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Assessing the Effects of Climate Change on Food Insecurity in Nigeria: Akwa Ibom, Bayelsa & Rivers States in Focus

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Abstract: In the South-South geopolitical zone of Nigeria, namely in the states of Akwa Ibom, Bayelsa, and Rivers, the aim of this study was to examine the effects of climate change on food security. The study postulated that the climatic conditions of these areas had shifted throughout time, resulting in excessive heat, deforestation, erosion, flooding, desertification, increasing rainfall and temperature patterns, and other forms of environmental degradation. Given reports from the Food and Agricultural Organisation (FAO) that conflict, national economies, and climate change are the primary causes of food insecurity globally, an examination of how changing climatic conditions affect food security in these three states in the nation's South-South geopolitical zone was required. Using the descriptive survey method, 1,050 research participants were chosen from communities in each of the senatorial districts of the three states to collect views on food security and climate change. The opinions gathered for this study were analysed using the Statistical Package for Social Sciences (SPSS-Ver. 25.0). According to the study's findings, among other things, the effects of climate change on food security have manifested as reduced availability, accessibility, and the inability to buy food in the quantities that people used to be able to. This bolsters the argument that climate change has made food insecurity worse in these three South-South geopolitical zone states of Nigeria. Based on these findings, it was recommended that regulations be implemented to reduce activities like deforestation, gas flaring, and over-exploitation of natural resources while promoting conservative habits like recycling and other variables that contribute to climate change.

Keywords*: Accessibility, Affordability, Availability, Climate Change, Food.*

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I. INTRODUCTION

Climate change, which affects agricultural productivity, food availability, and access to nutrition, is one of the largest risks to global food security. Nigeria, a country that heavily relies on agriculture for both economic growth and subsistence, is where the effects of climate change on food security are most apparent. Like many African countries, Nigeria is particularly vulnerable to the negative effects of climate change due to its dense population, reliance on rain-fed agriculture, and limited ability to adapt. Increased temperatures, unpredictable rainfall patterns, and extreme weather events like floods and droughts are all predicted by the Intergovernmental Panel on Climate Change (IPCC, 2021) to significantly threaten agricultural production and food security in Nigeria. Furthermore, there is strong evidence that extreme weather events linked to climate change would negatively impact the yields of key grain crops in Sub-Saharan Africa (SSA), according to the most current assessment from the Intergovernmental Panel on Climate Change (IPCC).

Numerous researches have documented the severe effects of the extreme climate on the agricultural sector, which is the primary source of income for many people in SSA. These studies include Ajetomobi (2016), Ficchi *et al.* (2021), Fuller *et al.* (2018), Humphries *et al.* (2020), and Wainwright *et al.* (2021b). Thus, numerous studies, such as those conducted by Amouzou *et al.* (2019), the Food and Agriculture Organisation (FAO) (2019), Atiah *et al.* (2022), Hadebe *et al.* (2017), Nyamekye *et al.* (2021), and Oluwaranti *et al.* (2020), have further noted the effects of climate change on the yields of the most commonly produced crops in sub-Saharan Africa, which are rice, maize, sorghum, and millet.

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Agriculture is the mainstay of Nigeria's economy, employing over 60% of the labour force and contributing significantly to GDP. However, climate change-related problems including water scarcity, soil degradation, pests, and sicknesses threaten the country's ability to meet the growing need for food. Smallholder farmers, who make up the majority of Nigeria's agricultural labour, are particularly vulnerable to these climatic concerns since they have limited access to resources, knowledge, and technology. The states of Akwa Ibom, Bayelsa, and Rivers in Nigeria's Niger Delta have unique environmental and socioeconomic challenges that exacerbate food insecurity. Despite having a wealth of natural resources, including fertile land and water bodies, these states still face high rates of poverty, unemployment, and underdevelopment, which jeopardise agricultural output and food access. For instance, the majority of people in Akwa Ibom State make their living from subsistence farming, where the primary staples are crops like palm oil, cassava, and yam.

However, crop failures and lower yields have resulted from agricultural activities being disturbed by regular flooding, soil erosion, and oil contamination. Similar problems with pollution, deforestation, and land degradation affect food security and agricultural productivity in the biodiversity-rich and oil-rich Bayelsa and Rivers States.

The intricate and interconnected impacts of climate change on food security affect many aspects of the food system, including production, distribution, and consumption. Variations in temperature and precipitation can alter the suitability of agricultural land, disrupt plans for planting and harvesting, and exacerbate water scarcity, all of which can reduce crop and animal production. In addition, extreme weather events like floods, hurricanes, and droughts have the power to destroy crops, infrastructure, and livelihoods, which can result in food shortages, volatile markets, and price volatility. In addition to endangering food supply, these climate shocks also impair food accessibility and consumption, especially for vulnerable groups including women, children, and rural communities.

According to researchers like Chikoore and Jury (2021), Thoithi *et al*. (2021), and Wainwright et al. (2021a), the effects of extreme climate events, such as protracted dry spells, unusual rainfall patterns, the resulting water scarcity, and heat stress, have gotten worse in recent years. According to Cuthbert *et al*. (2019), SSA is thought to be the region most sensitive to climate change, and they are having an impact on many people's livelihoods in addition to human activities. This is because, as mentioned by Gerardeaux *et al*. (2018) and Sarr *et al*. (2021), around 80% of the agricultural land and crop production in this region of the world is rain-fed, making rainfall essential to critical lives.

Nigeria's food security is seriously threatened by climate change, which has a negative impact on agricultural productivity, livelihoods, and nutrition. The Niger Delta states of Akwa Ibom, Bayelsa, and Rivers are particularly vulnerable to the consequences of climate change due to their socioeconomic and environmental weaknesses. Addressing the complex relationship between food insecurity and climate change requires collaboration and investment in creative, flexible solutions that prioritise the needs and rights of vulnerable people.

- *Statement of Problem*

Despite the abundance of natural resources and agricultural potential in Akwa Ibom, Bayelsa, and Rivers States, climate change poses a severe threat to food security and livelihoods in these regions. Among the negative effects of climate change are unpredictable rainfall patterns, rising temperatures, and extreme weather events, which have decreased agricultural productivity, exacerbated environmental degradation, and increased poverty and hunger in areas already at risk.

The problem of climate-induced food insecurity in the states of Akwa Ibom, Bayelsa, and Rivers is complex and multifaceted, resulting from a combination of socioeconomic, institutional, and environmental factors. Smallholder farmers, who form the backbone of the agricultural sector, lack the resources, knowledge, and instruments required to adapt to the changing climate. Additionally, the history of oil exploration and extraction in the Niger Delta region has exacerbated environmental degradation, pollution, and land degradation, which has reduced the resilience of local food systems and raised food insecurity.

The ramifications of food insecurity are extensive and affect not only the region's social, economic, and political stability but also the physical and emotional health of both individuals and communities. Insufficient availability to nutrient-dense food, particularly for women and children, results in malnutrition, stunted growth, and heightened vulnerability to illnesses. Additionally, by perpetuating cycles of poverty and inequality, food insecurity limits opportunities for social and economic growth.

The problem of climate-induced food insecurity in Akwa Ibom, Bayelsa, and Rivers States requires a comprehensive and well-coordinated approach that addresses the underlying causes and vulnerabilities while promoting flexible and innovative solutions. However, a lack of expertise, inadequate funding, and weak institutional capacity pose significant challenges to the region's efforts to adapt to climate change and provide food security. Because of the effects of oil exploration, Bayelsa, which has a different soil texture than Akwa Ibom and Rivers state, faces greater challenges. This implies that most of the nation's staple goods, including wheat, maize, beans, and rice, are imported mostly from the north. The impact of these changes on northern farm produce also affects the cost and availability of food for Bayelsa state people, considering that climate change is a global concern.

In their 2019 study, "The State of Food Security and Nutrition in the World," the Food and Agricultural Organisation (FAO) identified national economics, conflict, and climate change as the primary drivers of global food insecurity. According to Kralovec (2020), Nigeria is one of the nations where the three factors the FOA identified are particularly important in the deteriorating state of food

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security. In order to improve food access and nutrition for vulnerable populations in Akwa Ibom, Bayelsa, and Rivers States, as well as to promote sustainable agriculture and increase climate resilience, research, policy, and action are therefore desperately needed.

This is because food availability, cost, use, and stability have grown to be major concerns in these states. By addressing the root causes of food insecurity and building adaptive capacity at the local, national, and regional levels, Nigeria can create a more resilient and just food system that ensures the health and dignity of all of its citizens, both now and in the future.

The following research questions were considered for this study in light of the aforementioned:

- How has climate change affected the accessibility of food in the chosen states in Akwa Ibom, Bayelsa and Rivers States of Nigeria?
- How has climate change affected the availability of food in the chosen states in Akwa Ibom, Bayelsa and Rivers States of Nigeria?

➢ *Objectives of the Study*

This study's main goal was to look at how food insecurity is affected by climate change in Akwa Ibom, Bayelsa and Rivers States in Nigeria's Niger Delta. Therefore, the study's specific objectives were as follows:

- To investigate how climate change affects food accessibility in Akwa Ibom, Bayelsa and Rivers States of Nigeria.
- To investigate how food availability is impacted by climate change in Akwa Ibom, Bayelsa and Rivers States of Nigeria.

II. THEORETICAL FRAMEWORK

The vulnerability and resilience hypothesis served as the foundation for this investigation. This theory's principal proponents are Ribot (2010) and Adger (2006). A conceptual framework for comprehending how socioeconomic, environmental, and institutional elements interact to shape food poverty and susceptibility to climate change is provided by vulnerability and resilience theory. Vulnerability is the possibility that these stresses will result in harm or disruption, while resilience is the capacity of a system or community to absorb, adapt to, and recover from external pressures, such as climate change.

Vulnerability and resilience theory's basic premise is that, although resilience describes these systems' ability to tolerate shocks, adapt to changes, and change in response to environmental stressors, vulnerability to climate change is impacted by exposure, sensitivity, and individual and community adaptive capacity. Below, these are explained in further detail:

➢ *Exposure*

Due to their coastal locations, the states of Akwa Ibom, Bayelsa, and Rivers are susceptible to climate-related hazards such storm surges, sea level rise, and extreme weather conditions like floods and droughts. These hazards cause disruptions in food production and distribution, which directly impact livelihoods, fisheries, and agricultural productivity. Sensitivity: Because of their socioeconomic characteristics, such as high rates of poverty, limited access to resources and reliance on rain-fed agriculture and natural resources, communities in the research region are particularly vulnerable to climatic fluctuation and change. Small-scale farmers, artisanal fishermen, and marginalised populations are particularly vulnerable to shifts in the price and accessibility of food.

➢ *Adaptable Capacity*

Communities in the states of Akwa Ibom, Bayelsa, and Rivers have demonstrated tenacity in the face of extreme adversity by employing a range of adaptable strategies. These include developing early warning systems rooted in the community, diversifying revenue streams, adopting climate-smart farming practices, and strengthening social networks and institutions to support collective endeavours. The application of the Vulnerability and Resilience theory, which clarifies the complex relationships between environmental changes, socioeconomic dynamics, and food security outcomes, is highly beneficial to research on climate change and food insecurity in Nigeria, with a focus on Akwa Ibom, Bayelsa, and Rivers States.

III. LITERATURE REVIEW

This component of the study looked at the conceptual reviews of food (in) security and climate change as well as the actual research on the topic.

➢ *Changes in Climate*

According to the United Nations Framework Convention on Climate Change (2002), the term is sometimes used expressly to refer to changes in the climate brought about by human activity rather than by natural processes on Earth. Climate change is the phrase used to describe long-term changes in the weather patterns of the planet or a particular location. Changes in typical weather characteristics, such as temperature, precipitation, and wind patterns, are used to quantify the shift. In the context of environmental policy, the term "climate change" can also refer to a change in the distribution of weather around normal conditions or in ordinary weather conditions themselves, even though it has come to refer to "anthropogenic global warming," or the increase in the average surface temperature.

Variations in the amount of solar radiation that reaches the planet's system, the earth's position in relation to the sun, the positions of the continents in relation to the equator, and even whether or not the continents are contiguous are some of the natural factors that contribute to climate change, according to Dana (2008). There are more greenhouse gases in the atmosphere as a result of human activity. With greenhouse gases filling the atmosphere, it's like putting another blanket on the earth. The primary man-made sources of greenhouse gases are the burning of biomass (living matter) and fossil fuels. Other human activities that affect the

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planet's climate include air pollution, urbanisation, and deforestation (the loss of trees).

Sowunmi and Akintola (2010) went on to say that because of the dire ramifications for the survival of both man and nature, climate change is a global issue that is being discussed by governments, academia, agriculturists, environmentalists, and society at large. This is due to the fact that climate change was defined by the Intergovernmental Panel on Climate Change (IPCC) in 2007 as quantifiable and substantial changes in weather patterns over an extended period of time, typically decades. Persistent global warming is ultimately the source of climate change, which negatively affects agricultural productivity and poses a serious threat to food security.

Climate change is defined as the long-term alteration of weather patterns that results in changes in temperature, precipitation, flooding, desertification, erosion, and land degradation (Ojuederie and Ogunsola, 2017). Since climate change is the alteration of weather patterns that are shown to be persistent and to be progressing negatively over an extended period of time, it is distinct from global warming, which the increase in temperature is caused by the release of greenhouse gases.

- *Food Security in Nigeria*

Food security requires having access to basic, healthful food (Akpandem *et al*., 2025). "Everyone at all times has physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life," the United Nations Committee on World Food Security states. Food security is defined as the "availability at all times of adequate supplies of basic foods stuffs to sustain a steady expansion of food consumption and to offset fluctuation in production and prices" at the World Food Summit in 1974. Food insecurity is defined by the FAO as "all people do not have adequate physical, social, or economic access to food" (FAO, 2025). Accessibility refers to a person's capacity to receive food, whereas food availability deals with the quantity and quality of supply (Ayamba, 2023).

Nigeria has been identified as one of the sub-Saharan African countries most vulnerable to climate change (Ughaelu, 2017). Some researchers claim that throughout the past 10 years, food productivity and human suffering have increased in some parts of Nigeria due to frequent natural disasters (Ayinde *et al*., 2011; Ughaelu, 2017; Ikem, 2018). The climatic shifts caused by climate change have varying effects on Nigeria's six vegetation zones. For Ikem (2018), it causes decreased rainfall, drought, and increasing desertification in the semi-arid Sudan and the arid Sahel Savannah region. It also causes changes in the rainfall pattern in the Northern and Southern Guinea savannah belt, frequently resulting in late arrival of rainfall and a longer dry season. Additionally, it causes severe flooding along the shorelines during the rainy season. In the Rain Forest zone, it causes delays in the onset of rainfall, a longer dry season, heat waves, and flooding along the coast. In the Mangrove Swamp, it causes flooding of the typically dry plains, and the continuous rise in sea level puts farming operations at risk. Additionally, rising water temperatures have a negative impact on fishing (Berhanu and Wolde, 2019).

According to studies by Tirado *et al*. (2010), Wossen *et al*. (2018), and Uwazie (2020), food production suffers greatly from extreme weather conditions that show themselves as flooding, heavy rainfall, and desertification. Uwazie (2020) added that it is not implausible that the current food security and human security challenges in Nigeria are caused by climate change, which scientists have found to be a subtle contributing element. Through their different publications, the Food and Agricultural Organisation (2017) and the World Bank (2016) have cautioned that climate change will continue to represent a severe threat to Nigeria's sustainable food production.

Several studies show that the vagaries of climate change have a detrimental effect on Nigeria's agricultural productivity, leading to lower productive outputs. This situation has led to disruptions, price rises, and shortages of food. In Nigeria, food insecurity is becoming worse due to climate factors that have hindered agricultural productivity. Climate change-induced changes like droughts, excessive precipitation, and farmland floods, as well as rising temperatures, increased aridity and soil acidity, changes in relative humidity, and increased evaporation, have a negative impact on Nigeria's agricultural production and food systems.

According to Adishi and Oluka (2018), climate change has become a daily occurrence in Nigeria, causing environmental problems such floods, droughts, rising temperatures, and extreme weather events that interfere with agricultural productivity. According to Onuoha and Ezirim (2010), climate change-related pasture shortages and declining access to water pose a danger to the livelihood of around 15 million pastoralists in northern Nigeria.

Ayo *et al*. (2014) found that climate change is gradually worsening food insecurity in Nigeria, especially in areas that are already vulnerable to famine and undernutrition. Ayo *et al*. (2014) also noted that climatic unpredictability and extremes are likely to provide significant challenges for food stability. They stated that because food prices are constantly rising in many parts of Nigeria, low-income people will no longer be able to purchase essential meals. Growing aridity in the Sudanese and Sahelian savannah regions has made large swaths of land unfit for agricultural output, raising worries about food security in the densely populated affected areas, according to a study by Fasona and Omojola (2005). They went on to say that the risks associated with climate change are expected to lead to a steady rise in the number of undernourished children in Nigeria.

Idumah *et al*. (2016) used time series data from 1975 to 2010 to investigate the short- and long-term relationships between Nigerian agricultural output and a few meteorological factors, including rainfall, temperature, and relative humidity. Their study found a correlation between food production and climatic data over both the short and

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long periods. Their findings are in line with those of a few other academics who have carried out similar investigations.

IV. REVIEW OF EMPIRICAL STUDIES

Some empirical studies have found that agricultural productivity is negatively impacted by climate variability. Muringai *et al.* (2020) investigated the impact of declining water resources and warming temperatures coupled with increased carbon dioxide (CO2) emissions on agricultural output. They discovered a strong link between low agricultural yield and shifting climatic circumstances, just like most other researchers. The vast majority of scientific research indicates that climate change has an effect on the first step in the food supply chain, which is production. As a result, its effects inevitably affect every other link in a food supply chain. Climate variability also affects the fishery sector's supply chain, according to Muringai *et al*. (2020). According to Muringai *et al*. (2020), the fishing industry has been negatively impacted by climate change-induced drought, especially in regions where fishing relies on natural water supplies.

Anyika (2020) added that the region's once prosperous and thriving fishing industry has been significantly impacted by the climate change-induced reduction of water supplies in Nigeria's Lake Chad region, which has disrupted the region's fish supply chain and left many fishermen unemployed. A related study by Oyinloye *et al.* (2018) also claimed that climate change poses a major threat to aquatic life. According to researchers, fish habitat is destabilised and can result in low output, bacterial contamination, or fish mortality as a result of rising water temperatures brought on by climate change. The majority of scientists think that increasing desertification is the direct cause of the disappearance of water bodies and aquatic life.

Another aspect of food production that is impacted by climate change is food quality. According to some empirical study, climatic variability significantly affects the nutritional composition of food crops. People may not be able to get enough calories each day or may be exposed to eating toxic food as a result of deteriorating crop quality. In a meta-analysis of several studies on how climate change affects food production, Taub *et al.* (2018) discovered that crops exposed to high CO2 concentrations had lower protein concentrations. As a result, food crop quality would gradually deteriorate as atmospheric CO2 levels increased.

According to a related study by Berhanu and Wolde (2019), extreme weather events like drought, flooding, and heavy rainfall have a detrimental impact on the mineral element compositions in the soil. According to the study, heavy rainfall can result in leaching that lowers soil fertility, and flooding can increase soil acidity. Drought and soil toxicity were also linked in the study. Each of these conditions has an adverse effect on food production.

Climate variability poses serious challenges for food storage in addition to its effects on food production. According to a study by Ikem (2018), certain farmers and farm food merchants have suffered significant losses as a result of farm produce spoiling due to shifting climatic conditions that have frequently caused high temperatures and recurring heaving waves in sub-Saharan Africa. Furthermore, he noted that most affected farmers and business owners lack the capacity to set up storage facilities that would help condition the shelf life to prevent spoiling.

Changes in climate have some negative consequences on how roots, tubers, and vegetable harvests are stored, according to Ufot (2019). His results are consistent with those of Ikem (2018), who also observed that crops such yams, potatoes, tomatoes, onions, carrots, cabbage, pepper, pumpkins, and other vegetables decompose more quickly when the air temperature rises. According to him, Nigeria loses 2,500 tonnes of vegetable crops and over 2000 tonnes of yams annually as a result of deterioration. He stated that in response to the claimed damage caused by yam rotting, the Benue State government constructed a 200,000-ton tuber-capacity yam storage facility in Zaki Biam, a town famous for its yam growing. However, since Benue State produces roughly 70% of Nigeria's yams, Ufot (2019) believes the storage facility is inadequate. According to Ughaelu (2017), until measures are taken to establish storage facilities that would mitigate the effects of climate change, Nigerian farmers will continue to face difficulties related to food storage.

According to Ogbuchi (2020), climate change also affects food security because it alters the environment, which may force people to relocate from their original homes where they produce food and engage in other economic activities, leaving them vulnerable to food insecurity. Numerous more research has proven the connection between food insecurity and forced migration, including Ogbo *et al.* (2019) and Oyinloye *et al.* (2018). These studies' findings suggest that because of their limited availability to food, victims of forced migration are susceptible to under-nutrition.

Okoli and Ifeakor (2014) also claimed in their study that climate change poses a threat to Nigeria. For these authors, precipitation is one of the primary elements affecting food production output. In certain regions of Nigeria, the delayed onset and early termination of rains have resulted in changes in agricultural productivity patterns. Significant crop losses have also been brought on by severe field floods in a number of Nigerian districts. The frequency of these occurrences has major implications for Nigeria's food security. They went on to say that Nigeria's food security is suffering as a result of the climate change-induced decline in agricultural outputs. They also noted that poverty, hunger, starvation, and malnutrition affect a large number of Nigerians, and they asserted that climate change is exacerbating these issues.

Ethan (2015) claims that as a result of experience-driven changes in rainfall patterns, Nigeria's growing and harvesting season is progressively shifting. Ethan went on to say that climate change-induced changes in biomass, photosynthesis, and evapo-transpiration have a negative impact on crop productivity. Ethan (2015) further looked into the Nigerian climate data from 1914 to 1970, 1971 to 2000,

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and 2001 to 2011. His research indicates that changes in when rainfall starts and stops have an effect on the Nigerian food system's pattern. Nigeria's unparalleled agricultural output and rapid population growth are signs of a deteriorating food security crisis. This disease is brought on by the stressors connected to climate change.

Climate change threatens developing countries' ability to produce the appropriate amount of agricultural output. The persistence of this deficit points to a significant problem with food security. Climate change also affects aquatic habitats. Rising sea acidity, changing marine salinity, and sea warming are examples of physical changes brought on by climate change. Mass aquatic death outbreaks in the Niger Delta illustrate the catastrophic consequences of climate change. Such losses jeopardise the livelihood of riverine inhabitants that heavily depend on food and trade. Food insecurity is one of the primary consequences of climate change (Ethan, 2015).

Climate change has long had a detrimental effect on Nigeria's agricultural productivity, making food production uncertain and unsustainable. Nigeria's food supply is at risk from climate change in several ways, including:

- *Seasonal Variations in Planting and Harvesting:*

In certain parts of Nigeria, climate change has progressively altered the pattern of rainfall onset and cessation, resulting in modifications to the usual planting and harvesting seasons. The food system has been affected by the change, making certain staple commodities unavailable or in short supply at periods of the year when they should normally be in abundance. Due to the ongoing increase in food prices brought on by a shortage of food goods, low-income households and individuals are unable to purchase basic food.

- *Reduced Crop Output:*

A decrease in crop yield is a result of environmental changes brought on by climate change, such as higher precipitation, rising temperatures, high rates of evapotranspiration, drought, increased acidity of the soil, and flooding. Research indicates that increasing environmental carbon dioxide levels have both beneficial and negative effects on agricultural yields. Certain plants perform well in these kinds of environments, but others do not. Higher CO2 concentrations have been shown to reduce grain yields, which in turn reduces the amount of grain available for consumption by humans and livestock.

Conversely, high atmospheric CO2 concentrations boost pasture productivity; nevertheless, the same effect reduces the quality of feed and foliage from these pastures, making them less nutrient-dense for cattle. Additionally, it is hypothesised that if atmospheric temperatures rise above their optimal range, plant yields will probably decline. The quantity and quality of grazing pastures and human food have continuously declined due to extreme weather events like floods, droughts, and high temperatures.

- *Increased Pests:*

Variations in air temperature and relative humidity have led to an increase in a number of plant and animal pests. Pests that prey on plants and animals have become more prevalent. Considerable of these pests were insignificant before the recent changes in the ecology, but their increasing activity has given them considerable importance.

- *Impact on Livestock:*

Climate change is one of the largest threats to livestock. Cattle have suffered significant harm due to ongoing heat waves caused by global warming. Rising atmospheric mean temperatures reduce milk production and fertility and make animals more prone to disease. Drought also poses a severe threat to animal food supply. Foliage-dependent animals often have to endure extended periods of malnutrition or food scarcity.

- *Growing Demand for Irrigation:*

As rainfall decreases and aridity rises in Nigeria's Sahel and Sudan savannah regions, irrigation is gradually beginning to gain popularity as a replacement technique for providing water for agriculture. The price of food commodities would unavoidably rise as a result of this technique's increased farming expenditures. Furthermore, many peasant farmers who rely solely on natural water sources might not be able to maintain their farms due to the high cost of irrigating them, and their departure from fruitful agricultural activities has a detrimental impact on global food production.

- *Farmland Floods:*

Rising sea levels and more rainfall have caused flooding in some parts of Nigeria. Floods disrupt farming activities and typically result in crop destruction. Many stories of farmland submersion in Nigeria have surfaced in recent years. Farmers have repeatedly suffered large losses as a result of floods. Frequent floods reduce agricultural productivity by rendering certain arable farmlands unusable.

Because aquatic life has been adversely affected by changes in salinity, rising sea temperatures, and increased acidity, fisheries are in danger. Numerous instances of fish fatalities in the Niger Delta have surfaced in the past decade. Commercial fishing has suffered as a result of climate change. The declining outcomes of fishing activities pose a severe danger to food security and the livelihood of people who depend on marine resources (Ethan, 2015).

V. METHODOLOGY

The survey research design served as the foundation for this study, which was purposefully chosen in light of the goals and research topic. This design helped the researchers accomplish the study's goals by offering a precise and guided method of data collection.

- *Research Design*

This study used a case study research approach and was essentially a survey. Both primary and secondary sources of data were examined in order to achieve this.

Primary Source: The main tool used to collect data from research participants was a closed-ended questionnaire that the participants self-developed. In addition to lowering the

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degree of bias when making well-informed decisions at the end of the study, this was done to allow the researchers to extract the necessary information from the study participants.

Secondary Source: The researcher made sure that credible sources, such as published texts, high-impact journal articles or publications for reputable outlets, databases of international organisations and institutions, periodicals, and others, were used to gather material for this study.

➢ *Population of the Study*

Every Nigerian has the potential to participate in a study of this kind. However, because it was difficult to get individual responses from every Nigerian, the researcher decided to use the opinions of small farm owners and registered farmers' groups in the three senatorial districts of each state as research participants.

➢ *Sample Size/Sample Techniques*

The researcher used the stratified random sampling technique to choose three states (Akwa-Ibom, Bayelsa, and Rivers States) from the South-South region of the nation in order to determine the study's sample size. While all eight local government units in Bayelsa state were included in the study, three local government areas were chosen in each of the senatorial districts for Akwa Ibom and Rivers states. A straightforward random sampling method was used to determine the sample size from the research population. This is shown as follows:

Table 1: Sample Size Distribution

States	Senatorial District	Local Governments	Population	Sample Size
Akwa Ibom	Akwa Ibom North-East	Ibiono Ibom, Uruan, Itu	Registered Farmers & Community Small farm holders	150 registered farmers; 200 Community Small farm Holders
	Akwa Ibom North-West	Essien Udim, Ikono, Oruk Anam		
	Akwa Ibom South	Eastern Obolo, Urue-offong/Oruko, Ikot Abasi		
Bayelsa	Bayelsa Central	Kolokuma/Opokuma, Southern Ijaw & Yenagoa	Registered Farmers & Community Small farm holders	150 registered farmers; 200 Community Small farm Holders
	Bayelsa West	Ekeremor & Sagbama		
	Bayelsa East	Brass, Ogbia and Nembe		
Rivers	Rivers East	Etche, Ikwerre & Okrika	Registered Farmers & Community Small farm holders	150 registered farmers; 200 Community Small farm Holders
	Rivers South East	Andoni, Khana & Tai		
	Rivers West	Abua-Odual, Akuku-Toru & Asari-Toru		
Total				1,050

Source: Field Survey, 2024

➢ *Research Instrument*

"Climate Change and Food Insecurity," a tool the researchers developed, was used to collect data. All questionnaire items were scored on a four-point Likert scale: Strongly Agree (SA), Agree (A), Strongly Disagree (SD), and Disagree (D).

➢ *Validity of the Research Instrument*

Validity is the degree to which a research instrument measures what it is supposed to measure. To confirm the face and content validity of the developed instrument, copies were given to one expert in educational evaluation and measurement from the Department of Educational Foundations, Guidance and Counselling, Faculty of Education, University of Uyo, and two lecturers in the Department of Curriculum Studies, Educational Management and Planning. The validation process was expanded to include the educational assessment unit in order to ensure that an expert's opinion on the instrument's quality is sought.

➢ *Reliability of the Research Instrument*

Reliability is the consistency of scores on one measure as opposed to similar values on two different tests. According to Babbie (2007), the concern is whether applying a particular technique to the same object would consistently result in the same result. The structured questionnaire used in this study was distributed to thirty respondents who were not part of the main survey. The reliability of the information extracted from the recovered questionnaire copies was investigated using the Cronbach alpha reliability analysis. Cronbach's alpha reliability study of the collected data yielded a reliability coefficient of 0.88. The dependability of the instrument was then evaluated using this reliability coefficient. Consequently, the following table shows this:

Table 2: Cronbach Alpha Reliability Analysis Table

Chronbach's Alpha	Chronbach's Alpha Based on Standardized Items	Number of Items
.878	.886	20

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➢ *Scoring of Instruments*

The scoring instrument for data collection was a self-developed questionnaire that was based on a 4-point Likert scale as follows:

- Strongly Agreed (SA) - 4 Points
- Agreed (A) - 3 Points
- Disagreed (D) - 2 Points
- Strongly Disagreed (SD) - 1 Point

➢ *Method of Data Analysis*

The data generated by this study was analysed using frequency counts, tabular displays, and simple linear regression. Frequency counts were used to assess all of the field data, although basic linear regression analysis was used to look at the research issues at the 0.5 level of significance. This was accomplished using the Statistical Package for Social Science (SPSS) version 25.0. The accepted or rejected criterion of this type of regression is based on the decision rule that states that the researcher should reject the null hypothesis if the estimated t is more than (>) the t essential. Furthermore, this decision rule states that if the p value is less than (<) 0.05, there is a significant contribution of the independent variable to the dependent variable; if the p value is greater than (>) 0.05, there is no significant contribution.

➢ *Data Presentation and Analysis*

The conclusions based on the information gathered from both documentary evidence and the field data collected from the questionnaire were presented, analysed, and discussed in this section of the study. Research assistants who had received specialised training from the researchers on how to approach research participants and obtain their agreement to participate in the study helped administer the questionnaire for this study.

Following the distribution of the questionnaire to 1050 participants in all places throughout the three (3) states (Akwa Ibom, Bayelsa, and Rivers states), they obtained 936 copies of the questionnaire from the participants, resulting in an 89.1% retrieval rate. These 936 copies of the questionnaire served as the basis for the study's analysis. These comprised basic linear regression analysis, frequency statistics for the four-point Likert scale questions, and descriptive analysis of the respondents' demographics. The Statistical Package for Social Sciences (SPSS-Version 25.0) was the statistical program utilised to analyse all of the data.

Table 3: Completed and Returned Copies of Questionnaire

South-South States	No. of questionnaire distributed	No. of questionnaire completed and returned	Percentage (%) of Questionnaire completed and returned
Akwa Ibom	350	305	29.05
Bayelsa	350	301	28.67
Rivers	350	330	31.42
Total	1050	936	89.1

Source: Field Survey (2024)

Table 4: Demographic Data of Research Participants

Characteristics	Frequency (N=936)	Percentage (%)
Gender		
Male	534	57.0
Female	402	43.0
Total	936	100
Age (Years)		
18-30	169	18.1
31-43	264	28.2
44-56	271	28.9
57 yrs & Above	232	24.8
Total	936	100
Educational Level		
FSLC	179	19.1
SSCE/OND	211	22.5
HND/B.Sc	270	28.8
PG	194	20.7
Others	83	8.9
Total	936	100
Type/Nature of Work		
Livestock/Birds	217	23.2
Crop Cultivation	202	21.6
Crop Processing	211	22.5
More-than one of the above	306	32.7
Total	936	100

Source: Field Survey (2024)

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The results of the analysis of the demographic characteristic of the 313 research participants showed that 534 (57.0%) were male while 402 (43.0%) female. The data above also showed that 169 respondents representing 18.1% of the respondents were between ages 18 and 30; 264 respondents representing 28.2% were between ages 31 and 43; 271 respondents representing 28.9% were between ages 44 and 56 years; while 232 respondents representing 24.8% were 57 years of age and above. Accordingly, the data collected showed that 179 respondents representing 19.1% had the First School Leaving Certificate (FSLC) as their highest educational qualification. Going further, 211 respondents representing 22.5% had either SSCE/OND as their highest educational qualification; 270 respondents representing 28.8% had Higher National Diploma Certificate or Bachelor degree as their highest educational qualification; 194 respondents representing 20.7% had postgraduate certificates as their highest educational qualification; while 83 respondents representing 8.9% had other forms of educational qualification as their highest level of education. Finally, 217 of the research participants representing 23.2% were involved in livestock/birds; 202 participants representing 21.6% were involved in crop cultivation; 211 participants representing 22.6% were involved in crop processing; while 306 of the participants representing 32.7% were involved in more than one type/nature of agricultural work.

VI. RESULTS OF ANALYSIS OF DATA BASED ON THE VARIABLES

The table below captures the degree of responses by the research participants based on the variables of the study:

Table 5: Analysis of Data Based on the Variables

S/n	Statements: Climate Change	SD	D	A	SA	Total
1	There have been noticeable changes in rainfall patterns in my area over the recent years.	65	79	593	199	936
2	I have observed an increase in the frequency and intensity of extreme weather events such as floods or droughts.	77	92	401	366	936
3	Climate change has significantly affected the quality and fertility of agricultural land in my community.	129	221	287	299	936
4	Rising temperatures have impacted the growing season and productivity of crops in my area.	191	117	311	317	936
5	Climate-related environmental degradation (e.g. erosion, pollution) has increased in my community in recent years.	177	183	362	214	936
	Food Accessibility					
6	Erratic rainfall and extreme weather events have made it more difficult for my family to access food regularly.	201	179	325	231	936
7	Flooding and environmental damages have disrupted transportation routes to local food markets in my community.	191	233	271	241	936
8	Access to food becomes more difficult during prolonged rainy or dry seasons.	112	134	373	317	936
9	Most persons have had to skip meals due to climate-related inaccessibility to food.	210	219	254	253	936
10	Climate change has reduced the ability of my community to maintain stable access to nutritious food.	198	241	263	234	936
	Food Availability					
11	Climate change has led to decrease in the availability of staple crops (such as yam, cassava, maize) in my community.	172	188	333	243	936
12	Unpredictable weather patterns have caused frequent crop failures in my community.	116	203	351	266	936
13	Oil pollution and environment degradation linked to climate change have reduced local agricultural production.	193	152	318	273	936
14	My community experiences food shortages during periods of extreme weather.	197	175	333	231	936
15	The overall availability of fresh and locally grown food has declined due to the impacts of climate change.	148	155	332	301	936

Source: Field Survey (2024)

➢ *Interpretation of Responses on Climate Change*

According to findings from Table 5, only 7.0% of research participants strongly disagreed that my area's rainfall patterns have changed noticeably in recent years. Additionally, it showed that while 63.3% and 21.3% of individuals massively agreed and strongly agreed with the statement, 8.4% of people disagreed with it. The second item's replies likewise showed that 8.23% of respondents strongly disagreed that extreme weather events like droughts and floods had become more frequent and intense. 39.10% strongly disagreed, 42.84% agreed, and 9.83% disagreed with this issue. Additionally, according to the responses, 31.9% strongly agreed, 30.7% agreed, 23.6% disagreed, and 13.8% strongly disagreed that climate change has had a major impact

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on the fertility and quality of agricultural land in my neighbourhood. Additionally, it was found that 33.2% of respondents agreed, 12.5% disagreed, 20.4% strongly disagreed, and 33.9% strongly agreed that the growing season and crop productivity in my area have been harmed by rising temperatures. As a result, 18.9% of respondents strongly disagreed that environmental deterioration (such as pollution and erosion) caused by climate change has gotten worse in my community recently. Of the respondents, 19.6% disagreed, 38.7% agreed, and 22.8% strongly agreed with this issue.

➢ *Interpretation of Responses on Food Accessibility*

Furthermore, according to the data in the above table, 21.5% of participants strongly disagreed that my family's regular access to food has been hampered by unpredictable rains and extreme weather occurrences. It was also noted that 24.7% of respondents strongly agreed, 37.4% agreed, and 19.1% disagreed. Twenty-four percent strongly disagreed, twenty-nine percent disagreed, twenty-nine percent agreed, and twenty-eight percent strongly agreed with the statement that flooding and environmental damage have hampered transportation routes to local food markets in my community. Additionally, the results revealed that 12.0% of respondents strongly disagreed that extended dry or rainy seasons make it harder to get food. Of the respondents, 34.8% strongly agreed, 39.9% agreed, and 14.3% disagreed with this statement. As a result, 22.4% of respondents strongly disagreed that the majority of people have had to skip meals because of food inaccessibility brought on by climate change. Additionally, it was found that 27.1% of respondents agreed, 23.4% disagreed, and 27.1% strongly agreed. Additionally, the results indicated that 21.2%, 25.7%, 28.1%, and 25.0% of respondents disagreed, agreed, and strongly agreed, respectively, that climate change has made it harder for my community to have consistent access to wholesome food.

➢ *Interpretation of Responses on Food Availability*

18.4% of respondents strongly disagreed that climate change has resulted in a decrease in the availability of staple crops (such yam, cassava, and maize) in my community, according to the results for the second item. 26.0% strongly agreed, 35.5% agreed, and 20.1% disagreed with this issue. In addition, the results showed that 28.4% strongly agreed, 37.5% agreed, 21.7% disagreed, and 12.4% strongly disagreed that crop failures in my community had been frequently caused by unpredictable weather patterns. Additionally, it was found that 29.2% highly agreed, 16.2% disagreed, 34.0% agreed, and 20.6% strongly disagreed that local agricultural production has been lowered by oil pollution and environmental degradation associated with climate change. As a result, 21.1% of respondents strongly disputed that there are food shortages in their neighbourhood after severe weather events. Of the respondents, 18.7% disagreed, 35.5% agreed, and 24.7% strongly agreed with this issue. Furthermore, 15.8% of respondents strongly disagreed that the effects of climate change have resulted in a decrease in the overall availability of fresh, locally farmed food. The results showed that 32.2% of respondents strongly agreed, 35.5% agreed, and 16.5% disagreed.

➢ *Evaluation of Research Questions*

- *Research Question 1:*

What are the effects of climate change on food accessibility in the selected states in South-South geo-political zone of Nigeria?

Table 6: Regression Analysis for Climate Change and Food Accessibility

Groups	N	β	R Square	df	t calculated	t critical	P value
CC				2			
	936	0.601	.361	933	1.165	1.96	.000
FACC				934			

β = regression coefficient

Interpretation: The coefficient of determination (r-square) indicates that climatic change accounted for just 36.1% of the overall variation in food accessibility in Akwa Ibom, Bayelsa, and Rivers states. Consequently, 63.9% of the fluctuations in food accessibility in Akwa Ibom, Bayelsa, and Rivers states are influenced by factors not accounted for in the model.

The calculated t-value of 1.165 for the impact of climate change on food accessibility in Akwa Ibom, Bayelsa, and Rivers states is less than the tabulated t-value of 1.96 ($t_{cal} < t_{tab}$). This indicates that rising temperatures, increased frequency and intensity of extreme weather events, environmental degradation, and alterations in rainfall patterns due to climate change have adversely affected crop productivity and the fertility and quality of agricultural land, consequently leading to food inaccessibility for the populace in these three states within the South-South geopolitical zone. This judgment is further substantiated by the acquired p-value of 0.000, which is less than 0.05 ($p < 0.05$).

- *Research Question 2:*

How has climate change affected food availability in the selected states in South-South geo-political zone of Nigeria?

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Table 7: Regression Analysis for Climate Change and Food Availability

Groups	N	β	R Square	df	t calculated	t critical	P value
CC				2			
	936	0.836	.699	933	1.219	1.96	.000
FAVA				934			

β = regression coefficient

Interpretation: Based on the coefficient of determination (r-square), 69.1% of the total variation in the food availability in the three south-south geo-political states selected for this study was accounted for by climate change. In other words, only 30.9% of food availability in the three south-south geo-political states is affected by variables not included in the model.

Given that the t calculated value of 1.219 was obtained for the climate change with regards to food availability in Akwa Ibom, Bayelsa and Rivers states as against the t tabulated value of 1.96 ($t_{cal} < t_{tab}$), it is an indication that climate change-related issues like the unpredictable weather patterns, oil pollution, flood and droughts has contributed to some level of food unavailability in these states which are evidenced in the decline in locally grown food, food shortages during periods of extreme weather, frequent crop failure and decrease in staple crops like yam, cassava and maize. This decision is further affirmed with the obtained p-value of 0.000 that is less than 0.05 ($p < 0.05$).

VII. DISCUSSION OF FINDINGS

Going by the evaluation of research question one, it has been clearly established that climate change has some degree of effects on the level of food accessibility in three states (Akwa Ibom, Bayelsa and Rivers states) in Nigeria where the investigation was conducted. Climate change has caused noticeable changes in rainfall patterns, environmental degradation, a rise in the frequency and intensity of extreme weather events, and changes in the production and quality of agricultural produce. While it can be affirmed that these factors have contributed to food inaccessibility to an extent, other factors not considered in the model which include inflation, shortage of food supply from the northern part of the country due to insecurity, foreign exchange, amongst others could have also contributed to the 63.9% of the factors that have equally contributed to food inaccessibility in these three states.

These findings gain support from the works of Muringai *et al.* (2020) on the impact of declining water resources, higher temperature with an increasing CO2 emission on food production. Like most other researchers, they found a strong correlation between poor crop performance and changing climate conditions, which ultimately affects people's access to food. According to these authors, climate change impacts the first stage of the food supply chain, production.

The evaluation of the second research question also revealed that climate change manifested in the three states in the form of unpredictable weather patterns, oil pollution, flood and droughts which to a large extent led to noticeable decline in locally grown food, food shortages during periods of extreme weather, frequent crop failure and decrease in staple crops like yam, cassava and maize. Unlike the result obtained for the research question one, only 30.9% of food availability in the three south-south geo-political states is affected by variables not included in the model. This is because climate change-related issues like the unpredictable weather patterns, oil pollution, flood and droughts in these oil producing states (Akwa Ibom, Bayelsa and Rivers) has impacted negatively on crop yields therefore resulting to food unavailability.

The above finding corroborates the earlier studies by Uwazie (2020) which held that the reason for food security and human security crises currently faced in Nigeria is not far-fetched; changes in climate has been identified by researchers as the subtle causative factor for these. Furthermore, through their numerous publications, the Food and Agricultural Organisation (2017) and the World Bank (2016) cautioned that climate change will continue to pose a severe threat to Nigeria's sustainable food supply.

VIII. CONCLUDING REMARKS

As demonstrated by the obvious changes in rainfall patterns, drought, floods, desertification, deforestation, rising temperatures, erosion, and environmental degradation, this study sought to understand how climate change impacts food security, specifically in relation to the quantity and quality of food crops in the states of Akwa Ibom, Bayelsa, and Rivers. Without question, when food crop production and quality are impacted, it suggests that food availability, affordability, and accessibility have been jeopardised.

It was noted that the research participants in the three states (Akwa Ibom, Bayelsa, and Rivers) of the south-south geopolitical zone where this study was carried out answered the questions according to the local food security situations brought on by the effects of climate change. These answers served as the foundation for all of the conclusions drawn from the analysis. Considering the aforementioned, the following suggestions have been made:

- Given that Akwa Ibom, Bayelsa and Rivers States are oil-producing states, there should be legislative policies that target the reduction of anthropogenic activities like deforestation, gas flaring, and the over-exploration of natural resources while supporting conservative practices like recycling and other human-inducing factors that drive climate change.
- More effort should be targeted towards promoting proper waste management, energy efficiency and other environmentally friendly practices that do not put our climate at risk of frequent volatile changes and patterns.

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- The government and other stakeholders should focus on channeling resource to research in developing animal and crop varieties with minimal maturity periods that can withstand reduced rainfall and extreme temperatures so as to ensure food production that can sustain food security.
- There is also need for our farmers and other small farm holders in these three states (Akwa Ibom, Bayelsa and Rivers) to adopt improved agricultural practices that are less vulnerable to climate change so as to ensure that food security is sustained.

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