inventory of their annual crop productivity. To fill the gap of inadequate inventory of crop productivity, farmers answered questions on whether their crop yields had either increased, decreased or remained unchanged over the last ten years (Table 4). The results show varying perception of crop productivity among the farmers as 69.4% of farmers indicated that their annual crop productivity had reduced over the years. Less than a fifth (16.4%) of them affirmed that their annual agricultural productivity had remained unchanged over the last ten years while 14.2% reported an increase in their annual crop productivity over the last ten years. However, majority of the farmers attributed the decreasing crop productivity to decreasing rainfall due to climate change (Table 5). To further examine farmers' perception of the effects of climate change, the various areas in which climate variability manifested are shown in Table 5.

Farmers perception of climate change manifestations were increase in temperature, decrease in rainfall, dry soils, delayed onset of rain and prolonged dry season (Table 5). The late start of rainfall affect cultivation of seasonal plants and plants die due to prolonged dry season. Reduced rainfall also affect plant growth, and all these affect crop productivity as well livelihoods of farmers. Majority of the farmers perceived climate change to have affected agricultural productivity through decreased rainfall (28%) and delay in the onset of rainfall (22%) during the rainy season and these affect crops like maize and yam since they practice subsistence and rain-fed agriculture. This gives credence to the report shown in Table 3 where majority of the farmers reported that rainfall had significantly reduced over the years and it is in agreement with the findings of Omotosho et al. (2023) who reported that climate change has caused decrease in rainfall that has impacted agriculture negatively. Prolonged dry season, increase in temperature and dryness of soils were reported 18.9%, 17.1% and 14% respectively as a manifestation of climate change. The implication of this result is that there is a negative impact on livelihood of the farmers since their agricultural productivity is affected.

Table 4: Perceived agricultural productivity over the last 10 years

Crop harvest	Frequency	Percent
Increasing	54	14.2
Decreasing	263	69.4
Almost the same (unchanged)	62	16.4
Total	379	100.0

Source: Author's Field work 2023

Table 5: Perceived manifestations of climate change

Climate change parameter	Frequency	Percentage
Delayed onset of rain	173	22.0
Increased temperature	135	17.1
Dryness of soil	110	14.0
Prolonged dry season	149	18.9
Decreased rainfall	221	28.0
Total	788	100

Source: Authors computation, 2023

Note: the total is more than 379 because it is a multiple-choice question

Perceived effects of climate change on agricultural productivity

Since the study is mainly questionnaire-based, data on climate change effects were analysed along with other factors influencing agricultural productivity in the study area. Respondents were requested to list the factors they perceived as mainly influencing agricultural productivity and the results of their perception are shown in Table 6.

The results reveal that climate change has the greatest (46.1%) effect on agricultural productivity while man power has the least (8.7%) effect on agricultural productivity. In the same light, income was ranked second with 25% of respondents indicating it as a major factor that influence crop productivity while soil texture was ranked third as reported by 20.3% respondents (Table 6). The effects of climate change is seen in the area of unprecedented rise in temperature causing longer dry days or increased drought events due to change in rainfall pattern throughout the study area. With respect to income, the farmers are generally poor as only few (11%) earn 50,000 Naira and above monthly, so, it is difficult for them to practise mechanized or irrigation farming. Thus, the effects of climate change will still be on the rise as the farmers adaptive capacity is low, thus affecting their resilience and invariably their agricultural productivity.

However, climate change according to the respondents caused dryness of soil leading to deficiency in soils as the texture is affected. The increasing decline in agricultural productivity as the result of mostly climatic conditions discourages farmers to continue farming, and has resulted to change in livelihood especially in the rural communities. This has also fuelled the migration of the population especially the youth to urban regions thereby affecting development of the communities in the Igbo-Etiti Local Government Area. Farmers in the study area, practise mainly traditional agriculture where farm implements such as hoes are used to cultivate large expanse of land, so, intensive labour/manpower is needed. Since the farmers in the study area are generally poor, it is difficult to cultivate large expanse of farmland because of high cost of labour, and to recover from the shock of incessant reduced agricultural productivity. Hence, lack of the required man power (labour) affects crop productivity. Ultimately, decrease in agricultural productivity has a negative shift in food security as agreed by Akukwe et al. (2023). Therefore, concerted effort is needed to combat the negative effects of climate change on agricultural productivity in Igbo-Etiti LGA.

Table 6: Perception of respondents on factors that affect agricultural productivity

Factors that influence agricultural Productivity	Frequency	Percent	Rank
Climate change	175	46.1	1st
Income/Inadequate capital	95	25.0	2nd
Soil texture	77	20.3	3rd
Manpower/labour cost	32	8.6	4th
Total	379	100.0	

Source: Authors' computation, 2023

CONCLUSION

The study investigated the perceived effects of climate change on agricultural productivity in Igbo-Etiti Local Government Area of Enugu State, Nigeria. Evidence drawn from the indigenous knowledge of the farmers show that rainfall is decreasing and this corresponds with the results of the decadal annual rainfall analysis showing a decrease in rainfall over the study area. The results revealed that climate change negatively affected agricultural productivity primarily due to changed rainfall pattern (delayed onset of rain and decreased rainfall) in the study area since the farmers practised primarily rain-fed agriculture. Thus, their over dependence on rainfall makes them more vulnerable to climate change.

Climate change is perceived as the major cause of reduction in agricultural productivity in the study area. Evidence from the farmers revealed that climate change has caused delayed onset of rain, increased temperature, dryness of soil, prolonged dry season and decreased rainfall with associated combined adverse effect on agricultural productivity. Other factors that affect agricultural productivity in study as perceived by the respondents are; income level, soil texture and man power. The implication of the results is that climate change adversely impact on the primary source of livelihood of the farmers since their agricultural productivity is affected leading to associated negative

effect on their income, food security, ability to produce more among others.

To improve the resilience and increase the agricultural productivity and food security of the farmers, the following have been recommended; 1) Farmers' access to loans and grants to enable them scale up their land holding as well as engage in mechanized farming or use new agricultural technologies to boost their productivity. 2) Involvement in Climate Smart Agriculture such as small-scale irrigation. 3) Subsidies in the areas of improved climate change-resistant plants/fertilizers by the government. These plants can withstand the shock caused by prolonged dry season or delayed rainy season. 4) Indigenous and technological adaptation measures and 5) Awareness creation of resilience measures to help the farmers bounce back quickly.

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