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Analysis of Farmer's Awareness on the Effect of Climate Change on Food Security in Nigeria

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ABSTRACT
This study investigates the perception of farmers on the impact of climate change on food securityin the Ibadan North Local Government area of Ibadan, Oyo state, Nigeria. The study employs amultistage sampling technique and selects 400 respondents. Data is collected through structuredquestionnaires, analyzed using descriptive statistics, and validated for reliability. Descriptivestatistics, a 5-point Likert scale, and an ordinal logit regression model were employed in the study.Findings reveal a high awareness of climate change among farmers, with 96% having a significantunderstanding. Despite this awareness, perceptions of climate change's effects on food securitydiffer from observed changes in crop yields and food availability. Farmers report decreased cropyields (40%), reduced access to food resources (55%), and changes in weather patterns (85%).Coping strategies include climate-smart agriculture (55%) and crop/livestock insurance (44%).Government and institutional support are satisfactory (75%), with 60% participating in trainingprograms. Further results from the findings indicate that the coping strategies adopted by farmersreduce the effect of climate change on food security. Extension visits and farming experience have a positive influence on food security. The findings underscore the proactive role of farmers inadaptation, emphasizing the need for continued support and region-specific strategies to strengthenresilience in the face of climate change

Keywords: **Farmer's Awareness, Climate Change, and Food Security**

I. Introduction

Climate change could potentially interrupt progress toward a world without hunger. A robust and coherent global pattern is discernible of the impacts of climate change on crop productivity that could have consequences for food availability. The stability of whole food systems may be at risk under climate change because of short-term variability in supply. However, the potential impact is less clear at regional scales, but climate variability and change will likely exacerbate food insecurity in areas currently vulnerable to hunger and undernutrition (CCSP, 2020). Likewise, it can be anticipated that food access and utilization will be affected indirectly via collateral effects on household incomes, and food utilization could be impaired by loss of access to drinking water and damage to health (Ibrahim & Sule, 2023). The evidence supports the need for considerable investment in adaptation and mitigation actions toward a "climate-smart food system" that is more resilient to climate change influences on food security (Adeojo, 2019).

Climate change is one of the most pressing challenges facing humanity in the 21st century. It is a global phenomenon that has far-reaching impacts on various aspects of our lives, including food security. Food security refers to the availability, access, and utilization of food that ensures individuals have a nutritious and sustainable diet (Shaba, Yelwa, Obansa & Magaji, 2018). As the Earth's climate continues to change, it poses significant risks to agricultural systems, food production, and ultimately, the ability of communities to meet their food needs. Climate change is a well-documented and scientifically established phenomenon that has been attributed to human activities, particularly the burning of fossil

fuels and deforestation (IPCC, 2014). The consequences of climate change are wide-ranging and affect various sectors of society, including agriculture and food systems. The Intergovernmental Panel on Climate Change (IPCC) reports that the impacts of climate change are already being observed, with rising global temperatures, changing precipitation patterns, and an increase in extreme weather events such as droughts, floods, and storms (IPCC, 2014).

According to the Food and Agriculture Organisation of the United Nations (FAO, 2009), "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". Food security is built on four pillars (Committee on World Food Security, 2012; Ericksen, 2008; FAO et al., 2013; food availability (that is; sufficient quantities of food produced and supplied consistently); food access (that is; physical access and affordability); food utilization (proper use of food based on basic nutrition knowledge); and stability in food availability, access and utilization. The concept of food security (FS) has been central in the discussion on sustainable development. Indeed, the first Millennium Development Goal (MDG) aimed to "Eradicate extreme poverty and hunger" (United Nations, 2015). More recently, from 2016 on, the second Sustainable Development Goal (SDG) "Zero Hunger" aims to "End hunger, achieve food security and improved nutrition and promote sustainable agriculture" (United Nations, 2015). However, despite efforts made over the last decades, food insecurity is still a pressing issue in many countries, especially developing ones. The report on the State of Food Security and Nutrition in the World 2019 (FAO et al., 2019) shows that more than 820 million people were hungry in 2018, especially in Africa, Latin America, and Asia. Nevertheless, it was estimated that over 2 billion people do not have a good FS status, including 8% of the population of developed countries (for example, North America and Europe), when also considering people affected by moderate levels of food insecurity (FAO et al., 2019).

Food security is defined by the Food and Agriculture Organization (FAO) as "a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2012), is intrinsically linked to climate change. Agriculture, the primary source of food production, is highly dependent on climatic conditions, including temperature, rainfall, and seasonality. Changes in these factors directly impact crop growth, livestock productivity, and fisheries, thereby influencing food availability and accessibility. Food security, like climate change, is a multi-faceted issue. It is affected not only by obvious influences such as climate and weather but also by oil and commodity prices, trade and social policies, global politics, and population growth, to name just a few (Magaji & Musa 2015). Bringing the two together to determine how climate change may impact food security is complex. The effects of climate change on food security are diverse and geographically varied. Regions that are already vulnerable due to factors such as poverty, limited resources, and political instability are at heightened risk (Enaberue, Musa & Magaji,2024). Smallholder farmers, particularly in developing countries, often lack the financial resources, technology, and infrastructure necessary to adapt to changing climatic conditions (Wheeler and von Braun, 2013). Consequently, they face challenges in maintaining consistent food production and may experience increased food insecurity.

Studies have shown that climate change can lead to significant decreases in crop yields. For example, a study by Schlenker and Roberts (2009) found that for each 1°C increase in global mean temperature, there is an average reduction of about 6% in global maize yields. Similarly, Lobell et al. (2011) estimated that by 2050, climate change could cause a 3% to 4% decline in global wheat production for each degree of warming. Such reductions in crop yields have implications for food availability and affordability, potentially leading to increased food prices and decreased access for vulnerable populations. Also, the World Health Organization (WHO) describes three facets of food security: food availability, food access, and food use (WHO 2018). In addition to the direct impact on crop production, climate change also affects other components of the food system. Changes in temperature and precipitation patterns can disrupt pest and disease dynamics, altering the distribution and prevalence of agricultural pests and pathogens (Bebber et al., 2013). Extreme weather events, such as droughts and floods, can cause crop failures, livestock losses, and infrastructure damage, further compromising food security (Ismail, Musa & Magaji, 2019). Additionally, climate change can influence the nutritional content of crops, potentially reducing their quality and exacerbating malnutrition (Smith *et al*., 2019).

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Given the interconnectedness of climate change and food security, there is a need to assess and understand the impacts of climate change on food systems to inform policy and adaptation strategies. This study examines the consequences of climate change on food security. Furthermore, it will identify and evaluate potential adaptation and mitigation strategies to enhance food security in the face of climate change. The threats posed by climate change on food security have generated global concerns leading to some global initiatives and measures aimed at regulating human activities that induce global warming. The Kyoto Protocol for instance was aimed at regulating the emissions of greenhouse gas belts that have adverse effects on agricultural activities in the region (Ojo and Adebayo, 2012). Nigeria is not excluded from the rest of the world in terms of the effect of climate change. The outcomes of climate change have been felt across all regions of Nigeria most specifically in the Southwest. Research has shown that climate change is increasingly becoming a major threat to agricultural productivity in Nigeria. Some previously well-drained agricultural plains have become flooded in recent times, also the increasing aridity of the Sahel and Sudan savannah belts has adverse effects on agricultural activities in the region which in turn affects the food security level of other regions in the country which experience another effect from climate change (Ojo and Adebayo, 2012).

The main objective of this study is to look into the Analysis of farmers awareness on the effect of climate change on food security in Ibadan North Local Government in Nigeria

II. Literature Review

Climate change is a major worldwide concern, especially in agriculture, where it threatens food security in serious ways. As a country that relies mostly on agriculture for its economy, Nigeria is particularly at risk. The farmers of Ibadan North, a critically important agricultural region, are the focus of this research project. Challenges experienced by many rural communities in Nigeria are reflected in the study's focus on the region's distinctive ecological and socioeconomic features. The findings of this research can inform local initiatives and add to the international conversation on agriculture's role in coping with climate change. The study's ultimate goal is to strengthen local agricultural systems' resilience and promote long-term food security by informing policies and actions that are in tune with farmers' realities.

2.1 Conceptual Review

Agriculture is overly important in every society and its impact cannot be quantified. Climate change has a variable effect on Agriculture. It is therefore important to have a proper understanding of the concept of climate change, the concept of food security, and the concept of farmer's perception of climate change.

2.1.1 Climate Change

According to Pielke (2004), the Framework Convention on Climate Change (FCCC) defines climate change as " a change of climate that is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere, and that is in addition to natural climate variability over comparable period" By contrast, the Intergovernmental Panel on Climate Change (IPCC) defines climate change broadly as " any change in climate over time whether due to natural variability or as a result of human activity" These different definitions have practical implications for decisions about policy responses such as adaptation. They also set the stage for endless politicized debate

Worldwide observed and anticipated climatic changes for the twenty-first century and global warming are significant global changes that have been encountered during the past 65 years. Climate change (CC) is an inter-governmental complex challenge globally with its influence over various components of the ecological, environmental, socio-political, and socio-economic disciplines (Feliciano et al.2022). Climate change involves heightened temperatures across numerous worlds (Schuurmans,2021). With the onset of the industrial revolution, the problem of earth climate was amplified manifold (Leppänen et al.2014). It is reported that immediate attention and due steps might increase the probability of overcoming its devastating impacts. It is not plausible to interpret the exact consequences of climate change (CC) on a sectoral basis (Izaguirre et al.2021), which is evident by the emerging level of recognition plus the inclusion of climatic uncertainties at both the local and national levels of policymaking.

Climate change is characterized based on the comprehensive long-haul temperature and precipitation trends and other components such as pressure and humidity levels in the surrounding environment. Besides, the irregular weather patterns, the retreating of global ice sheets, and the corresponding elevated sea level rise are among the most renowned international and domestic effects of climate change (Michel et al.2021; Murshed

2020). Before the Industrial Revolution, natural sources, including volcanoes, forest fires, and seismic activities, were regarded as the distinct sources of greenhouse gases (GHGs) such as CO_2, CH_4, N_2O, and H_2O into the atmosphere (Murshed2022). United Nations Framework Convention on Climate Change (UNFCCC) struck a major agreement to tackle climate change and accelerate and intensify the actions and investments required for a sustainable low-carbon future at the Conference of the Parties (COP-21) in Paris on December 12, 2015. The Paris Agreement expands on the Convention by bringing all nations together for the first time in a single cause to undertake ambitious measures to prevent climate change and adapt to its impacts, with increased funding to assist developing countries in doing so. As so, it marks a turning point in the global climate fight. The core goal of the Paris Agreement is to improve the global response to the threat of climate change by keeping the global temperature rise this century well below 2 °C over pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C (Sharma,2020; Chien et al.2021.

The main greenhouse gases that are causing climate change include carbon dioxide and methane. These come from using gasoline for driving a car or coal for heating a building, for example. Clearing land and cutting down forests can also release carbon dioxide. Agriculture, oil, and gas operations are major sources of methane emissions. Energy, industry, transport, buildings, agriculture, and land use are among themain sectorscausing greenhouse gases.

2.2.2 Food Security

Food security is a flexible concept as reflected by the many attempts to define it in research and policy usage. The concept of food security originated some 50 years ago, at a time of global food crises in the early 1970s. Even two decades ago, there were about 200 definitions for food security in published writings (Maxwell, 2018), showing the contextual dependent features of the definition. The current widely accepted definition of food security came from the Food and Agriculture Organization's (FAO) annual report on food security "The State of Food Insecurity in the World 2001": Food security isa situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The last revision to this definition happened at the 2009 World Summit on Food Security which added a fourth dimension – stability – as the short-term time indicator of the ability of food systems to withstand shocks, whether natural or man-made (FAO, 2022).

In an attempt to bring more unity to the complexity of the concept of food security, a redefinition of food security was conducted through international consultations in preparation for the World Food Summit held in 1996 (Shaw, 2007), reflecting the complex interaction among, and between, individual, household, even to the global level. Food security, at all different levels, is achieved "when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2022). In the mid-1990s, as the term "food security" evolved, the terms "nutrition security" and "food and nutrition security" also emerged. Food security is then considered as a subset of "food security and nutrition". The next development of the definition of food security was redefined further in "The State of Food Insecurity in the World 2001" by adding the social emphasis as cited above. It was recognized that addressing poverty is necessary but not alone sufficient to achieve this goal (FAO, WFP, and IFAD, 2012). Then at the 2009 World Summit on Food Security, the last official revision added the fourth dimension of stability to the concept of food security (FAO, 2009). More recently it has been suggested that sustainability be added as a fifth dimension to encompass the long-term time dimension (Berry et al., 2015). Lack of food means poverty (Musa, Magaji, Eke, Abdulmalik, 2022; Musa & Yahaya, 2018; Magaji, Musa & Salisu, 2022)

Four dimensions of food security have been identified according to the definition (FAO, 2008). 1) Availability of food produced locally and imported from abroad. 2) Accessibility. The food can reach the consumer (transportation infrastructure) and the latter has enough money for purchase. To such physical and economic accessibility is added socio-cultural access to ensure that the food is culturally acceptable and that social protection nets exist to help the less fortunate. 3) Utilization. The individual must be able to eat adequate amounts both in quantity and quality to live a healthy and full life to realize his or her potential. Food and water must be safe and clean, and thus adequate water and sanitation are also involved at this level. A person must also be physically healthy to be able to digest and utilize the food consumed. The fourth domain of Stability deals with the ability of the nation/

community/(household) person to withstand shocks to the food chain system whether caused by natural disasters (climate, earthquakes) or those that are man-made (wars, economic crises). Thus, it may be seen that food security exists at several levels. Availability - National; Accessibility – Household; Utilization – Individual; Stability – may be considered as a time dimension that affects all the levels. All four of these dimensions must be intact for full food security. More recent developments emphasize the importance of sustainability, which may be considered as the long-term time (fifth) dimension of food security. Sustainability involves indicators at a supra-national/regional level of ecology, biodiversity, and climate change, as well as socio-cultural and economic factors (Berry et al., 2015). These will affect the food security of future generation

2.3 Theoretical Review

The theoretical review for this study draws upon one major key theory and concept in line with the major objective of this study. The climate change and agricultural theory provide a multidisciplinary lens through which to examine the complex relationship between climate change and food security.

2.3.1 Climate Change and Agriculture Theory

The Climate Change and Agriculture Theory (Lobell & Burke, 2010) serves as a foundational framework for comprehending the intricate ways in which climate change influences agricultural productivity and food production. This theory is paramount in unraveling the direct and indirect impacts of climate-related factors on the agricultural sector, shedding light on how changing climate patterns can disrupt food security.

This theory posits that climate change exerts a substantial influence on agricultural productivity, primarily through alterations in temperature and precipitation patterns. Temperature changes, both increases and decreases, have significant implications for crop growth and livestock management. Rising temperatures can affect crop development, potentially shortening growing seasons and altering the distribution of pests and diseases (Lobell et al., 2013). Conversely, temperature increases in some regions may extend growing seasons, presenting opportunities for new crop varieties. However, the extent to which these shifts in temperature affect crop yields and quality depends on various factors, including the crop type and local adaptation measures.

(Lobell et al., 2008) opined that altered precipitation patterns, another hallmark of climate change, can have profound impacts on agriculture. Changes in the timing and distribution of rainfall can lead to droughts, floods, or irregular water availability. Such events can reduce crop yields, damage infrastructure, and disrupt food production systems. The Climate Change and Agriculture Theory underscores the importance of understanding these precipitation-related challenges, as they pose significant threats to food security, particularly in regions heavily reliant on rain-fed agriculture. Furthermore, this theory delves into the potential for shifts in growing seasons and the suitability of existing agricultural practices under changing climate conditions. As temperatures rise, regions may experience shifts in optimal planting and harvesting times for various crops. This necessitates adaptive strategies, such as altering planting dates or transitioning to more climate-resilient crop varieties. Agricultural practices that have been effective in the past may need to be reevaluated and modified to accommodate new climate realities (Lobell *et al*, 2011).

The Climate Change and Agriculture Theory emphasizes the imperative of adopting climate-smart agricultural approaches that enhance the sector's resilience to changing climate patterns. These approaches encompass a range of strategies, including precision farming, improved irrigation practices, and the use of climate data and forecasting tools to inform decision-making. By incorporating these strategies, agriculture can better adapt to evolving climate conditions, optimize resource utilization, and contribute to long-term food security (Lobell et al., 2013).

2.4 Empirical Review

Similarly, Otekunrin et al. (2021) studied food insecurity, particularly among farming households in Nigeria. They employed the multi-stage sampling technique on a cross-section of 211 farming households. More precisely, they used the household food insecurity access scale approach to measure food insecurity, while they used the ordered logit method for analyzing the factors influencing food insecurity. Their study found that the percentage of food-secure farming households was 12.8%, while 87.2% were exposed to food insecurity. In addition, demographic and economic factors such as the age of the farmer, lead household's years of schooling, gender, farm size and experience, and access to extension service had a significant impact on food insecurity among the

observed farming households. The study therefore recommends the promotion of education-related intervention programs and the provision of rural infrastructural facilities such as boreholes, power supply, and healthcare services.

Tarasuk et al. (2019) examined the socio-demographic and geographic drivers of food insecurity among households in the Canadian economy. They observed a wide sample of households (about 120,909) spanning from 2011 to 2012. The 18-item Household Food Security Survey Module was used to access food security. Furthermore, they determine the presence and severity of food insecurity among households by using multivariable binary and multinomial logistic regression. Their result indicated there is food insecurity among households, and, it varied from region to region. It was 11.8% in Ontario, while it was 41.0% in Nunavut. They concluded that the probability of food insecurity and its severity depends on the province, source of income, level of education, and structure of households.

Furthermore, a study by Verschuur et al. (2021) used an extreme event attribution (EEA) approach and was combined with an explanatory framework that examined climate change's impact on worsening food production shocks in Lesotho. More precisely, they evaluated how crops are sensitive to climate change and gave some insights into its implications for food security. They found climate change to be a very important driver of food production shocks in Lesotho in 2007. The findings also revealed that the fragile state of the agricultural sector worsens their trade dependency. This can affect the country's ability to build resilience to climate change impact both in the present and in the future.

Molotoks et al. (2021) studied the future impacts of climate variability, population changes, and land use on food security in a global context. They used the food estimation and export for diet and malnutrition evaluation (FEEDME) modeling framework to determine the per capita calories. They also used two representative concentration pathway scenarios from the Intergovernmental Panel on Climate Change to account for climate variability. They incorporated land use and population change in their model together with three shared socio-economic pathways (SSP). Their findings showed that population changes made the SSP scenarios have a larger impact on future food insecurity. In addition, their findings showed that population growth is the dominant driver of changes in undernourishment in a global context. The study therefore recommends that improvement in maternal health care and increasing food access will mitigate all consequences of the projected population growth.

More recently, Affoh et al. (2022) examined the relationship between climate variables and food security utilization in 25 SSA countries spanning from 1985 to 2018. Using panel autoregressive distributed lag, they found that rainfall positively and significantly affects access to food, availability of food, and its utilization in the long run. On the other hand, temperature negatively impacts access to food and its availability, while it does not affect food utilization. They further estimated the model for robustness check using panel fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) and found a causal relationship between food availability and CO2 emission in the short run. In addition, food utilization was strongly connected with temperature, while the link with food accessibility was rather causal. They recommended that governments in the region should provide adequate funding for food production by providing subsidies to farmers and promoting proper irrigation systems in the country.

Despite the increased empirical efforts on the impact of climate change on food security, there appears to be a dearth of studies in developing countries compared to what is available in the developed world. This study extends the body of literature by seeking to shed more light on the complicated relationship between climate and food security in the study area.

In a study on the Effect of climate change on food security in Nigeriaby Ayo *et a*l (2014), principally effects have been identified to include: reduction of agricultural production, changes in the suitability of land for crop production, changes in precipitation patterns, and increase in temperature could lead to longer growing seasons, CO2 fertilization could increase yields for those crops with the physiology to benefit from CO2 enrichment, increased irrigation, planting and harvesting changes, decreased arability, more pest, the risk to fisheries, undernutrition (inadequate dietary intake and reduce calorie intake), increase aflatoxin contamination, increased pathogenicity of organisms(by environmentally induced mutation), etc. A step change is needed in efforts to create a 'climate-smart food system' that can better withstand whatever climate throws at us. This should include the development of drought- and heat-tolerant crops or new tillage techniques that reduce the release of carbon from soils, but we need to go further and ensure trade, investment,

and development policies all have 'climate-smart' food as a central goal.

Husen and Temesgen (2022) in a study on the Review of the Impact of Climate Change on Food Security in Africa stipulated that due to climate change extreme events/or droughts drive food crises/hunger many Africans were badly affected For instance, more than 100 million people were affected by drought-driven hunger in Africa. So, Africa especially, Sub-Saharan Africa is marked as the most food insecure region in the world, and has the highest proportion of food insecure people, with an estimated regional average of 26.8% of the population undernourished and this rate could be over 50%. Moreover, the risk of hunger will increase by 10-20% in 2050. Similarly, in Africa, due to climate change impacts, the number of malnourished children is projected to increase in 2030 and 2050 from the baseline (33 million) to 42 million and 52 million respectively. Thus, climate change impacts on food security have to be taken as a key issue, and impact reduction strategy options have to be implemented.

The Food Research International journal recently published a special issue on climate change impacts on food safety (Uyttendaele and Hofstra, 2015), which tackled this topic from various perspectives. Overall, the reviews conclude that climate change could reduce food safety and that more research is required to get a better understanding of the problems and to set up adaptation strategies

Ayanwuyi et al (2010) carried out a study on climate change and food production. The study assessed farmer's perception of the impact of climate change on food crop production in the Ogbomoso Agricultural zone of Oyo State, Nigeria. In the study, only 31.1% and 24.7% of the respondents indicated delayed rainfall and higher temperature respectively as their perception of climate change. About 12% indicated unusual heavy rainfall, 9.4% indicated undefined seasons, while 4.4% and 4.2% respectively indicated flood with serious consequences and later fruiting of tree crops respectively as their perception of climate change. About 80.3% of the respondents mentioned low yield of crops as the impact of climate change on crop production, stunted growth (37.2%), and ease the spread of pest and diseases attack crops (31.1%). Even though only 68.3% indicated increased water conservation as an adaptation strategy, 74.7% mentioned planting different crops while 54.4% changed row orientation concerning slope, as the adaptation strategy to mitigate the impact of climate change. A significant relationship at 0.05 significant level with a coefficient of ($R2 = 0.612$) was found between perceived climate change and adaptation strategies. Therefore, Arable food crop farmers are more knowledgeable of climate change and even its impacts on their livelihood that should be considered in policy formulation on the adaptation of agricultural production systems to climate change.

Although many studies have examined how climate change is affecting agriculture and how important it is to understand farmers' perspectives, however, most studies are not consistent with time based on the fact that climate change could have a different effect on farmers at a different point in time. It is therefore important to consistently study the current situation on climate change and it effect on food security. While there are studies that provide a high-level overview, a deeper dive into the aspects that determine how various farmers understand and react to climate change is required consistently to cope with latest development on the climate.

Therefore, the purpose of this research is to fill these gaps by performing an in-depth analysis of the current situation as it relates to climate change and its effect on food security, how various farmer households perceive climatic risk. By studying the intricacy of social networks, information exchange, and family characteristics, the study hopes to provide a more thorough knowledge of the elements impacting farmers' perceptions of climate change. By taking into account the impact of farmers' years of experience and collected knowledge, this study also hopes to provide light on the temporal component of these perceptions. The goal of the research is to provide useful information that may be used to create effective and individualized plans for adapting to climate change in the near and far future.

III. Methodology

This section presents the research methodology employed to assess the perception of farmers on the impacts of climate change on food security in Ibadan North Local Government in Nigeria. The methodology is designed to provide a comprehensive understanding of the effect of climate change on food security and mitigation strategies adopted in the study area. It encompasses data collection, analysis techniques, and the overall framework for conducting the study.

3.1 Study Area

This research focuses on the Ibadan North Local Government Area within Oyo State, situated in southwestern Nigeria. Oyo State is an inlandstatein southwesternNigeria. Oyo State isborderedto the north byKwara Statefor 337 km, to the east byOsun Statefor 187 km, partly across the River Osun, and to the south byOgun State, and to the west by theRepublicofBeninfor 98 km. With a projected population of 7,976,100 in 2022 (UN, 2022). *Ibadan* is thecapitaland most populous city ofOyo State, inNigeria. It is thethird-largest city bypopulationinNigeriaafterLagosandKano, with a total population of 2,949,000 as of 2022 (UN, 2022). Oyo State presents a multifaceted landscape ideal for comprehensive research. As the home to the historic city of Ibadan, the state offers a blend of historical, cultural, and economic significance. This diverse region encompasses both urban and rural areas, providing a broad spectrum for investigations across various domains.

3.2 Research Design

The research design for this study adopts a quantitative technique. This approach enables a more holistic understanding of the impacts of climate change on food security by integrating both subjective perspectives and objective data. The quantitative component of the research design involves the collection and analysis of numerical data to quantify the impacts of climate change on food security. Surveys and questionnaires will be administered to the selected respondents in the study area. These instruments will collect data on various aspects, such as changes in crop yields, adaptation strategies employed, and perceptions of the relationship between climate change and food security.

3.3 Population of the Study

The focus of this study is to evaluate the impacts of climate change on food security in the southwestern region of Nigeria, with the specific population of interest being farmers in Ibadan North Local Government Area of Oyo State, Nigeria.

3.4 Sampling Technique and Sample Size

A multistage sampling technique was employed for this study. The first stage involves the purposive selection of Ibadan LGA because of the preponderance of farming activities in the area. The second stage involves the purposive selection of 10/regions or districts that are mostly prompt to climate change in the Local Government Area. Thirdly from each selected region, a systematic random sampling method was used to select 40 farmers for data collection. This approach allows for a statistically valid sample size that represents the diversity of agricultural practices, cropping patterns, and socio-economic conditions within the study area. A total sample size of 400 respondent was used for this study.

3.5 Source of Data

The study makes use of cross-sectional data which was sourced from farmers and stakeholders in 10 different region/districts of Ibadan Local Government Area, Oyo State, Nigeria.

3.6 Methods of Data Collection

The study is based on primary data. The primary data used for this study will be obtained through the use of well-structured questionnaire. The primary data to be collected from the respondents include the socio-economic characteristics of the respondents, such as age of farmers, farming experience, educational level, farm size, household size, gender, frequency of extension contact, marital status, membership of cooperation, and occupational status,other data on the level of awareness, the perceived impact of climate change on food security and adaptative strategies was collected for the study.

A Reliability test for the Instrument used was conducted. The reliability assessment of the data collection instrument aimed to ascertain the consistency of results over time and their accuracy in representing the entire study population. This evaluation utilized the Cronbach's alpha method, where a reliability value of 0.7 or higher was considered indicative of reliability. The data used for this assessment were derived from the questionnaires administered during the pilot study.

3.7 Method of Data Analysis

Quantitative data obtained from surveys and questionnaires will be analyzed using descriptive statistics, a 5-point Likert scale, regression analysis, and other relevant statistical tools. This aid in reporting the results in frequencies, descriptive analysis, reliability and validity of the test. The descriptive statistics makes use of percentages, frequency, and standard deviation to achieve objective (i), a 5-point Likert scale was used to achieve objective (ii), (iii) and (iv). The ordinal logit regression model was used to achieve objective (v) The data collected will be coded and analyzed using Statistical Package for Social Sciences (SPSS 27.0).

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The ordinal logit regression model allows individual to analyze the relationship between multiple independent variables and the ordinal dependent variable representing different levels of coping strategies. It helps to understand how various factors influence the likelihood of adopting different coping strategies among farmers facing climate change impacts on food security. The explicit form of the ordinal logit regression model used to achieve objective (v) is specified as;

Y= a+b1x1+b2x2+b3x3+b4x4+b5x5+b6x6+b7x7+b8x8+b9x9+e ..... *(4)*

Where:

Y = food security status (1= food insecure with severe hunger, 2 = food insecure with moderate hunger, 3 = food insecure without hunger and 4 = food secure).

a = constant b1-n= regression coefficients x1= age of respondent (years) x2 = household size (number of people) x3 = Marital Status x4 = farm size (hectares) x5 = extension contact (number of visits in a production cycle) x6 = Monthly Income x7 = farming experience (years) x8 = amount of credit accessed (naira) x9 = Coping strategy (CS) e = error term

IV. Result and Data Analysis

This chapter deals with the analysis of the data collected through the use of questionnaire distributed to the respondents, interpretation of the results and subsequent discussion of it. The analysis is done with the aid of descriptive statistics of the research instrument, as well as descriptive of the information gathered. The use of a 5-point Likert scale and ordinal Logit regression Model. Information obtained was presented in tabulated format. A summary of the major findings of this study is presented in line with the stated purpose.

4.1 Socio-Demographic Characteristic of Respondents

Table 4.1: Distribution of the Respondents Demographic Information

Variables	**Frequency**	**Percentage (%)**
Gender		
Male	236	59.0%
Female	164	41.0%
Total	**400**	**100.0%**
Age		
30-39 years	218	54.5%
40-49 years	124	31.0%
50-59 years	58	14.5%
Total	**400**	**100.0%**
Educational Qualification		
No Formal Education	124	31.0%
Primary Education	52	13.0%
Secondary Education	108	27.0%
Tertiary Education	116	29.0%
Total	**400**	**100.0%**
Years of Farming Experience		

5 years	44	11.0%
7 years	28	7.0%
9 years	64	16.0%
10 years	68	17.0%
11 years	60	15.0%
12 years	136	34.0%
Total	**400**	**100.0%**
Marital Status		
Single	88	22.0%
Married	152	38.0%
Widowed	84	21.0%
Separated	76	19.0%
Total	**400**	**100.0%**
Household Size		
1-5	144	36.0%
6-10	136	34.0%
11-15	44	11.0%
16-20	32	8.0%
21-25	44	11.0%
Total	**400**	**100.0%**
Farm Size		
3-4	80	20.0%
4-5	100	25.0%
>5	220	55.0%
Total	**400**	**100.0%**
Monthly Income		
Less 50,000	72	18.0%
50,000-100,000	120	30.0%
100,000 and above	208	52.0%
Total	**400**	**100.0%**
Access to Extension Service		
Yes	220	55.0%
No	180	45.0%
Total	**400**	**100.0%**
Access to Credit		
Yes	236	59.0%
No	164	41.0%
Total	**400**	**100.0%**

Source: Author's Computations, 2023.

Table 4.1 shows the demographic distribution of respondents and provides an overview of the characteristics of the 400 respondents in the study, offering insights into the gender distribution, age groups, educational qualifications, years of education, marital status, household size, farm size, monthly income, and access to extension services and credit. This section analyzes the findings and relates them to existing literature. In respects to gender distribution in the sample shows that (59.0%) of the respondents are male, while (41.0%) are female. This distribution reflects a male majority in the sample. In many agricultural studies, gender disparities are commonly observed, with men often being more engaged in farming activities. According to FAO (2011), women make up a significant portion of the agricultural workforce in developing countries but often have limited access to resources and extension services. More so, the age distribution reveals that (54.5%) of respondents are aged between 30 and 39 years, (31.0%) fall within the 40-49 age group, and (14.5%) are aged 50-59 years. The dominance of respondents in the 30-39 age group suggests a relatively younger population participating in the study. Younger farmers might have different perspectives and adaptation strategies for climate change, as highlighted in studies like Sova et al. (2017).

Meanwhile, this data shows that (29.0%) of respondents have tertiary education, (27.0%) have secondary education, (13.0%) have primary education, and (31.0%) have no formal education. This variation in educational backgrounds is consistent with the findings of Tesfaye et al. (2020), which emphasize the importance of considering farmers' educational levels when examining their climate change awareness and adaptation. Also, as regards to years of farming experience, respondents with 12 years of farming experience account for the largest group at (34.0%), followed by (17.0%) with 10 years of farming experience. Education duration can influence farmers' awareness of climate change and adaptation practices (Alem et al., 2017). More so, the majority of respondents are either married (38.0%) or separated (19.0%). Marital status can have implications for household decision-making related to climate change adaptation strategies (Wong & Chang, 2013). The largest group, at (36.0%), has household sizes ranging from 1-5 members, and (34.0%) have 6-10 members. Larger households might face different challenges and adaptation strategies (Munyua & Win, 2017) and most respondents (55.0%) have a farm size greater than 5 acres. Larger farms can have diverse crops and increased exposure to climate change risks (Deressa et al., 2009).

However, the majority of respondents (52.0%) have a monthly income of 100,000 NGN and above. Higher income levels can provide more resources for climate-resilient practices (Kibonge & Simatele, 2019).(55.0%) have access to extension services, while 59% have access to credit.

Access to these services is vital for farmers' awareness of climate change and their capacity to implement adaptation measures (Pandey et al., 2018).

It can be deduced from this study that the demographic characteristics of the study's respondents reveal a varied sample with implications for climate change awareness, adaptation practices, and vulnerability. The literature supports the idea that factors such as gender, education, age, marital status, and access to resources play a crucial role in shaping farmers' responses to climate change challenges. Thiis is in line with the findings of Béné *et al* (2016) who stipulated that socioeconomic characters are contributing factors to farmers awareness, level of perception and strategies adopted to mitigate the effect of climate change on food scurt. These findings highlight the need for tailored interventions to enhance climate resilience among diverse farmer groups based on their socio-economics characteristics in the study area.

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4.2 Level of the Awareness of Farmers on the Effect of Climate Change on Food Security in the Study Area.

Table 4.2: Result on the Level of FarmersAwareness on the effect of Climate Change on Food Security

S/N	Item	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)	Mean
1	I have high information and awareness about climate change	192(48.0%)	144(36.0%)	24(6.0%)	8(2.0%)	32(8.0%)	4.14
2	I know about the effects of climate change	172(43.0%)	56(14.0%)	36(9.0%)	92(23.0%)	44(11.0%)	3.55
3	I know about the effects of climate change on food security	224(56.0%)	132(33.0%)	24(6.0%)	20(5.0%)	-	4.40
4	I know about food security and its effects on the society	208(52.0%)	128(32.0%)	24(6.0%)	40(10.0%)	-	4.26
5	I know about the relationship between food security and climate change	240(60.0%)	104(26.0%)	56(14.0%)	-	-	4.46
6	I have observed changes in agricultural productivity in my region in the past decade	60(15.0%)	144(36.0%)	72(18.0%)	60(15.0%)	64(16.0%)	3.19
7	I have personally experienced changes on my farm as caused by climate change	192(48.0%)	132(33.0%)	24(6.0%)	28(7.0%)	24(6.02.41	192(48.0%)
	Grand Mean 3.77						

Table 4.2 presents result on farmers' awareness and understanding of climate change in Ibadan North Local Government. The responses are categorized into "Strongly Agree," "Agree," "Neutral," "Disagree," and "Strongly Disagree," along with the mean values for each item. This section provides an analysis of the findings in the table and connects them to relevant literature. The data reveal that a substantial proportion of farmers have a high level of awareness about climate change, with (48.0%) strongly agreeing and (36.0%) agreeing that they have high information and awareness about climate change. This finding aligns with the idea that awareness is a crucial factor in climate change adaptation (Alem et al., 2017). Farmers who are aware of climate change are more likely to recognize its impact on their farming practices and food security. Also, the second item indicates that (43.0%) of farmers strongly agree and (14.0%) agree that they know about the impacts of climate change, but (23.0%) disagree and (11.0%) strongly disagree. This mixed response reflects a gap in understanding among some farmers. Research by Deressa et al. (2009) emphasizes that understanding the specific impacts of climate change is essential for implementing effective adaptation measures.

More so, the result shows that a significant portion of respondents (56.0%) strongly agree that they know about the impacts of climate change on food security, while (33.0%) agree. This high level of awareness is a positive sign, as food security is a critical concern linked to climate change in many regions (Béné et al., 2016). Farmers who are aware

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of this relationship are more likely to adopt practices that enhance food security. Similarly, (52.0%) of farmers strongly agree, and (32.0%) agree that they know about food security and its impacts on society. This awareness can be seen as an important step toward addressing food security challenges that may arise due to climate change (Wheeler & von Braun, 2013). The result also indicates that (60.0%) of farmers strongly agree, and (26.0%) agree that they are aware of the relationship between food security and climate change. Understanding this relationship is critical for building resilience and sustainable food systems in the face of climate challenges (Lipper et al., 2014).

And around (51.0%) of farmers either strongly agree or agree that they have observed changes in agricultural productivity in their region over the past decade. This observation aligns with the findings of several studies (Sova et al., 2017) that suggest climate change impacts are becoming increasingly visible in agricultural practices. Meanwhile, the data reveal that (48.0%) of farmers strongly agree and (33.0%) agree that they have personally experienced changes on their farm as caused by climate change. These findings are consistent with the idea that personal experiences often drive farmers to adapt to climate change (Adger et al., 2003).

The result of this table indicates a generally positive level of awareness and understanding of climate change among farmers in Ibadan North Local Government. However, some variability exists, particularly in the understanding of specific climate change impacts.

4.3 Perception of Farmers on the Effect of Climate Change on Food Security in the Study Area.

Table 4.3: Perceived Effect of Climate Change on Food Security

S/N	Item	Increased Yields	Moderate Yields	Decreased Yields	No Noticeable Impact
1	How has climate change affected your crop yields in	80(20.0%)	100(25.0%)	160(40.0%)	60(15.0%)
S/N	**Item**	**Improved Access**	**Moderate Access**	**Reduced Access**	**No Noticeable Impact**
2	How has climate change influenced your access to food resources (e.g., market availability, affordability)?	80(20.0%)	100(25.0%)	80(20.0%)	140(35.0%)
S/N	**Item**	**Yes**		**No**	
3	In your opinion, has climate change affected the weather patterns in your area?	340(85.0%)		60(15.0%)	
4	Have you observed any changes in	360(90.0%)		40(10.0%)	
5	food availability in your community due to climate Do you believe that climate change has had an impact on	320(80.0%)		80(20.0%)	

Table 4.3 presents the perceptions of farmers in the study area regarding the effects of climate change on food security. The data show that (40.0%) of farmers perceive that climate change has decreased their crop yields, while (25.0%) report moderate decreases. This finding is consistent with the work of (Lobell et al., 2011), which suggests that changing weather patterns and increased extreme events, such as droughts and floods, can lead to reduced crop yields. The perception of decreased yields may indicate real challenges faced by farmers due to climate change impacts. In terms of access to food resources, (35.0%) of farmers report moderate access reductions due to climate change. This aligns with the understanding that changes in climate can affect market availability and affordability of food resources, particularly for vulnerable communities (Hassan & Nhemachena, 2008). These findings highlight the multifaceted nature of food security, encompassing not only production but also accessibility and affordability. And a substantial

(85.0%) of farmers perceive that climate change has affected weather patterns in their area. Changes in weather patterns can lead to unpredictable growing seasons and increased risks, which have been reported in studies on climate change impacts on agriculture (Deressa et al., 2009).

An overwhelming (90.0%) of farmers have observed changes in food availability in their community due to climate change. This finding underscores the interconnectedness of local food systems with climate patterns. Similar results were reported in studies conducted by Tschakert et al. (2010) and Smit & Wandel (2006), which highlighted the impact of climate change on food availability in vulnerable regions.

The result indicates that (80.0%) of farmers believe that climate change has had an impact on their nutritional well-being. This perception is supported by studies linking climate change to food security and nutritional challenges, especially in regions where diets are heavily dependent on local agriculture (Grace et al., 2018).

The result from this finding reflects farmers' perceptions of climate change's impacts on food security, crop yields, and food availability in the study area. These perceptions align with the findings which emphasizes the vulnerability of agricultural systems and food security to climate change (Poudel et al (2017). Farmers' recognition of these challenges is a critical step toward implementing adaptive measures and building resilience in the face of climate-related threats.

V. Conclusion and Recommendation

From the findings of this study, it can be deduced that Farmers in the study area exhibit a high level of awareness and understanding of climate change and its effect on food security. This is because they are well-informed about the impacts of climate change and its link to food security. Informed farmers are better equipped to make decisions and adapt to climate change challenges. However, climate change has led to reduced crop yields and altered weather patterns. Access to food resources, including market availability and affordability was also affected. Nutritional wellbeing is perceived to be impacted, raising concerns about food security. Farmers over the years have proactively implementing adaptation practices, including climate-smart agriculture and crop and livestock insurance to reduce the effect of climate change on food security in the study area. Their active response demonstrates resilience and adaptability in addressing climate change challenges. Government agencies and agricultural institutions play a crucial role in supporting farmers. The support is well-received and highly accessible, indicating a positive partnership. The active participation of farmers in training programs highlights the mutually beneficial relationship between farmers and institutions. Farmers in the study area are well-prepared to face climate change challenges, emphasizing the need for informed decision-making. Climate change has substantial and multifaceted effects on food security, necessitating adaptive strategies and policies. Farmers on their own were able to adopt some coping strategies that were able to reduce the adverse effect of climate change on food security. The proactive engagement of farmers and effective government support offer promising pathways to strengthen the agricultural sector and ensure long-term food security. Therefore, the following recommendations were made in this study;

Encourage continuous education and awareness programs for farmers to enhance their understanding of climate change and its impacts on food security. These programs can be conducted through community-based initiatives and should focus on practical adaptation strategies, Government agencies and agricultural institutions should maintain and improve their support systems for farmers. This includes ensuring the accessibility of resources and services for climate change adaptation, Invest in research and development efforts to identify region-specific climate-smart agricultural practices that can further strengthen farmers' resilience to climate change. iv.In order to fully engaged the active youths faced by the climate change challenges, there is the need to explore alternative income streams such as agro-tourism, value-added products, or community-supported agriculture (CSA) to buffer against crop losses and market fluctuations caused by climate change. Farmers should engage in other additional means of income generation to improve their food security status and reduce the impact of climate change, Strengthen farm infrastructure against extreme weather events by investing in resilient structures, such as greenhouse technology for protected cultivation or flood-resistant crop storage facilities, Foster community-based initiatives to share knowledge and best practices among farmers, allowing them to learn from one another's experiences and successes and government and various agro-innovative institutions should intensify extension programmes and services which will in turn reduce the effect of climate change on food security.

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