

**DETERMINANTS OF ADOPTION OF CLIMATE CHANGE ADAPTATION  
STRATEGIES IN ATTAINING FOOD SECURITY: A CASE STUDY OF BENIN CITY,  
NIGERIA**

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TOXICOLOGY**

**DATE:**

**6TH NOVEMBER, 2025.**

## CERTIFICATION

This is to certify that this research titled **Determinants of Adoption of Climate Change Adaptation Strategies in Attaining Food Security: A Case Study of Benin City Nigeria** was carried out by **Suberu Michael Oluwafemi** and presented to the Department of Environmental Management and Toxicology, Faculty of Life Sciences, University of Benin, Benin City; in partial fulfilment of the requirement for award of Bachelor of Science (B.Sc.) in Environmental Management and Toxicology. It was conducted under stable conditions, was carefully supervised and subsequently approved as having met the requirements for the award of Bachelor of Science degree in Environmental Management and Toxicology.

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## **DECLARATION**

I, **Suberu Michael Oluwafemi** declare that **Determinants of Adoption of Climate Change Adaptation Strategies in Attaining Food Security: A Case Study of Benin City Nigeria** is my own work and that all sources that I have quoted have been acknowledged by means of complete references and that this work has not been submitted before any other degree at any other university.

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**SUBERU MICHAEL OLUWAFEMI**

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**DATE**

## **DEDICATION**

This project is dedicated to God Almighty for his unconditional love, mercy for seeing me through the entire process of this project and also to my parents and siblings for their moral and financial support and encouraging me when I needed it the most.

## ACKNOWLEDGEMENT

I wish to express my gratitude to Almighty God, who sustains all life, for giving me the knowledge, wisdom and understanding during this time. I sincerely want to acknowledge as well my parents, **Mr and Mrs. O. Suberu**, for their unwavering support; love and financial assistance throughout this journey; and my siblings, **Bukola, Rashidat, Muinat, Oluwatosin and Temidayo**, for their love and support during this period. I also would appreciate and thank my supervisor, **S. Odiana Ph.D**, for his unwavering support and for always making out time to guide and encourage me all through the process of this project. I really appreciate all you have done for me sir and may God bless you and your family. I want to sincerely appreciate **Prof. E. T. Aisien**, the head of department of the department of Environmental Management and Toxicology; **Dr. A. F. Eghomwanre**, my genial course adviser, who is always ready to listen and assist, whenever I needed help; and to all my lecturers for all their efforts throughout my academic journey. Finally, I would like to as appreciate my friends, **Godman and Favour** supporting and encouraging me throughout this project. And to the friends EMT gave me, **Best, Collins, Wealth, Mabel, Dumebi, Emmanuel** just to mention a few who made my journey in EMT fun and memorable, I am genuinely grateful for all the contributions in my life. God bless you all.

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## ABSTRACT

Climate change is part of the most pressing environmental challenges of the 21st century, with its adverse effects felt across the globe through increase in temperatures, altered rainfall patterns, and increasing incidences of extreme weather events. These changes pose serious threats to food security, livelihoods, and sustainable development. In regions like Benin City (Edo State, Nigeria), climate-induced flooding and other extreme events have undermined food availability and lead to food security. This study examines determinants of adopting climate change adaptation strategies for food security in Benin City. A structured Likert-scale questionnaire was distributed to one hundred and fifty (150) respondents using google form and the data collected was subjected to descriptive and correlation statistics using statistical package for social scientists (SPSS) . The results showed low awareness of climate change impacts on food security. Correlation analysis revealed moderate positive relationships between awareness to climate change and socio-demographic factors which is statistically significant ( $r=0.373$ ,  $p=0.000<0.05$ ) and between awareness to climate change and socio-cultural influences which is also statistically significant ( $r=0.380$ ,  $p=0.000<0.05$ ). However, the study also identified barriers such as inadequate institutional support, limited access to finance, and weak infrastructural capacity as key challenges limiting effective responses. It was concluded that although local communities in Benin City demonstrate resilience through livelihood diversification, their capacity to adapt remains constrained without coordinated government intervention and broader policy support. The study recommends the introduction of climate change awareness into educational and extension programmes, the promotion of renewable energy and sustainable agricultural practices, improved access to climate information, investment in sustainable agricultural practices, and stronger collaboration between government agencies, private actors, and civil society in order to enhance adaptive capacity and safeguard livelihoods.



# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND OF STUDY

The agricultural sector, which is still the foundation of food security in a lot developing nations, is majorly impacted by climate change, which is now a major concern globally. Climate change is defined as a discernible alteration in climatic conditions, identifiable through statistical analysis of mean and/or variability in its characteristics, and enduring for an extended duration, typically decades or more (IPCC, 2007). It may arise from natural internal processes, external forcings, or sustained anthropogenic modifications in atmospheric composition or land use. An analysis by the IPCC in their Fifth Assessment Report found that, Global surface temperature increases of 1.7 to 4.8 °C are projected to occur between now and the end of the twenty-first century, with the exact amount depending on four different scenarios that account for changes in population, economic growth, and carbon consumption (IPCC, 2014). But rising global temperatures are only one aspect of climate change. Extreme weather events and natural disasters including floods, droughts, hurricanes, tsunamis, etc., as well as longer dry spells, increased frequency of heavy precipitation events, water acidification, and possibly increasing sea levels are further consequences of climate change. Agriculture, fisheries, and livestock output may be impacted by the aforementioned climate change routes (FAO, 2008). A lot places have experienced changes in rainfall, leading to droughts, intense rain, or flood and also serious heat waves. Benin City, Edo State, Nigeria is not an exemption to the effect of climate change issues. Climate change has exacerbated food insecurity in the state capital and its surrounding areas

through flooding and other environmental challenges (Ezegwu *et al.*,2024). Food security is defined as the ability to meet one's dietary needs and make healthy lifestyle choices with access to enough food that is both safe and nutritious (FAO, 2002). Food security is a multi-faceted concept that includes production, trade, and nutrition, as well as the ability of nations and individuals to maintain food access over time despite various challenges (Ojo *et al.*, 2022). One of the complex relationships between food security and climate change is the influence of global warming on primary food production, which has been well-established, but the effects of climate change on food safety have gotten lesser attention (FAO, 2020).

Climate change's impact on food security is complex due to uneven vulnerability distribution and the capacity of households, communities, and countries to adapt to threats. While certain regions may benefit from climate change in terms of food security, underdeveloped countries may suffer severe consequences. Global warming and climate disruption have a wide range of negative effects on agriculture, which will worsen as temperatures rise. Climate change threatens global food supply and security, affecting plants like grains, vegetables, fruits, animals, and seafood. High temperatures and drought-related stress can reduce animal and crop productivity, especially milk yields. In parts of the world that currently rely on agriculture that is rain-fed, irrigation may be necessary, leading to increased expenses and disputes over water availability. Planting and harvesting may be slowed down by altering seasonal rainfall patterns, more intense precipitation events, and associated flooding. Regions with lower-latitude may become minimal in productivity as prime growth temperatures move to regions with higher latitudes where soil and nutrients may not be as conducive to agricultural production. As the humidity and temperature in each area fluctuates, new pests can potentially appear (Ayo *et al.*, 2014). The sustainable growth of any country's socioeconomic and agricultural operations, as well as the continuation of

human existence overall, are both increasingly facing danger from the issue of global warming (Zadawa & Omran, 2020; Rathoure & Patel, 2020).

Given Nigeria's agricultural population and various resources, one would anticipate agricultural households to be free of food insecurity challenges. Agricultural households, despite producing food, are particularly affected by current food insecurity challenges (Kuku-Shittu *et al.*, 2013; Ogunniyi *et al.*, 2016; Ogunniyi *et al.*, 2018).

In order to preserve the ability to manage changes in present and future and seize possibilities that are and may arise, adaptation is necessary. It refers to modifications made to processes or structures in response to anticipated or real climate change. Adaptation measures that can help Nigerians counter the effects of climate change on food security include using accurate and timely weather forecasts, growing crops that are resistant to drought, using irrigation systems that are effective, and making use of agricultural extensive services (Okoli, 2024). There are several forms of adaptation methods for different farmers, with the amount of climate change influencing the type and amount to which the tactics are adopted (Hasan & Kumar, 2019; Khan *et al.*, 2020; Ojo and Baiyegunhi, 2020). There are many ways that farms can adapt to climate change, according to Bryan *et al.* (2013). These include changing crop management practices (e.g., planting dates, planting densities, crop varieties), livestock management practices (e.g., livestock choice, feeding and animal health practices, transhumance timing and destinations), and land use and management (e.g., fallowing, tree planting or protection, irrigation and water harvesting, soil and water conservation measures, tillage practices, soil fertility management). However, household adoption of these adaptation measures is still unequal, which makes it necessary to look into the factors influencing their choices. Such determinants that affect households' decisions to adopt specific climate adaptation methods are driven by a mix of

socioeconomic characteristics (e.g., age, gender, education, income), farm-level attributes (e.g., landholding size, tenure security), institutional support (e.g., extension services, access to weather information, credit), perception of climate risk, social capital, and external enabling conditions such as market access and training opportunities.

## **1.2 STATEMENT OF PROBLEM**

Even though the hazards climate change is characterised by rising temperatures, unpredictable rainfall, flooding, droughts and reduced agricultural productivity are intensifying (IPCC, 2022), many individuals still fail to adopt available adaptation strategies. Climate change has a range of negative consequences for food security and agriculture that is wide, all of which will worsen as global temperatures rise. Climate change threatens hazards to global food production and security, including grain, vegetables, fruit crops, animals, and fisheries. High temperatures and drought-related stress can reduce animal and crop productivity, especially milk yields. Irrigation may be necessary in locations where rain-fed agriculture is insufficient, resulting in higher costs and water scarcity issues (Ayo *et al.*, 2014).

Nonetheless, the actual adoption rate of these strategies among farming households remains limited and inconsistent. This Sluggish uptake poses significant challenge, as it diminishes the resilience of agricultural systems and exposes rural populations to recurrent climate induced shocks, thereby continuing cycles of poverty and food insecurity.

Locally and globally, numerous adaptation measures have been promoted, yet adoption rates remain low due to barriers rather than a lack of options (Gifford *et al.*, 2011). Common obstacles include financial constraints, cultural beliefs, limited government support, psychological resistance to change, and insufficient awareness of climate risks (Ajayi *et al.*, 2021; van

Valkengoed & Steg, 2019). Socioeconomic characteristics including income , gender, and education can impact adaptive capacity (Below *et al.*, 2012).

Failure to adopt adaptation strategies exacerbates climate impacts, including agricultural losses, increased disasters, food and water insecurity (IPCC, 2022; FAO, 2020). The persistent gap between awareness and action raises critical questions: Why do individuals, despite recognizing climate threats, often fail to adopt adaptive behaviors? What factors most significantly shape their decisions? Without addressing these barriers, climate resilience efforts may remain ineffective (Clayton *et al.*, 2015). This project intends to examine the determinants of adoption of climate change adaptation strategies in attaining food security by households and promoting sustainable development and also developing effective climate change mitigation strategies.

### **1.3 AIM AND OBJECTIVES**

#### **AIM**

This study examines the determinants of adopting climate change adaptation strategies to achieve food security in Benin city

#### **OBJECTIVES:**

- 1.To assess people's perceptions and awareness of the risks associated with climate change.
- 2.To determine the major institutional, cultural, psychological, social, and economic obstacles preventing people from implementing climate change adaptation measures.
3. To evaluate how sociodemographic characteristics (such as age, education, income, and occupation) affect households' capacity and willingness to adapt.

4. To evaluate the impact of government laws and non-governmental organizations (NGOs) on community-level adaptation to climate change

#### **1.4 SIGNIFICANCE OF STUDY**

This study is significant as it explores the critical intersection between climate change and food security, particularly within the agricultural households of Nigeria. Despite being primary food producers, these households remain at risk to food insecurity due to the growing effects of climate change, such as extreme weather events, prolonged droughts, and declining agricultural productivity. By examining the factors impacting the adoption of climate change adaptation techniques, include drought-resistant crops, efficient irrigation, and early warning systems, this research provides valuable insights into enhancing resilience and ensuring sustainable food access.

The findings will inform policymakers, development agencies, and local stakeholders on how to promote equitable and widespread adoption of adaptive practices, thereby leading to improved food security and reduction of poverty in Nigeria and similar nations that are developing. The research will also enhance understanding of effective mechanisms for promoting and supporting climate within the agricultural sector, ultimately improving the capacity of vulnerable populations to withstand recent and projected climate risks and reducing the prevalence of food insecurity.

This finding will also serve as a valuable resource for decision makers, donor agencies, and researchers in climate change and food security field.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 CONCEPT OF CLIMATE CHANGE ADAPTATION

Climate change adaptation represents the adjustment process through which societies respond to both existing and projected climatic alterations. The fundamental objective of adaptation involves minimizing adverse impacts on human populations, typically implemented concurrently with mitigation efforts, while simultaneously capitalizing on emerging opportunities. Adaptation interventions may also facilitate natural system resilience to environmental changes (IPCC, 2022).

According to IPCC definitions, adaptation within human systems constitutes the adjustment process responding to real or anticipated climatic conditions and their consequences, aimed at reducing harm or leveraging advantageous possibilities. Within natural systems, adaptation represents the mechanism for adjustment to climatic conditions and their effects, whereby human action may support this process. Adaptation requirements demonstrate significant geographical variation. Adaptive measures differ substantially across regions and communities, contingent upon particular climate impacts and vulnerability patterns (O'Neil *et al.*, 2022). Adaptation functions to diminish climate-related risks by addressing three interconnected risk components: hazards, vulnerability, and exposure. Direct hazard reduction proves impossible since hazards stem from present and future climatic transformations. Consequently, adaptation targets the risks emerging from the ways in which climate-related hazards interact with the exposure and vulnerability of human and ecological systems (Ara Begum *et al.*, 2022). Exposure reduction becomes achievable through withdrawal from high-risk zones, including floodplains. Enhanced

early warning systems and evacuation protocols represent additional exposure reduction mechanisms (Abram *et al.*, 2019).

Numerous adaptation responses exist, alternatively termed adaptation measures, strategies, or solutions, which facilitate the management of impacts and risks affecting both human populations and natural environments. Contemporary adaptation emphasizes near-term climate risks alongside specific sector concerns such as water resources and agriculture, and regional priorities including Africa and Asia (IPCC, 2022). Adaptation responses encompass various categories, all directly aimed at risk reduction and opportunity exploitation and it includes:

1. Structural and physical adaptation (incorporating engineering solutions, built environment modifications, technological interventions, ecosystem-based approaches, and service provisions)
2. Social adaptation (encompassing educational initiatives, informational programs, and behavioural modifications)
3. Institutional adaptation (including economic organizational structures, legal frameworks, regulatory systems, and governmental policies and programs) (Noble *et al.*, 2015).

Climate change substantially affects livelihoods and living standards through multiple pathways, including access to natural resources and ecosystems, land tenure, and additional assets. Infrastructure service access encompassing water provision, sanitation facilities, electrical supply, transportation networks, and telecommunications constitutes another vulnerability dimension for communities and livelihoods confronting climate change (Birkmann *et al.*, 2022). The most significant livelihood-related risks emerge from agricultural yield losses, human health impacts, food security threats, residential destruction, and income reduction. Additional risks affect

fisheries and livestock systems upon which livelihoods depend. Adaptation may occur anticipatorily or reactively to observed changes.

Implementing effective adaptive policy faces challenges because policymakers receive greater rewards for short-term actions rather than long-term planning initiatives. Given that climate change impacts typically manifest over extended timeframes, policymakers possess limited incentives for immediate action. Moreover, climate change operates at a global scale, necessitating comprehensive international frameworks for adaptation and mitigation. However, most climate policies are implemented locally, as distinct regions require differentiated adaptation approaches. National and global policy enactment proves more challenging. Climate change adaptation has predominantly captured local authority attention, while national and international political discourse has emphasized mitigation. Exceptions occur in nations experiencing heightened climate vulnerability, where national-level adaptation focus has intensified (Di Gregorio *et al.*, 2019).

Climate change adaptation constitutes a long-term, continuous process extending across multiple decades. This extended temporal horizon contrasts sharply with conventional development planning timeframes, which rarely exceed five to ten years. Consequently, determining immediate adaptation priorities and intervention sequencing represents a critical concern.

Current adaptation research can inform decision-making among farmers, agribusiness stakeholders, and policymakers across timeframes ranging from short-term tactical to long-term strategic considerations (Easterling *et al.*, 2007). Agricultural systems across numerous regions maintain sensitivity to climate variability, with risk management capacity demonstrating significant variation. Given that climate change manifests through variability alterations across

multiple temporal scales, strengthening climate risk management capacity constitutes a fundamental adaptation strategy.

### **2.1.1 TYPES OF ADAPTATION**

Two fundamental adaptation categories exist: autonomous adaptation and planned adaptation.

Autonomous adaptations: manifest spontaneously without external investment or policy intervention. Within autonomous adaptation frameworks, farmers identify climatic shifts or variations and respond proactively to offset anticipated losses. For instance, farmers may modify crop selections, adjust planting and sowing schedules, and alter harvesting timelines in response to changing precipitation patterns.

Planned adaptation: represent deliberate policy choices, investments, or response strategies, frequently multisectoral in nature, designed to modify agricultural system adaptive capacity. Numerous adaptation options have been tested across different agricultural domains, with some yielding favourable outcomes while others remain under observation.

Ultimately, adaptation should be understood as a continuous process that forms a core part of effective risk management. This process involves identifying key risk factors and evaluating their potential impacts under different management options. From this perspective, adapting to climate change is similar to adjusting to climate variability, shifts in market conditions (such as changes in costs, prices, or consumer preferences), and institutional or other influencing factors. The main distinction lies in the pace of actual climate change relative to the speed at which solutions can be implemented. Separating climate change from other risk drivers can be useful, especially in early assessment stages when awareness of its relative importance is still limited. In practice, however, turning adaptation strategies into concrete actions requires integrating them

into a broader, comprehensive risk management framework. This would facilitate exploration of quantified scenarios addressing all key risk sources, facilitating better decision-making and learning for farmers, policymakers, and academics, ultimately improving climate knowledge (Meinke *et al.*, 2006).

Throughout supply chains, climate risks within a sector, such as agriculture, cascades into others, including food processing and textile industries (Mideksa, 2010). Similarly, adaptation measures implemented in a sector generate setbacks across other sectors. Flood-affected farmers may migrate to urban areas, depressing urban wages and rural land prices in their departure zones. Other economic agents respond by adjusting labor supply and capitalizing on reduced land prices until economic equilibrium restores (Banerjee, 2007). Although people have proven capable of adapting successfully throughout history, adaptation isn't a spontaneous process. Successful adaptation requires understanding, strategic thinking, collaborative effort, and the ability to anticipate future needs. The decisions involved are often complex and involve multiple factors, making adaptation a compelling problem from an economic perspective.

Adaptation conceptualization matters significantly. The foundational concepts employed in constructing understanding shape priorities regarding actions, purposes, actors, beneficiaries, and outcomes. The deliberate inclusion or exclusion of certain perspectives in adaptation conceptualization reflects dominant knowledge systems and institutional frameworks (Nalau & Verrall, 2021).

Adaptation should:

(1) Reduce costs while maximizing benefits.

- (2) Help accomplish goals related to physical resources, personal satisfaction, and interpersonal connections.
- (3) Lower susceptibility to harm and strengthen the ability to adapt, especially for the most at-risk populations and those confronting the most severe climate change threats.
- (4) Boost resilience by maintaining operational continuity over prolonged periods, allowing systems to bounce back from climate-related disruptions.
- (5) Exhibit financial, environmental, and societal sustainability, with deliberate attention to the enduring, cross-generational feasibility of adaptation measures.

## **2.2 Theoretical Framework for Vulnerability Assessment**

The diversity of conceptual interpretations and definitions has given rise to numerous methodological frameworks and analytical instruments employed in vulnerability assessment. Multiple research approaches exist for examining agricultural vulnerability to climate change, encompassing experimental studies, computational modeling techniques, meta-analytical reviews, and survey-based investigations. Two predominant frameworks dominate the scholarly literature regarding vulnerability quantification: the variable assessment methodology and the indicator-based technique. The variable assessment methodology operates through econometric analysis to quantify welfare deterioration across specific variables of concern—including household food consumption patterns, income levels, and agricultural productivity—in response to particular stressors such as climatic variations (Schimmelpfennig & Yohe, 1999; Gbetibouo *et al.*, 2010). A vulnerability index can be produced using this methods for specific geographic areas, it demonstrates limitations in comprehensively capturing all three vulnerability dimensions (Luers

*et al.*, 2003; Gbetibouo *et al.*, 2010). Among these methodological frameworks are the entitlement-based and the Sustainable Livelihood Approach (SLA).

### **Entitlement-Based Approach**

Within development economics, the entitlement-based perspective represents one variable assessment framework utilized for comprehending food insecurity dynamics. Sen (1981) pioneered this conceptual framework during the 1980s through his seminal publication “Poverty and Famine.” This groundbreaking contribution initiated a paradigm transformation in food insecurity scholarship, advancing beyond Malthusian theoretical constructs. The analytical focus shifted from food availability concerns toward food accessibility at the individual and household scales (Devereux, 2001). This theoretical perspective challenged Malthusian assumptions positioning inadequate agricultural production as the primary driver of food insecurity. Instead, it posited that individual entitlement bundles determine food access, thereby employing economic and institutional factors to break down food insecurity susceptibility (Sen, 1981).

According to Sen (1984), “entitlement refers to a person's ability to command various commodity bundles in society based on their rights and opportunities”. These resources, both actual and potential, include reciprocal arrangements, producing capacity, and productive assets accessible to households or communities during periods of crisis (Sen, 1984). Market food availability does not inherently guarantee individual or household access; rather, entitlement magnitude determines household vulnerability during food crises (Sen, 1981). Food insecurity manifests when households cannot leverage available entitlements to access food, despite abundant food supplies (Devereux, 2001).

This theoretical framework identifies four entitlement relationship categories: production-based, trade-based, labour-based, and inheritance or remittance-based relationships. This theory proposes that households obtain food access either directly or indirectly through these mechanisms. Three primary pathways exist for household food entitlement: (i) direct entitlement through household food production; (ii) indirect access through market-based food purchases by household members; and/or (iii) transfer entitlement via charitable organizations, non-governmental organizations (NGOs), or remittances from relatives and acquaintances (Fraser *et al.*, 2005). Due to the restricted ability to adjust food entitlement tactics, households are more vulnerable to food insecurity when their entitlement bundle is disrupted (Fraser *et al.*, 2005).

This theory has been criticised for placing too much emphasis on causality based on economic markets (Antwi Agyei, 2012). The approach disregarded the biophysical and sociopolitical factors that affect regional food insecurity, alongside the mechanisms through which individuals secure livelihoods during crisis periods (Burchi & De Muro, 2016). Devereux (2001) articulated four practical limitations of Sen's entitlement conceptualization. First, regarding endowment theory, empirical evidence demonstrates that individuals often accept hunger rather than liquidating assets. Second, according to De Waal's health crisis model, mortality stems not from entitlement rights but from migration patterns and disease exposure. Third, concerning entitlement rights, analysis focusing on individuals proves problematic in developing nations where communities, rather than individuals, possess poverty rights. Finally, the theory exhibits shortcomings regarding extra-entitlement transfer dynamics. Hunger transcends individual problems, encompassing institutional failures, social contexts, and political crises.

Despite these criticisms, this framework establishes a valuable foundation for analyzing how diverse entitlement bundles possessed by individuals can explain protective buffers during

extreme climatic events. For this study, this approach allows for a more comprehensive understanding and examination of the various resource assets that agricultural households and communities can utilize to reduce the negative impacts of climate change fluctuations.

### **Sustainable Livelihood Approach**

Sustainable Livelihood Approach (SLA) was developed for poverty assessment, building upon the entitlement framework (Sen, 1981). Fundamentally, the SL framework addresses asset availability to households, encompassing both tangible and intangible resources, paralleling the endowment concepts within entitlement theory. These resources are organized into five categories: human capital, financial capital, natural capital, social capital, and physical capital. Although characterized as people-centered, the “pentagon of assets” actually constitutes the core emphasis of the framework for sustainable livelihood. This approach has been used in a number of obstacles to development, such as problems with food (Devereux *et al.*, 2004; Hussein, 2002).

The general Sustainable Livelihood framework possesses two distinctive characteristics that represent advantages in food security analysis compared to previous frameworks. First, the theory adopts a long-term perspective; second, it emphasizes contextual factors (economic, social, physical, cultural, and political dimensions), although it remains primarily focused on agricultural activities and rural settings, rarely incorporating macroeconomic or economy-wide considerations.

Integrating analytical aspects with household asset studies results in three interconnected notions for food security analysis in SL frameworks, which were previously missed:

First, the theory explicitly addresses risk, shock, and the internal dimensions of vulnerability, manifesting as limited capacity to manage challenges without incurring damage, which

Chambers (1995) characterized as “not lack or want but exposure and helplessness.” This encompasses two aspects: external exposure to shocks, stresses, and risks; and internal weakness, representing insufficient means to overcome challenges without experiencing damaging losses.

Second, a key tenet of the sustainable livelihood framework is the sustainability notion, which is intimately related to vulnerability and resilience. Livelihood sustainability, according to the Department for International Development (DFID, 1999), occurs when systems are able to recover from shock and stress while preserving or improving assets and capacities both now and in the future.

Third, the framework addresses coping strategies, which represent sequential activities undertaken particularly by households responding to external shocks that diminish food availability (Curtis, 1993; Davies, 1993). Coping strategies integrate into broader survival mechanisms comprising combined activities selected by populations to achieve livelihood objectives. The sustainable livelihood concept has been extensively applied in food security measurement, particularly within humanitarian disaster contexts.

The DFID SL framework conceptualizes how individuals respond to vulnerability, it investigates the ways people draw upon diverse livelihood assets and capital singly or in combination under the influence of seasonal factors, economic difficulties, and persistent trends. Their strategies are shaped by vulnerability circumstances, patterns of resource access, and the role played by institutions and processes.. It further investigates how they optimise their livelihood strategies. to achieve preferred living outcomes (DFID, 2000). The framework assumes that when. Individuals have better access to capital assets and a greater capacity to impact structures and processes, allowing for greater responsiveness to their requirements (Carney, 2000).

## 2.3 CONCEPT OF FOOD SECURITY

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”. The concept of food security (FS) has been fundamental to sustainable development debates. The first MDG targeted the goal to “Eradicate extreme poverty and hunger” (United Nations, 2015). Following this, from 2016 onwards, SDG 2, titled “Zero Hunger,” endeavors to “End hunger, achieve food security and improved nutrition and promote sustainable agriculture” (United Nations, 2015).

However, despite decades of concerted efforts, food insecurity persists as a pressing concern in numerous countries, particularly developing nations. Over 820 million people, mostly in Africa, Latin America, and Asia, went hungry in 2018, according to the 2019 State of Food Security and Nutrition in the World report (FAO *et al.*, 2019). Additionally, when accounting for persons with moderate levels of food insecurity, estimates show that over 2 billion people lack appropriate FS status, including 8% of populations in wealthy countries (such as North America and Europe) (FAO *et al.*, 2019).

‘Food security’ terminology at national and global levels has frequently emphasized supply-side considerations within the food equation, specifically nations’ ability to supply sufficient food that satisfies the needs or requirements of their populations either through local production or by purchasing food from abroad (Pinstrup-Andersen, 2009). As a result, for significant food-importing countries like the majority of Middle Eastern and North African states, trade balance

and foreign exchange reserves represent critical elements of national food security. (Diaz-Bonilla *et al.*, 2002; Breisinger *et al.*, 2012).

Food security can be achieved through both commerce and production. Self-sufficiency in production is not necessary for household or national food security. Food security often involves purchasing rather than growing food, and even wealthy nations rely on imports for basic consumption needs. Reductions in food production caused by climate change may threaten food security at both household and national levels, particularly for populations that depend substantially on farming and possess few alternative income sources. Consequently, grasping the full scope of climate change effects on food security necessitates understanding the consequences for costs, earnings, and commerce, in addition to impacts on production. For instance, reduced local food production drives up food costs, which compromises food accessibility for all consumers who depend on markets.

Four food security dimensions have been identified according to the definition (FAO, 2008):

1. Availability of locally produced food and imported supplies.
2. Accessibility food- reaches consumers (transportation infrastructure) and consumers possess adequate purchasing power. Physical and economic accessibility is complemented by socio-cultural access ensuring cultural acceptability and social protection networks assisting vulnerable populations
3. Utilization- individuals must consume adequate quantities and quality to live healthy, fulfilling lives realizing their potential. Food and water must be safe and clean, thus adequate water provision and sanitation are involved. Physical health enables food digestion and utilization

4. Stability -the fourth dimension addresses the capacity of nations/communities/households/individuals to withstand food chain system shocks whether caused by natural disasters (climate events, earthquake) or human-induced factors (conflicts, economic crises)

Climate change's most direct food security implications emerge through impacts on global food production. FAO (2016) states that "Through its impacts on agriculture, climate change will have negative effects on food security in all of its dimensions, while food security will be affected through other channels for example, by extreme weather events that reduce urban dwellers' incomes and thus access to food, agriculture is a key channel through which climate change affects food security". Climate change affects natural resources (water, land) utilized in agricultural production (Cadro *et al.*, 2019; Čustović *et al.*, 2012; Simunic *et al.*, 2019).

According to some research, climate change is to blame for a rise in animal disease incidence (Hussain *et al.*, 2016). Furthermore, effects of climate on crops and livestock demonstrate strong linkages; for instance, reduced forage growth diminishes livestock weight gains (Butt *et al.*, 2005). Climate change diminishes food accessibility by adversely affecting both the cost of food and the livelihoods of rural populations. Inadequate food supplies caused by climate change's detrimental effects on crop yields and agricultural output would drive up food costs.

The relationship between climate change and food security is bidirectional, though literature predominantly emphasizes climate change effects on food security. Research on how climate change relates to food insecurity has often exhibited bias, characterizing climate change as the principal cause of food insecurity rather than investigating how the arrangements established to protect food security have worsened climate change (Islam & Wong, 2017).

Numerous researchers emphasize the advantages of climate-smart agriculture (CSA) for both mitigating and adapting to climate change (Abegunde *et al.*, 2019; García de Jalón *et al.*, 2017). According to Loboguerrero *et al.* (2019), climate-smart agriculture has the potential to create synergies among productivity, adaptation, and mitigation efforts. Within this framework, FAO (2016) proposes that food and agricultural systems should be at the forefront of global climate change adaptation initiatives, implementing policies and actions that address vulnerabilities and risks while promoting agricultural systems characterized by resilience and sustainability.

Food insecurity represents an environmental challenge because hunger driven by inadequate food access forces populations to overexploit marginal agricultural areas, mismanage water resources, deplete soil fertility, and clear forested lands. Agriculture is impacted by climate change in multiple ways. For instance, unpredictability in the beginning of planting seasons caused by altered rainfall patterns—where initial rains may not persist and planted crops may face extreme heat—can lead to repeated planting of unsuitable crops. Okoh *et al.* (2011) describe such scenarios as potentially causing food scarcity due to harvest failures. Additionally, severe weather events including thunderstorms, powerful winds, and flooding devastate agricultural land and can lead to complete crop loss.

The global population lacking consistent access to adequate food remains persistently elevated, surpassing 800 million with minimal reduction. More than 60% of the world's undernourished individuals live in Asia, while a quarter are located in Africa (FAO, 2002). Food insecurity continues to pose a worldwide threat and humanitarian crisis, generating significant health, social, psychological, and behavioral impacts, and is inextricably connected to poverty.

## **2.4 LINK BETWEEN CLIMATE CHANGE ADAPTATION AND FOOD SECURITY**

Climate change represents our era's most significant environmental challenge, threatening both human existence and environmental integrity. It represents a significant danger to food security and agricultural systems throughout numerous Sub-Saharan African nations, Nigeria included. Food security faces threats from climate change through its effects on agricultural systems. Weather conditions are fundamental to agricultural production in most Sub-Saharan African countries, including Nigeria. Climate change has direct effects on the productivity of physical production factors such as soil moisture levels and soil fertility, which influence agricultural outputs and subsequently have negative consequences for food security. Put differently, national food security relies on the stability of the agricultural sector and the sustained availability of sufficient food supplies.

Climate change affects how we use food in two main ways: it makes food less safe throughout the supply chain and it affects health by affecting nutritional outcomes. Generally, climate change likely decreases food safety due to increasing microbial growth rates at increased temperatures (Hammond *et al.*, 2015).

Numerous Nigerian towns and villages located along coastal and littoral states in the south and northern frontline states face exposure to climate variability or extremes including temperature shifts, rainfall variations, storms, and sea level rise. These weather pattern changes negatively impact agricultural activities and food security. All six geopolitical zones in Nigeria face climate change vulnerability, although the extent of vulnerability differs across zones. The South-South and South-West zones primarily experience impacts from rising sea levels and changes linked to deforestation; the South-East zone is mainly affected by erosion, flooding, and land degradation;

the North-Central zone's principal impacts stem from overgrazing and deforestation; while both the North-East and North-West zones experience comparable effects including drought, desertification, and heat stress (Ozor, 2009). Food security is crucial for considering national wealth and economic sustainability. Agriculture plays a vital role in Nigeria's economy, although development funding is obtained from the exploitation of petroleum, oil, and gas resources. Additionally, data from the 1991 National Population Census indicate that agriculture contributes 40% to Nigeria's GDP, while 69% of the nation's workforce is engaged in agricultural activities (Ijeoma & Stanley, 2012). The agricultural sector experiences more severe impacts from climate variability and extreme weather events than any other economic sector. These impacts are evident through alterations in rainfall patterns (both frequency and intensity), droughts, floods, modifications in soil moisture and nutrient composition, proliferation of crop and livestock pests and diseases, desertification, land deterioration, thermal stress, rising sea levels, and erosion. Such unfavorable climatic conditions present significant obstacles to crop cultivation, livestock rearing, aquaculture, and hunting activities in Nigeria.

Any production phase from planting through development to harvest can be negatively influenced by climate change. Crops that encounter insufficient water availability (low rainfall) or excessive heat conditions (abnormally high temperatures) yield poorly, escalating hunger and starvation threats. Crop productivity falls considerably as temperatures climb and rainfall patterns grow more irregular. Severe weather occurrences like thunderstorms, intense winds, and flooding wreak havoc on agricultural areas, causing crop failures and major agricultural losses, consequently compromising food security. Climate has a variety of effects on health, including vector-borne illnesses, heat stress, and natural catastrophes. These effects then impair people's nutrition and ability to care for their dependents and children, which in turn affects food security

(Costello *et al.*, 2009). Water-related climate change consequences, such as reduced water availability for sanitation (McDonald *et al.*, 2011) or increased water contamination due to rising flood strength and frequency (Uyttendaele *et al.*, 2014), may also endanger food safety and health. There are worries that increased disease prevalence would result in misuse of veterinary medications and pesticides, particularly in fisheries (Tirado *et al.*, 2010). Climate change's indirect health effects, including employment and livelihood loss, migration, and disrupted public health services, disproportionately affect poor and indigenous populations (Costello *et al.*, 2009; Ford, 2012), resulting in negative food security outcomes.

People's ability to obtain food will be impacted by climate change primarily through purchases. According to White *et al.* (2010), “affordability also depends on household purchasing power, which is influenced by the climate, particularly in agricultural households”. Numerous studies have examined how communities and households adjust to climate shocks. (Rufino *et al.*, 2013).

By supplying (food, water, timber, genetic resources), regulating (climate, flood, disease, pollination), and providing (soil formation, water cycling, nutrient cycling) activities, food security has a direct and indirect impact on ecosystems (Millennium Ecosystem Assessment, 2005). Climate warming exacerbates ecosystem stressors (Cabell & Oelofse, 2012). For example, biodiversity declines and community assembly linkages alter due to rising temperatures and extreme weather (Oppenheimer *et al.*, 2014), endangering the resilience and productivity of the current food system (Khoury, 2014). The social and economic aspects of the agricultural sector are also threatened by climate change and fluctuation. The most vulnerable groups to climate change are those with few resources and marginalised communities; risks to these groups could weaken communal resource systems and intensify conflicts (Oppenheimer *et al.*, 2014).

Climate change may cause adjustments in agricultural or livestock production areas, potentially impacting pricing, trade flows, and food access (Havlik *et al.*, 2014). Climate change can impact food access, transportation systems, and physical health. (White *et al.*, 2010). Issues also exist regarding intra-household food allocation, for example to women and children, and how such allocation may be affected in more variable climates.

## **2.5 Climate Variability and Extreme Impact on Food Security in Nigeria**

- **Effect on Crop Production:** Nigeria's crop production is affected differently across regions by changes in rainfall patterns. Beyond the total amount of rain, the timing and consistency of rainfall are critical, if rains come too late or are absent during key growth periods, crop yields decline, threatening food security. Climate change alters how crops grow and develop, which can either shorten or extend growing cycles, resulting in either reduced or improved productivity (Ifeanyi-Obi *et al.*, 2012). Changes in temperature and precipitation create conditions where new pests and diseases which thrive only under particular temperature and moisture conditions can emerge. These emerging threats create additional challenges for ensuring safe, secure food supplies and protecting public health.
- **Effect on Fish Farming and Aquaculture:** Fish farming serves as a vital source of income and jobs in Nigeria. Climate change affects aquatic ecosystems including rivers, lakes, seas, and oceans along with the plant and animal life found and cultivated within them. For millions of Africans, especially Nigerians who depend on fishing and aquaculture for their livelihoods, climate change presents significant challenges. These challenges stem from climate-induced alterations in temperature, salinity, wind patterns, ocean currents, and upwelling intensity, all of which dramatically influence where fish are found, how plentiful they are, and whether they remain accessible in the country. Furthermore, water

scarcity combined with these environmental changes causes certain fish populations to decline while important species relocate to areas where fish farmers can no longer easily reach them, further disrupting fish abundance, distribution, and availability nationwide. (Ifeanyi-Obi *et al.*, 2012).

## **2.6 DETERMINANTS OF CLIMATE ADAPTATION ADOPTION**

Climate adaptation adoption is a complicated and dynamic process affected by a wide range of factors. As climate change continues to intensify, communities, individuals, and institutions are increasingly forced to make adjustments to protect their lives, livelihoods, and environments. However, adaptation adoption extent varies widely due to differences in exposure, vulnerability, capacity, and perception. Understanding climate adaptation adoption determinants is essential for designing effective policies, strategies, and interventions responsive to different population realities.

Adoption decisions are influenced by more general considerations when selecting adaptation measures (Zilberman *et al.*, 2012). strategy for adaption. Consequently, the adoption of adaptation strategies by individual farmers is essential to overall effectiveness of adaptability in smallholder environments. Adoption is a multi-phase procedure in which farmers To optimise advantages, apply adaptation methods to differing degrees (Adesina & Zinnah, 1993). When there are several options in smallholder agriculture, farmers frequently use multiple adaption strategies to meet particular adaptation requirements (Islam *et al.* 2014; Tessema *et al.* 2013).

1. Social Factors: Due to improved access to opportunities, services, and information, education and training may help farmers overcome some adaptation obstacles (Thinda *et al.*, 2020). Education and information access also play critical roles. More educated people are typically

better informed about climate change, its potential impacts, and possible responses. This awareness often translates into higher likelihood of adopting proactive adaptation measures. Education also enhances capacity to interpret climate information, apply new technologies, and make informed decisions under uncertainty. Moreover, access to climate-related information through media, extension services, and communication technologies influences adaptation decision timing and nature. When people are aware of forecasted risks or new adaptive practices, they are more likely to respond effectively.

Gender and power dynamics are equally important. In many world parts, women have less access to resources, land, education, and decision-making power, which limits their effective adaptation ability. Addressing these disparities through inclusive policies and programs can enhance overall community resilience. Youth and marginalized groups may also face adaptation barriers despite being crucial stakeholders in long-term resilience strategies. Climate change adaptation policies for smallholder farming systems need to prioritize eliminating gender discrimination and ensuring that women-headed smallholder farms have better access to opportunities. Addressing gender inequalities in agriculture, improving farmers' access to credit, modifying farming methods, and building on farmers' existing knowledge of managing climate-related risks could all help overcome obstacles that prevent the adoption of particular climate change adaptation strategies. Due to its relationship to experience, age can also have an impact on the quality of labour. It is anticipated that older family heads will have more management and farming experience (Nhemachena & Hassan 2007; Temesegen *et al.* 2008; Di Falco *et al.* 2011). Social networks and peer influence also play roles, as people are often influenced by others' behavior in their community. When adaptation measures are visibly successful among peers, others may be encouraged to adopt similar practices.

## 2. Economic Factors

- One of the most significant climate adaptation determinants is individuals' or communities' socio-economic status. Income levels, wealth, and economic stability determine the ability to invest in adaptive measures such as improved housing, irrigation systems, or climate-resilient crops. Wealthier individuals and communities often have better resource and technology access, making it easier to adopt and implement adaptive strategies. Conversely, poorer populations, despite being more vulnerable to climate impacts, may lack necessary financial resources to take meaningful action, creating an adaptation gap.
- Insufficient income, limited resources, and inadequate infrastructure are also likely to constrain the ability of most rural farmers to adapt. Farmers without adequate financial means and resources will be unable to afford the expenses required to implement adaptation measures, and therefore may not be able to effectively utilize whatever information they possess.
- Market Access and Climate Adaptation

Agricultural producers who can effectively engage with both input procurement channels and product distribution networks demonstrate enhanced capacity for implementing adaptive responses to climate variability. The availability of input markets enables farming communities to obtain essential resources necessary for climate-responsive agricultural practices, including diverse seed cultivars, soil enrichment products, and water management technologies. Conversely, reliable access to market outlets for agricultural products creates economic incentives for cultivating commercially viable

crops, thereby strengthening farmers' resource foundations and enhancing their capacity to respond effectively to shifting climatic patterns (Mano *et al.*, 2003; Nhemachena & Hassan, 2007).

### 3. Institutional Determinants of Adaptation

- Information and Resource Access

The selection and implementation of crop-based adaptation approaches by farming households are shaped by multiple interconnected elements, including information accessibility, economic resources available to households, labor availability, educational attainment, age demographics, marital arrangements, gender dynamics, land parcel characteristics, and the availability of agricultural extension programs, financial services, and market infrastructure (Temesege *et al.*, 2008; Di Falco *et al.*, 2011).

Enhanced access to meteorological and agricultural intelligence empowers farmers to make evidence-based comparative assessments of various crop management approaches, ultimately enabling them to select strategies that effectively address climatic variations (Nhemachena & Hassan, 2007). Conversely, information deficits regarding both short-term seasonal patterns and long-term climate trajectories, as well as agricultural production dynamics, create significant barriers to farmers' adoption of climate adaptation measures, consequently elevating the risks associated with failing to embrace innovative technologies and adaptive practices.

- Extension Services and Government Support

The uptake of adaptive agricultural practices is positively influenced by farmers' access to governmental extension programs. Extension service delivery operates principally through

mechanisms including farmer collective mobilization, capacity-building workshops, field exposure activities, and practical demonstrations. Support mechanisms encompass direct farmer engagement, community-level agricultural demonstrations, affordable educational publications, information dissemination through printed resources, and the creation of digital technology packages.

- Governance and Policy Frameworks

Institutional infrastructure and governance mechanisms serve as fundamental determinants of adaptation capacity. The existence of enabling policy environments, governmental initiatives, and regulatory architectures can either facilitate or impede adaptive responses. For instance, well-defined land ownership rights stimulate investment in land stewardship and resource conservation, whereas unclear or unstable tenure arrangements discourage such commitments. The provision of extension programming, effective local administration, and social protection mechanisms can strengthen community capacity for action, while institutional weaknesses tend to intensify vulnerabilities. The contribution of local leadership structures, community-based organizations, and non-governmental entities in organizing and facilitating adaptation initiatives represents a critical factor.

#### 4. Cultural Dimensions of Adaptation

Social and cultural contexts exert substantial influence on adaptation behaviors. Cultural worldviews, traditional practices, and social conventions shape both the perception of climate-related risks and the acceptance of particular response measures. For example, certain communities place considerable reliance on indigenous environmental knowledge systems and

customary practices, which may either complement or contradict scientifically-informed recommendations.

## 5. Environmental and Technological Determinants

- Access to technological resources and financial mechanisms constitutes another essential determinant. Technological advances including drought-tolerant seed varieties, climate-responsive agricultural systems, and early alert mechanisms provide tangible instruments for adaptation. Nevertheless, without the capacity to obtain or sustain these technological solutions, numerous communities remain exposed to climate risks.
- Access to climate-relevant information via media channels, extension networks, and communication platforms shapes both the timing and character of adaptation decisions. When populations receive information about anticipated risks or emerging adaptive techniques, their capacity for effective response increases substantially.
- Financial Services

Financial mechanisms such as credit facilities, savings programs, insurance products, and remittance flows can help absorb economic disruptions linked to climate impacts and supply the investment capital required for adaptation measures. Frequently, the presence of microfinance initiatives or subsidized insurance programs determines whether agricultural producers adopt innovative farming techniques or coastal populations strengthen protective infrastructure.

The implementation of climate adaptation strategies is not governed by any single element, but rather emerges from complex interactions among socioeconomic, institutional, environmental, technological, cultural, and psychological factors. Effective adaptation necessitates

comprehensive approaches that acknowledge these multiple determinants and address obstacles preventing individuals and communities from taking protective action. Through understanding and incorporating these factors into policy formulation and program architecture, stakeholders can establish more equitable, effective, and sustainable trajectories for adapting to climatic changes.

## **2.7 Climate Adaptation Strategies in Nigeria**

Global climate alterations are generating severe consequences for both environmental and human systems (IPCC, 2014). Agricultural producers confront substantial risks stemming from climate change, including erratic precipitation distributions during critical planting periods and extreme meteorological events (Abidoje *et al.*, 2017; Konchar *et al.*, 2015). The escalation of risks and vulnerabilities threatens the livelihoods of rural farming populations, generating a pressing need for adaptive strategies to mitigate risks and vulnerabilities brought on by unfavourable weather and climatic (Aldunce *et al.*, 2016). Key adaptation strategies and measures include:

### **1. Crop-Specific Innovations**

Farmers experiencing heightened environmental variability can employ crop diversification approaches such as polyculture or companion planting systems to distribute farm-related risks across multiple crops. Rusinamhodzi *et al.* demonstrated that companion planting can prevent complete production losses resulting from climate-induced drought circumstances (Challinor *et al.*, 2007). Integrated farming approaches under climate change conditions that leverage indigenous crop genetic diversity can enhance resilience, as these crops have evolved to suit local climatic circumstances over extended periods. They demonstrate strong performance and ensure sustained farm-level productivity (Challinor *et al.*, 2007; Morton, 2007). Such

diversification practices provide resilience by suppressing pest and disease pressures, since varied crops exhibit differential responses to climatic stresses and maintain functional capacity relative to monoculture systems. This approach holds potential for strengthening food security while sustaining or enhancing farmer revenues (Armbrecht & Gallego-Ropero, 2007; Lin, 2011).

Farmers also cultivate indigenous crop cultivars well-adapted to local environmental conditions, succeeding where other varieties may fail (Grubben *et al.*, 2014; Luoh *et al.*, 2014). Crop rotation optimizes land utilization for diverse crop production while simultaneously reducing pest and disease incidence. In drought-affected regions, farmers adopt drought-resilient varieties to protect against productivity declines. Wheat cultivation in arid zones performs substantially better than dry season rice production. Evidence shows that drought-resilient maize variety cultivation increases productivity by 617 kg/ha and 240 kg/ha compared to conventional maize varieties in moderately drought-prone locations (Lunduka *et al.*, 2019).

## 2. Planting Date Adjustment

Rainfall variability has been identified as a primary contributor to diminished productivity in Nigerian agricultural systems (Abiodun *et al.*, 2011). To mitigate crop production risks arising from precipitation variability, farmers modify planting schedules, establishing crops before rainfall onset, immediately following initial rains, or several days post-rainfall. Staggered planting represents a deliberate risk distribution strategy, ensuring optimal utilization of available moisture by crops planted in prepared fields (Akinagbe & Irohibe, 2015; Waha *et al.*, 2013).

Sustainable crop management approaches including crop diversification, novel cultivar development, ecological pest control, and seed storage infrastructure strengthen climate resilience through agricultural innovation. Innovative crop development programs boost

agricultural productivity by introducing early-maturing and high-yielding crop varieties. Furthermore, farmers employ drought-tolerant crops as a safeguard against crop losses resulting from more frequent climate-driven droughts. Cultivars resistant to pests or diseases help farmers cope with the increased pressure from climate-related pest and disease outbreaks.. Adopting alternative crops for cultivation, particularly heat-tolerant varieties, provides protection against climate change-induced elevated temperatures and reduced precipitation (Atedhor, 2015; Westengen & Brysting, 2014).

### 3. Sustainable Land and Soil Management

Tree planting, cover crop systems, mulching, and contour cultivation are examples of sustainable soil and land stewardship techniques that sustain smallholder farmers' livelihoods by limiting erosion through structural and vegetative barriers (FAO, 2017). While conventional tillage may effectively control weeds and pests, it proves problematic in climate-vulnerable areas, potentially disrupting soil physical properties and accelerating erosion and degradation (Stavi, 2013).

Alternative approaches that circumvent conventional tillage's detrimental effects, providing minimal soil layer disruption while preserving or enhancing soil quality, include reduced tillage or no-till practices. Zero or minimum tillage approaches improve productivity, help susceptible soils retain organic carbon, and promote environmental sustainability (Lal, 2015). However, zero or low tillage might lead to increased pesticide application on farmlands, thus jeopardising ecological sustainability (Sanz *et al.*, 2017).

Integrated soil fertility management utilizing both organic and synthetic fertilizers falls within this thematic area. Applying agricultural fertilizers boosts farmers' income and financial resources by improving crop yields, while also aiding soil management through nitrogen

replenishment. The use of both synthetic and organic fertilizers improves soil quality, enhances the soil's ability to retain moisture, and helps maintain soil organic carbon levels (Stavi *et al.*, 2016). Conversely, inappropriate synthetic fertilizer application may accelerate soil degradation through excess use.

Another approach to sustainable soil and land management involves integrated agricultural systems, which include practices such as mixed farming and agroforestry. In rural smallholder settings, growing trees and maintaining forests is crucial for sustaining livelihoods. These methods have the potential to improve the productivity of smallholder farmers in Nigeria (Agbonlahor *et al.*, 2003).

#### 4. Water Management Practices

Water management techniques are essential adaptation strategies for smallholder farmers facing drought challenges. In areas at risk of drought and crop failure, sustainable water management methods such as rainwater harvesting or irrigation systems designed to minimize crop water stress increase crop productivity and support economic viability. These water management practices promote food security, help reduce poverty, and improve farm productivity (Merrey & Sally, 2008).

#### 5. Climate Education and Information Services

Farmers can increase agricultural output by making better decisions about crop variety selection, production techniques, and planting schedule modifications thanks to information provided by climate information systems (CGIAR, 2016). Climate education services equip farmers with knowledge about effective strategies for managing climate change impacts. This information can increase their readiness to seek credit and enable them to adopt improved farming technologies

that enhance productivity. Such knowledge potentially strengthens economic resilience by helping farmers respond when unfavorable weather conditions affect crop production (CGIAR, 2016).

## 6. Access to Finance

Access to credit services can strengthen household livelihood security while improving climate change adaptation capacity by facilitating diversification means acquisition. Index-based insurance services within agriculture also incentivize farmers to plan for climate-related disruptions. In northern Nigeria, approximately 96 percent of farmers are cognizant of and negatively affected by climate change (Abraham & Fonta, 2018). They attribute their adaptation capacity to credit availability, particularly through microcredit or microinsurance mechanisms. The availability of credit allows farmers in northern Nigeria to fulfil additional climate adaptation criteria, such as buying better crop types (hot resistant to pests, diseases, droughts, and other threats). Access to funds offers financial capital and makes it possible to acquire natural capital, like fresh farmland, which is crucial for maintaining and enhancing rural livelihoods (BNRCC, 2011).

## 7. Livelihood Diversification

As the impacts of climate change continue, the need for farmers to diversify their income sources beyond agriculture becomes increasingly urgent. This is particularly important for reducing poverty among poor rural farmers in Nigeria. Through off-farm diversification, farmers can generate income to reinvest in agricultural activities, which helps maintain or enhance their overall earnings. (Asfaw *et al.*, 2017).

Additionally, diversification through involvement in value chains is a significant adaptation measure. This can include southern Nigerian cassava farmers and northern Nigerian millet and groundnut farmers transforming their crops into value-added products and participating in the sale and marketing of these goods. Other activities include snail farming and beekeeping. Farmers engaged in these supplementary activities reportedly experience enhanced productivity and higher incomes (BNRCC, 2011; Nzegebulu *et al.*, 2019).

## CHAPTER THREE

### MATERIALS AND METHODS

#### 3.1 RESEARCH DESIGN

This study adopts a descriptive method, using a survey research design with a Likert scale questionnaire to identify the determinants of adoption of climate change adaptation strategies in attaining food security in Benin City, Nigeria. The survey method allows for the collection and analysis of data from respondents without changing any factors.

#### 3.2 DESCRIPTION OF STUDY AREA

This research was carried out in Benin City, situated in Edo State, Nigeria, as illustrated in Figure 3.1. Benin City functions as the state capital and represents the most populous urban area in Edo State. In terms of geographical positioning, Benin City is located within a narrow, key-shaped land corridor extending from north to south in the West African region. Based on the 2006 national population census, the recorded population stood at 3,233,366, and with an annual growth rate of 2.9%, projections estimated the population would reach 1.3 million by 2010 (NPC, 2024). The city operates as the primary administrative and socio-economic center for both Oredo Local Government Area and the broader Edo State. Geographically, the city lies between latitudes 06°19'E and 6°21'E and longitudes 5°34'E and 5°44'E, at an average altitude of 77.8 meters above sea level. Benin City is characterized as a humid tropical urban area and encompasses three Local Government Areas: Egor, Ikpoba Okha, and Oredo.. Their respective land areas are 293 km<sup>2</sup> for Oredo, 93 km<sup>2</sup> for Egor, and 862 km<sup>2</sup> for Ikpoba Okha (Butu *et al.*, 2019).

### **3.2.1 CLIMATIC CONDITION OF THE STUDY AREA**

Benin City falls under the Af category of Köppen's climatic classification, indicating a tropical rainforest climate. The rainy season ordinarily commences in March or April and continues through October or November. Precipitation in this area tends to be substantial and frequently displays a bimodal distribution pattern, featuring a short dry interval in August commonly known as the 'August Break'. The city undergoes a wet season spanning March to October and a dry season lasting from November to February, with monthly precipitation levels varying between 150 mm and 300 mm.

Temperatures in Benin City are consistently high, ranging from 26°C to 34°C, though it can reach up to 38°C during the hottest months, particularly between February and April. The city is also marked by high humidity levels, typically between 70% and 90%. During the Harmattan period, which occurs from December to February, the area experiences lower temperatures, reduced humidity, and diminished visibility. Additionally the average rainfall of Benin city is 2284.5mm and mean temperature is 27.7 (Odiana & Ochulor, 2024).

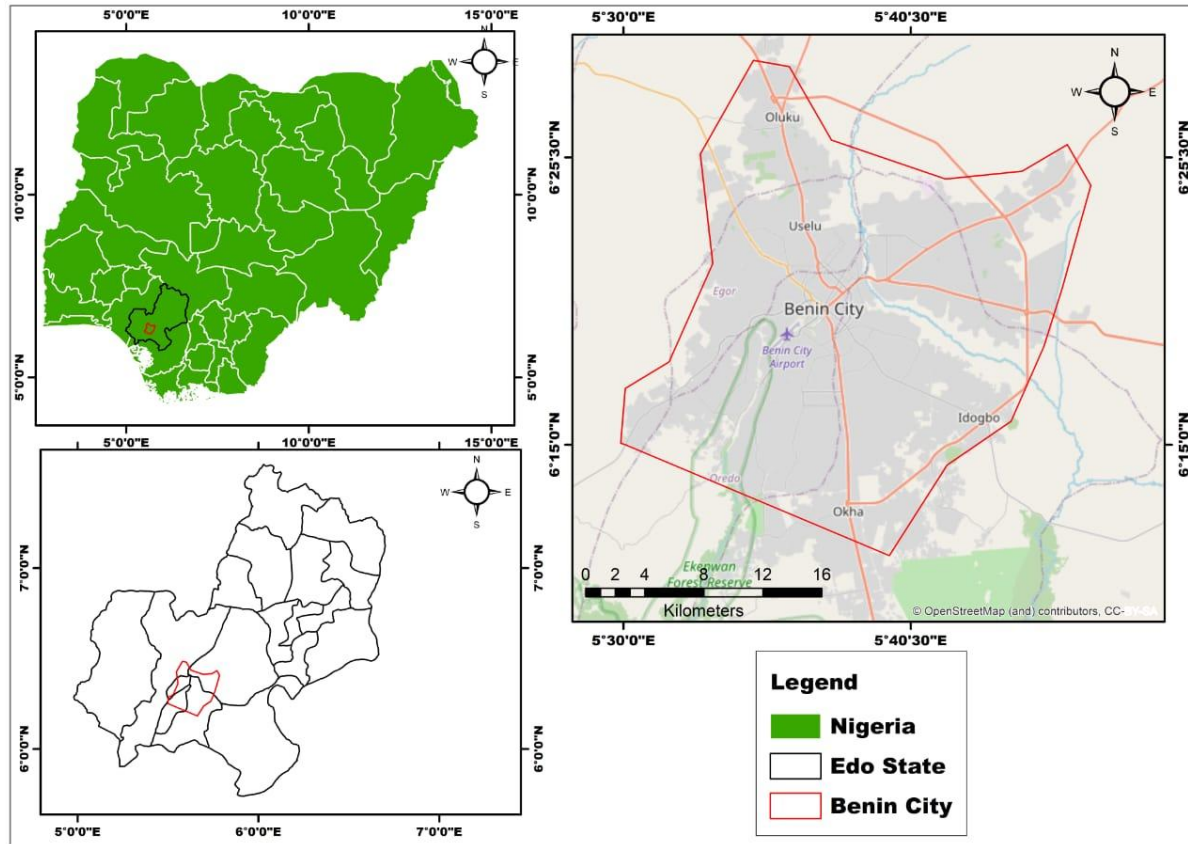


Fig 3.1 Map of the Study Area

### **3.2.2 VEGETATION AND SOIL OF THE STUDY AREA**

Located within the lush rainforest belt of southern Nigeria, Benin City lies on a lowland plain that gradually ascends to the Esan Plateau in the north, an area renowned for its fertile, agriculture-friendly soils. The city is underlain by the Benin Formations, sedimentary layers dating back to the Miocene and Pleistocene periods. These soils, originating from complex basement rocks, are rich in iron, resulting in their distinctive red coloration (Orobator & Odjugo, 2016). North of the city, savannah vegetation dominates, where wild oil palm grows abundantly. At higher elevations, the soil becomes gravelly, shifting to sandy toward the Orle Valley. The eastern plateau showcases diverse vegetation, with savannah in the north and forest in the south. In deforested zones, elephant grass and secondary vegetation prevail. The soils here are clay-based or composed of porous red sand, supporting oil palm and rubber cultivation. The Benin lowlands, once covered by extensive rainforest, have been largely converted to rubber plantations. In the southern riverine areas, mangrove swamp vegetation predominates (Alens, 2016).

### **3.3 SOURCES OF DATA**

For the purpose of this research, primary data served as the main source of information. A structured questionnaire was designed in Likert-scale and administered using Google Forms, which enabled the researcher to collect responses from 150 randomly selected residents of Benin City. The questionnaire comprised closed-ended items aimed at capturing data on respondents' perceptions and awareness of climate change risks, barriers to adaptation, socio-demographic characteristics, and the role of government and non-governmental organizations in promoting

adaptation. The use of Google Forms facilitated easy distribution, real-time submission, and efficient retrieval of data while ensuring anonymity and convenience for respondents.

### 3.4 METHOD OF DATA COLLECTION

The researcher employed a simple random sampling technique to distribute questionnaires to 150 respondents across in Benin City. A structured questionnaire was designed using Google Forms and the link was randomly shared among eligible participants through community groups, social networks, and direct messaging to ensure that every resident had an equal chance of being selected. The respondents completed the questionnaires online at their convenience, and their submissions were automatically recorded upon completion. This method was adopted to collect reliable information on people’s perceptions and awareness of climate change, the barriers hindering adaptation, the influence of socio-demographic characteristics, and the role of government and non-governmental organizations in community-level climate change adaptation.

### 3.5 METHODS OF DATA ANALYSIS

The reliability of the instrument was tested using reliability statistics like Cronbach Alpha.

The mean, standard deviation and Pearson correlation coefficient were obtained using the formulae below:

$$\text{Mean } (\bar{x}) = \frac{\sum x_i}{N} \dots\dots\dots \text{eq 1}$$

Where,

$\Sigma x_i$  = Summation of all individual items

$x_i$  = Mean of the  $x$ -variable in a sample

$n$  = Total number of entries

**Standard Deviation ( $\sigma$ )** =  $\sqrt{\frac{\Sigma(x_i - \bar{x})}{n}}$  ..... eq 2

Where,

$\Sigma(x_i - \bar{x})$  = Summation of all the individual items

$x_i$  = Mean of the  $x$ -variable in a sample

$\bar{x}$  = Mean of the values of the  $x$ -variable

$n$  = Total number of entries

**Pearson correlation coefficient ( $r$ )** =  $\frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 (y_i - \bar{y})^2}}$  ..... eq 3

Where,

$\Sigma$  = Summation

$r$  = Correlation coefficient

$x_i$  = Mean of the  $x$ -variable in a sample

$\bar{x}$  = Mean of the values of the  $x$ -variable

$y_i$  = Values of the  $y$ -variable in a sample

$\bar{y}$  = mean of the values of the  $y$ -variable

However, Statistical analysis software like Statistical Package for Social Scientists (SPSS) was used for speed and accuracy in analyzing the data collected through questionnaires.

## CHAPTER FOUR

### RESULTS

The reliability of the instrument used for this study is 0.927 as shown in table 4.1

Table 4.1: Reliability Statistics

Cronbach's Alpha	N of Items
0.927	25

#### 4.1 DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

The gender, age, marital status and educational level of the respondents are shown in Table 4.2. There were 50.0% male and 50.0% female which means that there is gender balance among the respondents. As such, responses was not tilted to one gender. In terms of age, 7.3% were less than 20 years, 36.7% were between 21-30 years, 30.7% were between 31-40 years and 25.3% were over 40 years. This showed that most of the respondents were in their economically productive age. This is crucial because young people could have higher tendencies to engage in carbon emitting activities and for a longtime thereby contributing to climate change. As shown in the table, 45.6% were married and 43.3% were single, indicating that the respondents were mostly married. The result also revealed that 0.7% had only primary school education, 18.7% had secondary education, 64.7% had tertiary education and 16.0% had no formal education signifying that most of the respondents were literate. Being mostly literate connotes that

accepting innovations like that could help in adapting to climate change would not be a much problem in the study area.

Table 4.2: Demographic characteristics of the Respondents

<b>Characteristics</b>	<b>Components</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Gender	Male	75	50.0
	Female	75	50.0
	Total	150	100.0
Age	20 or less	11	7.3
	21-30	55	36.7
	31-40	46	30.7
	41 and above	38	25.3
	Total	150	100.0
Marital Status	Married	68	45.3
	Single	65	43.3
	Widow/Widower	12	0.8
	Divorced	05	3.3
	Total	150	100.0
Educational Level	Primary	01	0.7
	Secondary	28	18.7
	Tertiary	97	64.7
	No formal education	24	16.0
	Total	150	100.0
Religion	Christianity	108	72.0
	Islam	34	22.7
	Others	08	5.3
	Total	150	100

**Source:** Researcher’s computation, 2025

#### 4.2 Perceptions and Awareness of Climate Change Risks on Food Security

The results as shown in table 4.3, reveals that most of the respondents agree that there is adequate information about how climate change leads to food scarcity. They also agree that awareness programs about climate-related food risks are available and accessible. However majority are not in agreement that people are aware that climate change affects food security and that local weather changes are increasingly recognized as threats to food. They also disagree that most households understand the connection between farming outcomes and climate change. It can be inferred that awareness of climate change risks on food security is minimal.

Table 4.3 Perceptions and awareness of climate change risks on food security

<b>ITEMS</b>	<b>SA</b>	<b>A</b>	<b>UD</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>STD</b>	<b>Remark</b>
	<b>Freq (%)</b>	<b>Freq (%)</b>	<b>Freq (%)</b>	<b>Freq (%)</b>	<b>Freq (%)</b>			
People in Benin city are aware that climate change affects food security.	40(26.7 )	61(40.7 )	19(12.7 )	21(14.0 )	09(6.0)	2.32	1.18 3	Low awareness
Local weather changes are increasingly recognized as threats to food.	32(21.3 )	51(34.0 )	31(20.7 )	26(17.3 )	10(6.7)	2.54	1.19 6	Low awareness

There is adequate information about how climate change leads to food scarcity.	12(8.0)	25(16.7)	36(24)	48(32.0)	29(19.3)	3.38	1.20	high awareness
Most households understand the connection between farming outcomes and climate change.	25(16.7)	40(26.7)	31(20.7)	32(21.3)	22(14.7)	2.91	1.31	low awareness
Awareness programs about climate-related food risks are available and accessible	5(3.30)	15(10.0)	40(26.7)	49(32.7)	41(27.3)	3.71	1.07	high awareness

Strongly Agreed (SA) = 1; Agreed (A) = 2; Undecided (UD) = 3; Disagreed (D) = 4; and Strongly Disagreed (SD) = 5. **Weighted Average (WA) = 2.97**

### 4.3 Influence of Socio-Demographic Characteristics on Climate Adaptation and Food Security

Table 4.4 shows that majority of the respondents are of the opinion that gender roles influence how people contribute or respond to food insecurity issues. On the other hands, most of the respondents disagree that younger individuals are more willing to adopt climate-friendly farming and that education level affects how people respond to climate change impacts on food security.

They also disagree that higher income levels increase the capacity to implement adaptation strategies and that occupation(e.g., farming, trading) determines one's approach to coping with food insecurity . Therefore, it can be deduced that socio-demographic characteristics has minimal influence on climate adaptation and food security in the study area.

Table 4.4 Influence of Socio-Demographic Characteristics on Climate Adaptation and Food Security

<b>ITEMS</b>	<b>SA</b>	<b>A</b>	<b>UD</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>STD</b>	<b>Remark</b>
	<b>Freq</b> <b>(%)</b>	<b>Freq</b> <b>(%)</b>	<b>Freq</b> <b>(%)</b>	<b>Freq</b> <b>(%)</b>	<b>Freq</b> <b>(%)</b>			
Younger individuals are more willing to adopt climate-friendly farming.	65(43.3 )	47(31.3 )	16(10.7 )	15(10.0 )	07(4.7)	2.01	1.170	Low influence
Education level affects how people respond to climate change impacts on food security.	93(62.0 )	40(26.7 )	06(4.0)	05(3.3)	06(4.0)	1.61	1.003	Low influence
Higher income levels increase the capacity to implement	98(65.3 )	37(24.7 )	10(6.7)	05(3.3)		1.48	0.766	Low influence

adaptation strategies.								
Gender roles influence how people contribute or respond to food insecurity issues.	35(23.3)	22(14.7)	39(26.0)	30(20)	24(16.0)	2.91	1.387	high influence
Occupation(e.g., farming, trading) determines one's approach to coping with food insecurity.	71(47.3)	55(36.7)	17(11.3)	06(4.0)	01(0.7)	1.74	0.863	Low influence

Strongly Agreed (SA) = 1; Agreed (A) = 2; Undecided (UD) = 3; Disagreed (D) = 4; and Strongly Disagreed (SD) = 5. **Weighted Average (WA) = 2.07**

#### 4.4 Socio-Cultural Influence on Adaptation of Climate Adaptation Strategies

Table 4.5 reveals that most of the respondents are in agreement that cultural beliefs may hinder or promote climate adaptation practices in food production and that religious teachings play a role in shaping people's responses to food insecurity. However, majority disagree that social norms affect people's decisions to change farming or food practices and that family structure impacts decisions on food production and consumption in climate-affected times. They also disagree that social class affects access to resources needed for climate change adaptation in agriculture. It can be deduced that there is little influence of socio-cultural factor on climate change adaptation strategies.

Table 4.5 Socio-Cultural Influence on Adaptation of Climate Adaptation Strategies

<b>ITEMS</b>	<b>SA</b>	<b>A</b>	<b>UD</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>STD</b>	<b>Remark</b>
	<b>Freq (%)</b>	<b>Freq (%)</b>	<b>Freq (%)</b>	<b>Freq (%)</b>	<b>Freq (%)</b>			
Social norms affect people's decisions to change farming or food practices.	45(30.0) )	59(39.3) )	35(23.3) )	07(4.7)	04(2.7)	2.11	0.977	Low influence
Cultural beliefs may hinder or promote climate adaptation practices in food production.	33(22.0) )	65(43.3) )	26(17.3) )	19(12.7) )	07(4.7)	2.35	1.099	high influence
Family structure impacts decisions on food production and consumption in climate-affected times.	56(37.3) )	76(50.6) )	13(8.7)	05(3.3)		1.78	0.741	Low influence
Religious teachings play a role in shaping people's responses to food	23(15.3) )	23(15.3) )	50(33.3) )	34(22.7) )	20(13.3) )	3.03	1.239	high influence

insecurity.								
Social class affects access to resources needed for climate change adaptation in agriculture.	70(46.7)	58(38.7)	18(12.0)	04(2.7)		1.71	0.78	Low influence

Strongly Agreed (SA) = 1; Agreed (A) = 2; Undecided (UD) = 3; Disagreed (D) = 4; and Strongly Disagreed (SD) = 5. **Weighted Average (WA) = 2.19**

#### **4.5 Institution Roles In Climate Change Adaptation for Food Security**

As shown in table 4.6, majority of the respondents are of the opinion that government agencies actively support farming households in climate adaptation and that climate adaptation policies are effectively communicated by relevant authorities. They also agree that institutions provide financial and material support to mitigate climate change impacts on food security. However, most of them are not in agreement that extension services provide adequate training for climate-resilient farming and that local leaders influence the implementation of food security programs. As such, it can be inferred that there is high institutional effort in climate change adaptation to achieve food security.

Table 4.6 Institution Roles in Climate Change Adaptation for Food Security

<b>ITEMS</b>	<b>SA</b>	<b>A</b>	<b>UD</b>	<b>D</b>	<b>SD</b>	<b>Mea</b>	<b>STD</b>	<b>Remar</b>
	<b>Freq</b>	<b>Freq</b>	<b>Freq</b>	<b>Freq</b>	<b>Freq</b>	<b>n</b>		<b>k</b>
	<b>(%)</b>	<b>(%)</b>	<b>(%)</b>	<b>(%)</b>	<b>(%)</b>			
Government agencies actively support farming households in climate adaptation.	10(6.7)	10(6.7)	35(23.3)	52(34.7)	43(28.7)	3.72	1.148	High role
Extension services provide adequate training for climate-resilient farming.	13(8.7)	25(16.7)	55(36.7)	23(15.3)	34(22.7)	3.27	1.230	Low role
Local leaders influence the implementation of food security programs.	15(10)	53(53.3)	34(22.7)	18(12.0)	30(20.0)	2.97	1.297	low role
Climate adaptation policies are effectively communicated by relevant authorities.	08(5.3)	13(8.7)	32(21.3)	50(33.3)	47(31.3)	3.77	1.144	High role

Institutions provide financial and material support to mitigate climate change impacts on food security.	11(7.3)	16(10.7)	39(26.0)	37(24.7)	47(31.3)	3.62	1.23	5	High role
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Strongly Agreed (SA) = 1; Agreed (A) = 2; Undecided (UD) = 3; Disagreed (D) = 4; and Strongly Disagreed (SD) = 5. **Weighted Average (WA) = 3.47**

#### **4.6 Relationship Between Awareness to Climate Change and Socio Demographic Factors on Climate Change Adaptation and Food Security**

Table 4.7 reveals moderate positive relationship between awareness to climate change and socio demographic influences which is statistically significant ( $r = 0.373$ ,  $p = 0.000 < 0.05$ ). It can be inferred that as awareness of climate change increases, socio demographic factors on climate change adaptation and food security also increase.

Table 4.7: Correlation between awareness to climate change and socio demographic factors on climate change adaptation and food security

			Awareness	socio demography
Pearson Correlation (r)	awareness	Correlation Coefficient	1	0.373
		Sig. (2-tailed)	.	0.000
		N	150	150
	Socio demography	Correlation Coefficient	0.373	1

#### **4.7 Relationship between Awareness to Climate Change and Socio Cultural Influences on Climate change Adaptation Strategies**

Table 4.8 reveals moderate positive relationship between awareness to climate change and socio cultural influences which is statistically significant ( $r = 0.380$ ,  $p = 0.000 < 0.05$ ). It can be inferred that as awareness of climate change increases, socio-cultural influences on climate change adaptation strategies also increase.

Table 4.8: Correlation between awareness to climate change and socio cultural influences

			Awareness	socio cultural influences
Pearson Correlation (r)	awareness	Correlation Coefficient	1	0.380
		Sig. (2-tailed)	.	0.000
		N	150	150
	socio cultural influences	Correlation Coefficient	0.380	1

## CHAPTER 5

### DISCUSSION

#### 5.1.1 Perceptions and Awareness of Climate Change Risks on Food Security

The study found that respondents in Benin City have a low awareness of how climate change directly affects food security. This is consistent with Ezegwu *et al.* (2024) observation that the majority of respondents have a low exposure to campaigns on climate change issues, hence restricting their knowledge of climate hazards. In contrast, other studies show substantially higher awareness. For example, Botir *et al.* (2025) discovered 97.5% of cashew farmers in Ghana are aware of climate change, while Béné *et al.* (2016) quoted in (Ezegwu *et al.*, 2024) discovered that the majority of Southwest Nigerian farmers really believe they are knowledgeable about climate change. These disparate results demonstrate the variance in awareness levels across contexts. Evidence from Benin City indicates that a lack of exposure and poor information transmission hinder awareness of the threats to food security posed by climate change.

#### 5.2.1 Influence of Socio-Demographic Characteristics on Climate Adaptation and Food Security

The findings reveal that socio-demographic characteristics including age, gender and education have only a minor impact on climate adaptation and food security responses in the study area. This is consistent with Kumar *et al.* (2024) finding no significant gender-based differences in adaptation strategies among livestock producers in Nepal, implying that some demographic characteristics may not always be decisive. Other studies, however, offer conflicting evidence. According to Williams and Tumba (2021) “experience and education in agriculture have a big

impact on farmers' adoption of climate-resilient practices". This suggests that socio-demographics have a greater impact in particular situations. However, in Benin City, demographic factors were not the key drivers of adaptive behaviour, emphasising that climate adaptation programs should focus on structural and institutional supports that cross demographic lines.

### **5.3.1 Socio-Cultural Influence on Climate Change Adaptation Strategies**

The study found that socio-cultural norms and beliefs have little influence on climate change adaptation measures in Benin City. On the contrary, numerous experts emphasise the significance of culture. Udeh *et al.* (2024) found that religious customs and cultural beliefs have a big impact on how the community reacts to environmental concerns, whereas Okon *et al.* (2023) found that socio-cultural limitations may limit the adaptive capacity of females. These contrasting viewpoints imply that culture can either facilitate or hinder adaptation. In the instance of Benin City, the lower influence found may be attributable to a stronger reliance on institutional and economic variables. Nonetheless, considering the significance culture plays elsewhere, adaptation measures should not disregard cultural and religious leaders who can affect local behaviour.

### **5.4.1 Institutional Roles in Climate Change Adaptation for Food Security**

The findings indicate that institutions are actively engaged in promoting food security and adaptation, despite the fact that their performance varies across different regions. Akinkuolie *et al.* (2024) state that among the various programs the Nigerian government has put in place to promote food security and climate adaption, including climate-smart agricultural policy and information services. However, they additionally stress that low finance, weak institutional

ability, and subpar policy implementation frequently make [adaptation] interventions less successful . This underscores a recurring contradiction: institutions may appear to be active on paper, but their efficacy is frequently hampered by a lack of financing and capacity. In Benin City, the term high institutional effort refers to the presence of policies and initiatives, but it also highlights the need for greater outreach, extension services, and local leadership training to ensure that policies are translated into real action.

### **5.5.1 Relationship Between Climate Change Awareness and Socio-Demographic Factors**

The study shows a moderately favourable relationship between climate change awareness and socio-demographic factors. In other words, more knowledge tends to reinforce the importance of factors like education and income in influencing adaptive responses. This is consistent with Baloyi *et al.* (2025) finding that respondents with higher education levels showed more concern about climate change, implying that education increases both awareness and proactive engagement. However, the same study cautions that the digital divide and lack of information access can prevent some groups from benefiting equally from awareness campaigns. As a result, while awareness can improve socio-demographic advantages like schooling, unequal access to knowledge can exacerbate gaps. In Benin City, these results show that awareness programs should be broad-based and inclusive, ensuring that marginalized populations are not left behind.

### **5.6.1 Relationship Between Climate Change Awareness and Socio-Cultural Influences**

The study concluded that larger sociocultural influences on adaptation are linked to greater awareness of climate change. Supporting evidence is provided by Udeh *et al.* (2024), who point out that religious teachings often emphasise stewardship of natural resource influencing behaviours that support sustainable land use. This demonstrates how raising awareness can

positively impact cultural norms. However, Adger *et al.* (2009) warn that cultural beliefs promoted by religion could result in maladaptation, such as when societies depend more on prayer than on useful strategies. The dual nature of socio-cultural influence is highlighted by these opposing viewpoints. As awareness grows in Benin City, cultural and religious beliefs are expected to play a larger role in influencing food insecurity responses. The implication is that awareness campaigns should actively involve religious and community leaders in order to harness good cultural values while counteracting potentially harmful ideas.

## **5.2 CONCLUSION**

This study looked at the determinants of the adoption of climate change adaptation strategies in attaining food security in Benin City by assessing climate change knowledge, socio-demographic and socio-cultural factors, and institutional involvement in enhancing food security in Benin City, Nigeria. The findings revealed that understanding of climate change hazards to food security is often poor, and that socio-demographic and socio-cultural factors have less influence when compared to institutional issues. The study also found that institutional involvement in climate adaptation is important, but it is hampered by insufficient finance, outreach, and implementation gaps. Finally, the study found that when awareness grows, socio-demographic and socio-cultural factors become more prominent, implying that education and community engagement might improve adaptive behaviour. Overall, the study finds that increasing knowledge, strengthening institutions, and involving cultural leaders are critical for enhancing climate change adaptation and food security in Benin City.

### 5.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. To raise understanding of food security threats, government agencies, non-governmental organizations (NGOs), and community groups should launch ongoing climate change awareness campaigns using radio, social media, and town hall meetings.
2. Climate change and food security should be included in secondary and postsecondary education curricula to help students become more educated and proactive.
3. To increase the reach and effectiveness of climate adaptation and food security efforts, agencies responsible for their implementation should be given with enough resources and training.
4. Promote and subsidize drought-resistant seeds, irrigation systems, and other climate-smart practices to improve food security and resilience in peri-urban and rural supply zones.
5. Engage churches, mosques, and traditional institutions in spreading climate adaptation messages, utilizing culturally familiar channels to promote healthy actions and refute maladaptive views.
6. Encourage partnerships between public, commercial, and non-governmental organizations to finance climate-smart infrastructure, sustainable farming initiatives, and renewable energy.
7. In order to enhance policy decisions, universities and research organizations should regularly assess the success of adaptation activities and awareness campaigns.

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## APPENDIX ONE

### SAMPLE QUESTIONNAIRE

**SECTION A: DEMOGRAPHIC INFORMATION**

1. Sex: a) Male [ ] b) Female [ ]
2. Age: a)  $\leq 20$  [ ] b) 21 – 30 [ ] c) 31 – 40 d)  $\geq 40$
3. Marital Status: a) Single [ ] b) Married [ ] c) Divorced [ ] d) Widow/Widower [ ]
4. Religion a) Christianity [ ] b) Islam [ ] c) Others [ ]
5. Educational Level a) Primary [ ] b) Secondary c) Tertiary [ ] d) No Formal Education [ ]

**SECTION B: DEVELOPMENT OF RESEARCH QUESTIONS**

Kindly tick {√} the column that best indicate your opinion using the following keys:

Strongly Agreed (SA) = 1; Agreed (A) = 2; Undecided (UD) = 3; Disagreed (D) = 4; and Strongly Disagreed (SD) = 5.

S/N	ITEMS	SA 1	A 2	UD 3	D 4	SD 5
<b>I.</b>	<b>Perceptions and Awareness of Climate Change Risks on Food Security</b>					
1.	People in Benin city are aware that climate change affects food security.					
2.	Local weather changes are increasingly recognized as threats to food.					
3.	There is adequate information about how climate change leads to food scarcity.					
4.	Most households understand the connection between farming outcomes and climate change.					
5.	Awareness programs about climate-related food risks are available and accessible					
<b>II.</b>	<b>Influence of Socio-Demographic Characteristics on Climate Adaptation and Food Security</b>					
6.	Younger individuals are more willing to adopt climate-friendly farming.					
7.	Education level affects how people respond to climate change impacts on food security.					
8.	Higher income levels increase the capacity to implement					

	adaptation strategies.					
9.	Gender roles influence how people contribute or respond to food insecurity issues.					
10.	Occupation(e.g., farming, trading) determines one's approach to coping with food insecurity.					
<b>III.</b>	<b>Socio-Cultural Influence on Adaptation of Climate Adaptation Strategies</b>					
11.	Social norms affect people's decisions to change farming or food practices.					
12.	Cultural beliefs may hinder or promote climate adaptation practices in food production.					
13.	Family structure impacts decisions on food production and consumption in climate-affected times.					
14.	Religious teachings play a role in shaping people's responses to food insecurity.					
15.	Social class affects access to resources needed for climate change adaptation in agriculture.					
<b>IV.</b>	<b>Institution Roles In Climate Change Adaptation for Food Security</b>					
16.	Government agencies actively support farming households in climate adaptation.					
17.	Extension services provide adequate training for climate-resilient farming.					
18.	Local leaders influence the implementation of food security programs.					
19.	Climate adaptation policies are effectively communicated by relevant authorities.					
20.	Institutions provide financial and material support to mitigate climate change impacts on food security.					

## APPENDIX TWO

### SPSS OUT PUT

#### Perceptions and Awareness of Climate Change Risks on Food Security

**Statistics**

		People in Benin city are aware that climate change affects food security.	Local weather changes are increasingly recognized as threats to food.	There is adequate information about how climate change leads to food scarcity.	Most households understand the connection between farming outcomes and climate change.	Awareness programs about climate-related food risks are available and accessible
N	Valid	150	150	150	150	150
	Missing	0	0	0	0	0
Mean		2.32	2.54	3.38	2.91	3.71
Std. Deviation		1.183	1.196	1.202	1.318	1.078

**Influence of Socio-Demographic Characteristics on Climate Adaptation and Food Security**

**Statistics**

		Younger individuals are more willing to adopt climate-friendly farming.	Education level affects how people respond to climate change impacts on food security.	Higher income levels increase the capacity to implement adaptation strategies.	Gender roles influence how people contribute or respond to food insecurity issues.	Occupation(e.g., farming, trading) determines one's approach to coping with food insecurity.
N	Valid	150	150	150	150	150
	Missing	0	0	0	0	0
Mean		2.01	1.61	1.48	2.91	1.74
Std. Deviation		1.170	1.003	.766	1.387	.863

**Socio-Cultural Influence on Adaptation of Climate Adaptation Strategies**

**Statistics**

		Social norms affect people's decisions to change farming or food practices.	Cultural beliefs may hinder or promote climate adaptation practices in food production.	Family structure impacts decisions on food production and consumption in climate-affected times.	Religious teachings play a role in shaping people's responses to food insecurity.	Social class affects access to resources needed for climate change adaptation in agriculture.
N	Valid	150	150	150	150	150
	Missing	0	0	0	0	0
Mean		2.11	2.35	1.78	3.03	1.71
Std. Deviation		.977	1.099	.741	1.239	.782

### Institution Roles In Climate Change Adaptation for Food Security

		Statistics				
		Government agencies actively support farming households in climate adaptation.	Extension services provide adequate training for climate-resilient farming.	Local leaders influence the implementation of food security programs.	Climate adaptation policies are effectively communicated by relevant authorities.	Institutions provide financial and material support to mitigate climate change impacts on food security.
N	Valid	150	150	150	150	150
	Missing	0	0	0	0	0
Mean		3.72	3.27	2.97	3.77	3.62
Std. Deviation		1.148	1.230	1.297	1.144	1.235

### Correlation between awareness to climate change and socio demography

		Correlations	
		awareness	sociodemograph y
awareness	Pearson Correlation	1	.373**

	Sig. (2-tailed)		.000
	N	150	150
sociodemography	Pearson Correlation	.373**	1
	Sig. (2-tailed)	.000	
	N	150	150

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Correlation between awareness to climate change and socio cultural influences

### Correlations

		awareness	sociocultural
awareness	Pearson Correlation	1	.380**
	Sig. (2-tailed)		.000
	N	150	150
sociocultural	Pearson Correlation	.380**	1
	Sig. (2-tailed)	.000	
	N	150	150

\*\* . Correlation is significant at the 0.01 level (2-tailed).

### RELIABILITY

#### Reliability Statistics

Cronbach's	
Alpha	N of Items
0.927	20