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Social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria

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A THESIS submitted to the **SCHOOL OF GEOGRAPHY, ARCHAEOLOGY & ENVIRONMENTAL STUDIES, FACULTY OF SCIENCE, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG,** in fulfillment of the **DEGREE OF DOCTOR OF PHILOSOPHY in GEOGRAPHY AND ENVIRONMENTAL STUDIES**

May 2024

DECLARATION

I, **Franklin Chimaobi Okoro**, hereby declare that this thesis is my original work, conducted under the supervision of Prof. Jasper Knight. All the sources and references used in this thesis have been duly acknowledged and cited. Any assistance received during the course of this research project has been acknowledged appropriately.

I confirm that this thesis has not been submitted for any other degree or qualification at any other institution. The work presented in this thesis is the result of my own intellectual efforts except where otherwise acknowledged.

I also declare that the data and results presented in form of tables, figures, graphs and quotes are accurate and truthful to the best of my knowledge and abilities. I have followed the ethical guidelines and procedures in conducting this research and have obtained the necessary approvals where applicable.



_____

Franklin Chimaobi Okoro
12 May 2024

Abstract

Rural communities in developing countries such as Nigeria are faced with frequent extreme weather/climate events that impact their economy, health, and environment due to the combination of high social vulnerabilities, low social resilience, and low adaptive capacities. The aim of this study is to investigate the root causes of social vulnerability in rural communities in Nigeria and how rural households use their social capital and networks to adapt to the impacts of climate change. The study used ten (10) social vulnerability indicators (factors) to ascertain their influence on social resilience and adaptive capacity during climate related disasters. To achieve this purpose, three communities in Imo State, Southern Nigeria were selected, and distributed 240 structured questionnaires to rural household heads, interviewed 18 local stakeholders and climate change actors (government agencies), and conducted three (3) Focus Group Discussions (FGDs) with group of farmers from the three selected communities. The questionnaire survey, interview, and FGD guides contained open-ended questions that allowed participants to report freely. The quantitative data derived from the questionnaire survey were subjected to descriptive analysis using SPSS while the qualitative data were subjected to thematic analysis to derive relevant themes for discussions. The result of the study shows that social vulnerability is a function of age, gender, education, household size, income, sources of livelihood, disability, means of transport, access to healthcare, and alternative accommodation being available during climate emergencies. The study further shows that social vulnerability of rural residents was exacerbated by societal vulnerability influenced by political, economic, cultural, and social factors. Although there are other weather/climate extreme events (disasters), however, the most prominent is floods, constituting 48.3% of the weather/climate events experienced in the study area with its impacts requiring more efficient climate adaptation strategies other than the traditional measures like relocation/migration, use of early maturing crop varieties, early planting and harvesting. However, rural households drew support from government, NGOs, and oil companies but the help from family members, friends, neighbours, social group members (social networks) were more beneficial and helped more rural residents to improve their social resilience. The study recommends that rural residents be encouraged to join social groups since their memberships in such groups will help to improve their social resilience, and that government and its agencies should engage multi-stakeholders in their genuine efforts to develop more effective measures for climate change adaptation.

Key terms: *Social vulnerability, rural communities, climate change, adaptation, resilience, social capital, social networks, disaster risk reduction*

Dedication

This thesis is dedicated to God Almighty for his divine direction throughout the course of this research.

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My profound gratitude goes to God for leading me through this path successfully. It would not have been achievable without the mercies of God.

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List of Abbreviations

IPCC – Inter-governmental Panel on Climate Change

NEMA – National Emergency Management

NESREA – National Environmental Standard Regulations and Enforcement Agency

NiMET – Nigeria Meteorological Agency

NIHSA – Nigeria Hydrological Services Agency

CBD - Convention on Biological Diversity

NBSAP - National Biodiversity Strategy and Action Plan

UNFCCC - United Nations Framework on Climate Change Convention

DRR – Disaster Risk Reduction

CCA – Climate Change Adaptation

HFA - Hyogo Framework for Action

WCDR - World Conference on Disaster Reduction

SFDRR - Sendai Framework for Disaster Risk Reduction

AR4 - Fourth Assessment Report

AR5 - Fifth Assessment Report

NAPA - National Adaptation Programs of Action

COP - Conference of the Parties

LCDs - Less Developed Countries

APF - Adaptation Policy Framework

CDM - Clean Development Mechanism

OECD-DAC - Organization for Economic Cooperation and Development–Development Assistant Committee

USAID - United States Agency for International Development

DfID - Department for International Development

SDGs - Sustainable Development Goals

CBA – Community Based Adaptation

CBIs - Community Based initiatives

SSC - Structural Social Capital

CSC - Cognitive Social Capital

TPB – Theory of Planned Behaviour

GRRs - Generalized Resistance Resources

DG – Director General

NRD – National Regulatory Dialogue

SEMA - State Emergency Management Agency

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Global climate change is already having effects on the majority of people's economic circumstances in developing countries, increasing the variability and uncertainty of the circumstances under which people strive to make a living (IPCC, 2007, 2021; Wu *et al.,* 2021). It does so mainly through its impacts on agricultural, pastoral, fishery, and forestry resources, which are the primary sources of income for many rural communities in the developing world (Cannon and Mahn, 2010; Osbahr *et al.,* 2010; Mekonen and Berlie, 2021). The availability and utilization of these primary resources have a significant impact on rural-urban exchanges, such as the flow of commodities, services, money, and labour between rural and urban communities (Cannon and Mahn, 2010).

Climate change has created conditions such as rising sea levels, increased temperature, excessive rains, and droughts that have devastated large investments in the economy, infrastructure, and social and cultural systems of nations like Nigeria (Saja *et al*., 2018). Climate change is likely to worsen the frequency and intensity of hydro-meteorological disasters like floods, sea level rise, and droughts, and is also expected to be a prevalent stress factor on socio-economic systems, exacerbating the probable scale and frequency of extreme events (Mabuku *et al.,* 2018). The negative effects of climate change are getting worse in Nigeria, as a result of the rise in cases of floods, droughts, and overall rainfall variation during the last several years (Obi *et al.,* 2017). In Imo State, the reported effects of climate change include decreasing crop yields, diminishing soil fertility, events of drought, floods, increased heat waves, and soil and coastal erosions (Ozor *et al*., 2015). Due to the weather/climate extreme events associated with climate change particularly in developing countries like Nigeria, it is paramount that suitable adaptation measures are designed by policymakers to assist communities in building resilience to climate risks.

In rural communities that rely on agriculture, households perceive climate risks in different ways because their vulnerability relates to age, income, family structure, ethnicity, culture, social networks, housing, and the physical environment (Keogh *et al*., 2011; Bacha *et al.,* 2018). These rural households therefore have varying responses to climate change impacts and stressors like early planting and harvesting of crops, migration to other places, change of planting dates, and cultivation on marginal lands (Hufschmidt, 2011; Michalak, 2016; Jamshed *et al.,* 2020). They employ a wide range of adaptation measures to resist

the effects of climate change and climatic extreme events (Kuchimanchi *et al.,* 2019).

It is noteworthy that socially vulnerable communities may have high illiteracy levels, limited access to healthcare, limited access to funds, and suffer exclusion in governance and decision-making which will influence their climate change adaptation capacity and resilience (Willroth *et al.,* 2012; Herman-Mercer *et al.,* 2019; Martins and Gasalla, 2020). Inefficiencies in adaptation options can be attributed to neglect of the social vulnerability of communities resulting in inappropriate adaptation measures. When communities facing severe social vulnerability to climate risks employ various adaptation measures, the actions of the communities may exacerbate the impacts. This is because social vulnerability to climate change impacts is partly a function of their social, economic, and political marginalization (Gibb, 2018). It has been observed over time that victims of climate-related disasters are spatially marginalized due to their closeness to hazard-prone areas, and socially marginalized because they are impoverished and politically marginalized because their opinions are not considered during adaptation policy formulation (Pongponrat and Ishii, 2018). Socially vulnerable communities have lower resilience to climate risks and because the population is marginalized, and lacking appropriate responsiveness and recovery mechanisms, they are hardest hit by climate crisis (Pongponrat and Ishii, 2018).

In Nigeria, 80% of the population lives in rural regions, and their livelihoods are largely dependent on the agricultural economy (Abaje *et al*., 2016; Abaje, 2017). Furthermore, the rural region is defined as having a low population density, limited geographic areas, and relative isolation, from people who share similar beliefs, norms, customs, and cultures (Ekanem and Umoh, 2021). Poor and damaged roads, insufficient health facilities, insufficient and poorly equipped educational institutions, poor social amenities, high levels of poverty, unplanned residential layout, and other obstacles that impede human well-being define Nigeria's rural areas (Abaje *et al.,* 2016; Ekanem and Umoh, 2021).

In rural communities, there is proximity to nature, and natural resources from agriculture and ecosystem services provide the foundation for rural residents' basic requirements. The majority of people in rural areas, for example, rely on rain to begin farming activities. However, a large number of rural residents may be displaced as a result of current climatic conditions and associated disasters like floods, storms, droughts, and landslides, particularly in coastal areas (Abaje *et al.,* 2016). Droughts, floods, and sea-level rise have all been connected to people being displaced and migrating from and to different towns

in coastal areas (Abaje *et al.,* 2016). The impact of climate change is also expected to be unevenly distributed among developing countries, with Nigeria being particularly vulnerable due to its geography, climate, vegetation, soils, population and settlement, energy demand, and agricultural activities (Mertz *et al.,* 2009; Shiferaw *et al.*, 2014; Abaje *et al*., 2016).

Climate conditions influence both natural and societal systems through weather extremes and annual and seasonal oscillations of rainfall. The ability of rural households to raise enough food to support themselves is considerably hampered in some rural areas by short rainy seasons and heavy downpours (Ekanem and Umoh, 2021). These weather patterns have an impact on agricultural production, can diminish crop yields, and allow farmers to adapt their farming operations in response to changing conditions (Ekanem and Umoh, 2021). In the Niger Delta region of Nigeria, it was observed that Akwa Ibom State was exposed to the negative effects of climatic variability and change which became apparent in light of widespread poverty, unequal land distribution, over-reliance on rain-fed agriculture, low income, and weak institutional competence (Umoh, 2013).

However, the social aspects of vulnerability to climate risks are rarely explored. This neglected aspect of vulnerability deals with the way people, groups, or individuals are exposed to stress occasioned by the impacts of climate change. To effectively adapt to climate change impacts in rural communities, the factors of social vulnerability must be taken into consideration. However, social insecurity of people in rural regions is generally disregarded in disaster literature, and it is also the least documented condition, which explains why social losses are frequently ignored in post-disaster cost/loss estimations (White and Howe 2012; UN, 2018). The inability to analyze all aspects of climate-related vulnerability would harm people's adaptability and resilience to climate-related threats.

For socially vulnerable communities, the effectiveness of any climate change adaptation measure will take into account their socio-cultural contexts and perceptions concerning climate risks (Artur and Hilhorst, 2012). Climate change adaptation in sub-Saharan Africa has been ineffective due to inconsistencies in the processes involved in developing such adaptations, as well as a lack of social justice within the countries' political systems and negligence of societal and social vulnerabilities of rural residents (Osbahr *et al.,* 2010). Farmers may be discouraged from diversifying of livelihoods due to the losses incurred while investing in new adaptation strategies, necessitating the need for cheap but more

robust adaptation options capable of improving their resilience to negative climate change impacts. Similarly, victims of climate extreme events who live in marginalized communities have lower capacity to diversify their livelihoods due to a high rate of poverty, and low social cohesion, hence diversification of livelihoods may not be efficient.

The ineffectiveness of adaptation and recovery from climate-related hazards is also exacerbated by a lack of social capital such as trust, norms, shared values, and networks that help communities to function more effectively (Blake *et al.,* 2017). Communities will be less able to reorganize and rebuild without social cohesion or social resources or will rely on the government, Non-governmental organizations (NGOs), religious groups or local leaders. When social capital in a community is maximized fully, there will be an increase in climate resilience among the households and vice versa (Blake *et al.,* 2017). For example, when farmers in rural areas, have poor social capital/network on which they depend upon in times of shocks, their vulnerability to climate risks increases (Boansi *et al.,* 2017). However, belonging to a social group such as social clubs, cooperative societies and farmers' groups could improve the use of flood-tolerating crops, mixing crops with livestock, and irrigation practices, frequently boosted by group/community members investing jointly in irrigation facilities to assist in reducing climate risks (Boansi *et al.,* 2017). Insufficient social defense (for example; health insurance, health services, construction rules, preventive strategies, etc.) and restricted social networks further contribute to the social vulnerability of communities (Gaillard, 2010). This emphasizes the significance of the community's social capital in enhancing resilience to the negative impacts of climate change.

The ability of a community to absorb disruptions and reorganize while experiencing change yet retaining essentially the same feature, framework, individuality, and feedback is referred to as resilience (Adger *et al.,* 2011). Communities need to build social resilience, which manifests itself in three ways, namely adaptive capacity involving actions taken to reduce risks from harmful effects of climate change, coping which deals with actions people take to mitigate the effects of climate change, and participatory which gives rural communities the opportunity of getting involved in climate change adaptation actions (Lorenz, 2013). These abilities and how they interact are critical for understanding social resilience and the contribution of social science to interdisciplinary resilience research (Lorenz, 2013). As a result, a community's social resilience can be built through the General Resistance Resources (GRR), which includes coping, adaptive, and participative capabilities (Bodoque *et al.,* 2016). One problem

communities may encounter while improving resilience to climate change impacts is to determine how the response to individual stressors affects the wider social system. The adaptive capacity of a resilient community must be assessed in light of social goals and the distribution of rewards and risks (Nelson, 2011). This implies that communities must strengthen their resilience to climate-related risks through cooperation at all levels.

Vulnerable groups must prepare for climatic risks, which necessitates the ability to have adequate personal, social, and economic assets (Scolobig *et al.,* 2012). Communities unable to prepare due to financial constraints, inadequate social ties, capacity, or assistance, however, will be hit hard by climate events (Blake *et al.,* 2017). Socially vulnerable people are disadvantaged in emergency preparedness activities because they lack the resources, funds and government assistance to prepare. In addition, to be able to make adequate preparations for future climate risks, communities need to improve their levels of risk awareness. This study examined communities' social cohesion and actions in Nigeria using existing social capital to improve their resilience against future climate risks by making adequate preparations. It will therefore, add to the body of knowledge on climate risk perception, awareness, and preparedness at the community and household levels, as well as examine community resilience through the integration of community climate change adaptation into disaster risk reduction strategies. With this, decision-makers may be able to modify community behaviors before and during climatic extreme events by understanding the elements impacting communities' ability to plan for and adapt to climate change impacts (social vulnerability factors). The purpose of such policies will be to improve community perceptions, awareness, and readiness for climate risks, as well as community resilience to future climate risks through communities' inclusiveness in decision-making. Doing so, may help to increase resilience and reduce vulnerability among rural residents. However, to achieve these objectives requires an integrated, multi-disciplinary approach.

To improve the understanding of used terminologies in this research, table T.1 provides definitions of such terms according to the context of the study.

Table 1.1: Definition of terms

Term	Definition
Social vulnerability	The exposure of communities or households to stresses (unanticipated changes in livelihoods) caused by changes in climatic conditions is known as social vulnerability (Otto *et al*., 2017).
Adaptation	The process of modifying a community's system to mitigate the effects of climate change, seize new opportunities, or deal with the consequences of climate change is known as adaptation to climate change (Adge et al., 2003).
Social capital	Social capital is that vital component of a community like trust, norms and networks which helps the society to function more effectively and enable collective efforts (Cannon and Muller-Mahn, 2010).
Community resilience	Resilience is defined as the capacity to adapt to dangers, shocks, stressors, and adversity (Sapountzaki, 2012). It refers to the capacity of a community to make preparations for, react appropriately to, and recover from natural disasters (Saja *et al.*, 2018; Kais and Islam, 2016). Community resilience is also defined as a community's social capital, physical infrastructure, and culturally based interconnectedness, which enables it to recoup after drastic change, retain adaptation, and support new growth that incorporates knowledge gained during and after climate crisis (Ungar, 2011).
Climate risk	Climate risk is the probability of negative consequences as a result of extreme climate occurrences interacting with vulnerable environmental, social, economic, political, or sociocultural conditions in a community (IPCC, 2012).
Marginalization	Marginalization is a term used to describe processes that cause someone to be socially, economically, politically, and legally disadvantaged (Gibb, 2018).

1.2 Research Problem

Climate change and variability will keep increasing in frequency and intensity for many years to come due to anthropogenic activities (IPCC, 2012, 2021). This implies that every community must be prepared to anticipate climate risks that may ensue. Socially vulnerable communities must equip themselves appropriately using their social capital/networks to avoid harsh climate change impacts. Unfortunately, socially vulnerable communities are marginalized economically and politically and may not be able to develop such preparatory processes (Cutter, 2016; Pongponrat and Ishii, 2018). During climate extreme events, community members may suffer lots of losses that are not accounted for or compensated by the government (Osuteye *et al*., 2017). Since government support for rural communities in developing countries such as Africa is minimal, rural community members may resort to collective efforts to adapt to the impacts of climate change. However, how these community-based adaptation is achieved, and its effectiveness in climate change adaptation needs to be fully explored in research.

Many recommended adaptation measures may be ineffective and could even increase vulnerability in these communities (Adger *et al.,* 2005; McEvoy *et al.,* 2010; Tumbo, 2015). Also, government agencies may ignore community stakeholders and local authorities while making climate change adaptation decisions that affect them. This action has promoted faulty adaptation measures that have low efficiency, particularly among socially vulnerable and marginalized communities. Individual and societal risk perceptions, knowledge, and experience all play a role in deciding the nature of adaptation strategies (Adger *et al.,* 2009). Neglecting to stress the importance of risk perception among socially and politically excluded groups in structuring adaptation policies, results in numerous response methods that risk diminishing system resilience due to poor design (Adger *et al.,* 2011).

Rural communities in Africa and indeed Nigeria inclusive have low adaptive capacity and suffer the impacts of climate change (Abdul-Razak and Kruse, 2017; Boansi *et al*., 2017; Martins and Gasalla, 2020) due to the interplay of social and societal vulnerability. However, these aspects of vulnerability are not fully explored in climate change adaptation researches as a result of the intricacies involved in measurement of the factors contributing to social vulnerability. Neglecting these factors in designing climate change adaptation policies may exacerbate vulnerability and lower community resilience. Therefore, to address this problem requires that government and its agencies like the National Emergency Management Agency (NEMA) strengthen rural community engagements and local stake-holders linkages in their efforts to move from disaster management to disaster risk reduction.

This study will therefore investigate the root causes of social vulnerability to climate change and variability of rural communities in Imo State, Nigeria. The study will seek to understand how vulnerable communities utilize their social capital to strengthen their resilience against climate risks. Further, the study will explore the mainstreaming of disaster risk reduction into climate change adaptation strategies in building strong resilience to climate change among socially vulnerable households in rural communities.

1.3 Research Questions

This study addressed the following research questions:

1. What factors predispose communities to societal vulnerability in the face of climate change and weather events in rural communities of Imo State?

2. What are the forms of responses adopted by these rural households and communities to cope with the effects of climate change events?
3. In what ways does social capital contribute to building the adaptive capacity and resilience of the most vulnerable groups of people to climate change in Imo State?
4. In what ways can participatory adaptation, community synergy, and social interaction contribute to building resilience against climate risks?
5. How can community inclusiveness in adaptation decision-making contribute to the formulation of effective adaptation policies?
6. How can community adaptation measures and risk reduction measures enhance community resilience to climate risks?

1.4 Aims and Objectives

i. **To understand the coping strategies and level of preparedness among socially vulnerable communities against future climate risks**.

a. To determine the socio-economic and demographic characteristics of the communities that predispose them to climate change impacts.
b. To evaluate climate risk awareness at the household and community levels that contribute to building resilience among socially vulnerable communities.
c. To assess the perception of climate risks by vulnerable communities and evaluate their response mechanisms.
d. To identify the available social capital of vulnerable households and investigate the role they play in building resilience against future climate risks.

ii. To explore the intertwinement of community-based adaptation and disaster risk reduction in building a strong resilient society against climate risks (extreme events) in socially vulnerable communities

a. To evaluate the capacity of collective efforts, participatory adaptation, political inclusiveness, and social interactiveness in developing sustainable adaptation measures at the community level.
b. To evaluate the contributions of local authorities, stakeholders and government agencies in building climate risk resilience among socially vulnerable communities.

c. To assess the contributions of adaptive governance in using approaches of adaptation measures and disaster risk management to strengthen and enhance communities' climate change resilience.

1.5 Structure of the Thesis

The seven chapters that make up this thesis are organized about the goals and objectives of the research. After this introductory chapter, **Chapter Two** presents a review of the relevant literature on climate change risks, social vulnerability of rural households and how it affects their resilience and capacity to adapt, social capital and networks of rural households that provide support during extreme events (disasters), and the integration of climate change adaptation into disaster risk reduction practices. **Chapter Three** describes the characteristics of the study area including its location, climate, geology and soil, and human and economic activities. **Chapter Four** describes the research design, selection of study sites and sampling procedure. It also describes the data collection methods including instruments used and data analysis techniques employed. The ethical consideration used in the study was also explained as well as the limitations of the study. **Chapter Five** presents the findings on the weather/climate events that most affect the study area, highlighting the environmental, economic, and health impacts of these extreme events, the social and societal vulnerability indicators that lower the resilience of rural residents, their coping strategies, supports received through social capital and networks, and the prospects of mainstreaming disaster risk reduction into climate change adaptation programs. **Chapter Six** presents a discussion of the results, comparing relevant aspects to related literature. **Chapter Seven** presents the conclusion of the study by summarizing the main findings and highlighting the contribution of the study to the broader literature on the social vulnerability of rural residents in adapting to the impacts of climate change in sub-Saharan Africa while making recommendations for future research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section reviews the literature on climate risk, perception, awareness, preparedness, social vulnerability, adaptation strategies, adaptation capacity, social capital and building resilience through disaster risk reduction and management. This provides the context for the investigation into the social vulnerability of rural communities influencing rural residents' climate change adaptation behaviour.

2.2 Climate Risks, Awareness, Perception and Preparedness

Climate risk is the probability of a specific climate event happening and the resulting negative repercussions (Banaitiene, 2012). Climate risk is the result of a complex interplay of climate hazards, such as the extent and duration of severe temperatures or rainfall, as well as the vulnerability of disadvantaged communities (Banaitiene, 2012). Risks related to climate change are more pronounced during weather/climate extreme events.

Climate change is expected to continue throughout the century, with approximately 26.4 million people affected globally every year by climate extreme events, and this number will undoubtedly rise over time (Ebi and Bowen, 2016). Extreme climate events caused by climate change have been on the rise in Africa and around the world over the last decade (Dube *et al.,* 2021). Climate risks will also become more frequent and intense around the world, particularly among Africa's most vulnerable populations in several years to come (Brooks *et al.,* 2005; Shiferaw *et al.,* 2014; Clay and Zimmerer, 2020; Kapuka and Hlásny, 2020). Temperature and rainfall regime fluctuations, rising mean temperatures, increasing heat waves, sea level rise and related coastal and soil erosion, flooding, and increased evaporation (which causes streams and rivers to dry up), are all evidence of climate change and variability in Imo State, Nigeria which is the study area of this research (Okorie *et al*., 2015). These conditions are serious, given that soil erosion, whether gullying or sheet erosion is already of catastrophic proportions in Imo State, with floods affecting many parts of the country each year, especially in the rainy season (Oladipo, 2010). It is estimated that there are about 600 gully erosion sites in Abia, Anambra, and Imo states all in the southeastern part of Nigeria (Oladipo, 2010). For example, the massive landslide in Anambra which is one of the southeastern states is evidence of potential climate-induced changes in erosion frequency. Soil

erosion has become so severe in Imo State that infrastructure and farmlands are frequently damaged as a result of heavy rains.

On the one hand, increasing climate risk awareness is critical for adaptation and decision-making processes (Eakin and Patt, 2011); on the other hand, perception of risk is a critical component of climate risk management, and understanding risk perception is critical for implementing appropriate measures for disaster risk reduction (Rana *et al*., 2020). As risk perception and awareness improve, communities are expected to raise their capacity to adapt by implementing climate change adaptation and disaster preparedness measures (Ndah and Odihi, 2017a; Tauzer *et al.,* 2019; Rana *et al.,* 2020; Bajracharya *et al*., 2021). However, Ozor *et al*. (2012) reported that 84% of farmers in southern Nigeria are aware of climate change as a result of efforts by relevant climate change actors. This may not necessarily translate to better climate change adaptation behaviour.

Climate risks in Africa are perceived differently by different communities. For example, in Gladstone, South Africa, farmers' perceptions of climate risk and adaptation strategies are determined by socio-economic and political factors like poverty and marginalization (Gandure *et al.,* 2013). Extreme climate events may vary in form and pattern in the future, requiring a community to engage in coordinated preparedness to resist climate change threats such as floods and droughts (Ebi and Bowen, 2016). It is crucial to understand that climate risk perception, awareness, and preparation are intertwined and complement each other because a community can readily prepare for devastating climate disasters if they have a proper collective understanding of the risks. However, research on the vulnerability of some human settlements to flood risk in southern Nigeria discovered that families' flood awareness and past flood experience have a significant association, but risk awareness and preparedness do not (Salami *et al*., 2017). This study will therefore unravel the connection between community risk awareness, perception and preparedness.

It is crucial to understand that preparing for future climate extreme events entails making adequate provisions that will sustain households, and prevent losses and damages during and after the occurrence. These actions may be coordinated in a community with developed social capital, to reduce the social vulnerability of households to climate risks.

2.3 Climate Risks in Developing Countries

Many developing countries have already witnessed more frequent or intense weather events like floods, droughts, heat waves, and tropical cyclones than in the past, and the resultant impact points to future climatic changes and effects on the environment, production systems, and incomes (Saito *et al.*, 2017; Bacha *et al.*, 2018, 2021). Over the previous 100 years, average global surface temperatures have increased by 0.74°C. Most of the heating (0.55^{o}C) has occurred in the last 30 years (Mertz *et al*., 2009; Oladipo, 2010; Dumenu and Obeng, 2016; Gyimah *et al.*, 2020).

Large sections of Africa, Asia, and Latin America have seen temperature increases in the range of 0.5 to 1.0^{o}C over the last 30 years, however, certain locations have seen bigger shifts (e.g., southeastern Brazil and North Asia) (Bacha *et al.*, 2018). Surface air temperatures over land have risen at almost double the pace of temperatures over the ocean, implying that small island states (e.g. in the Pacific) have seen less warming (Mertz *et al*., 2009).

Since the 1970s, precipitation has been decreasing across the tropics between 10^{o}S and 30^{o}N (Titley *et al.*, 2021). Eastern sections of South America and northern and central Asia have been wetter, whereas the Sahel, southern Africa, and parts of southern Asia have become drier. Since the 1970s, more intense and longer droughts have been seen throughout larger areas, primarily in the dry tropics and subtropics. Since the mid-1970s, global assessments of tropical cyclone potential destructiveness have shown a considerably increased trend, with a trend toward longer storm lifetimes and greater storm intensity (Kilavi *et al*., 2018; Leaman *et al*., 2021). Higher tropical sea surface temperatures are significantly linked to this. Even though these findings are dependent on data quality and the start date is chosen, the evidence available suggests that the potential for destruction has never been as strong as it is now (Kilavi *et al.*, 2018; Leaman *et al*., 2021).

Enhanced glacier melt altering river flows, as well as changes in phenology and productivity of biological systems as a result of temperature and rainfall variations, have had particularly large consequences in developing countries (Ebi and Bowen, 2016; Silver *et al.*, 2019; Perez *et al*., 2020). Climate change and technological advancements both influence agricultural land use and management in agricultural systems, although the consequences of climate change on agriculture may be more visible in many

developing nations with traditional land management (Ozor *et al*., 2012; Umoh, 2013; Kuchimanchi *et al.,* 2019).

Throughout the continent and in all seasons, Africa is expected to warm faster than the global annual mean. The tropics will warm more than the dry subtropical regions (Munsamy, 2019). In parts of Mediterranean Africa, northern Sahara, and southern Africa, yearly rainfall is expected to decline (Matewos, 2020). The average annual rainfall in eastern Africa is expected to rise, whereas rainfall forecasts for the Sahel, the Guinean Coast, and the southern Sahara are questionable.

The Inter-governmental Panel for Climate Change (IPCC, 2021) reports have underlined Africa's vulnerability to climatic unpredictability and change. Even though they are the least responsible for these changes, they are more vulnerable to their effects since their economies are heavily reliant on climate-sensitive natural resources, and they have fewer resources and options to address the effects of climate variability and change. Millions of people may suffer disasters and extreme weather events which will likely become more intense and frequent as global temperatures rise, disrupting crops, water supply, and the spread of diseases, among other things. Climate variability and change are expected to affect between 75 and 250 million people in Africa by 2020 (IPCC, 2021). This will hurt people's livelihoods. However, this number is increasing with devastating floods in Nigeria and other parts of Africa.

Through rigorous analysis of meteorological data, the climate of Nigeria has revealed significant temporal and regional shifts in variability and change from the late 1960s and early 1970s (Federal Republic of Nigeria, 2003; Nigerian Meteorological Agency, 2012). Droughts, floods, ocean surges, and other extreme weather and climatic phenomena have become more common in Nigeria. Although the effects of these disasters are gradual, their destruction of life and property has negative economic impacts. Floods have become nearly an annual occurrence in many sections of the country, with rising severity each year, resulting in massive losses and distress (Nigerian Meteorological Agency, 2012).

Previous studies have shown that climate change affects different locations and surroundings differently, thus people will be exposed to varying effects of climatic variability and change depending on where they reside. For example, a study of the Sudano-Sahelian Ecological Zone of Nigeria's changing climatic scenarios using probabilistic analysis of rainfall data revealed that the frequency of drought increases

from 1949–1958 to the decade 1979–1988; after that, the zone experienced a dramatic decline in the frequency of hydrological drought occurrences to recent years (Abaje *et al.,* 2013).

Developing countries will be affected differently by climate change, not only due to disparities in expected changes of climate parameters but also due to variations in vulnerabilities and adaptation capacity among nations and regions. Sub-Saharan Africa is extremely vulnerable to climate change and other stressors, some of the countries identified as highly or moderately vulnerable to climate-related mortality (Brooks *et al.,* 2005). Sub-Saharan African countries also score in the bottom percentile in terms of their ability to adapt to climate change.

2.4 Climate Change Vulnerability in Nigeria

Increases in temperature, unpredictable rainfall, rising sea levels, flooding, drought and desertification, land degradation, more frequent extreme weather events, impacted freshwater resources, and biodiversity loss is all signs that Nigeria's climate is changing (Haider, 2019). Rainfall duration and intensity have increased, resulting in major runoffs and flooding in many parts of Nigeria, and rainfall variability is expected to continue (Haider, 2019). Precipitation is projected to increase in southern areas, and increasing sea levels are expected to worsen flooding and coastal land submersion (Akande *et al.*, 2017). Droughts have become a regular occurrence in Nigeria, and they are predicted to persist in Northern Nigeria due to a decrease in precipitation and temperature rise (Olapido, 2010).

Climate change, in general, poses a substantial challenge to achieving the Sustainable Development Goals, particularly those connected to poverty alleviation and environmental sustainability (Oladipo, 2010). Climate change would exacerbate vulnerability and impede or halt developmental growth (Martins and Gasalla, 2020). Agriculture and food security, water resources, public health, and habitat are the sectors in Nigeria that are most vulnerable to climate change. Coastal regions (including deltas, particularly those impacted by storms and storm-induced floods) and erosion-prone areas in the southeastern and northern parts of the country are vulnerable (Oladipo, 2010). Farmers, fishermen (especially those who live in susceptible locations), the elderly, women, children, and poor people living in rural areas are all members of the vulnerable population (Oladipo, 2010). Sea level rise may contribute to growing coastal inundation and flooding of low-lying places (Salami *et al*., 2017; Chikwue *et al*.,

2021). Unfortunately, many Nigerian states lack the infrastructure needed to appropriately respond to such catastrophes.

Climate change has direct effects on biodiversity, ranging from biomes to species, and these effects differ by region. While certain species, such as grasshoppers and other pests, may expand in quantity or range, climate change exacerbates the danger of extinction for many endemic species and results in biodiversity loss (Oladipo, 2010). Although Nigeria became a party and committed itself to the three core objectives of the Convention on Biological Diversity (CBD) in 1994: the conservation of biological diversity; the sustainable use of biodiversity components; and the equitable use and sharing of benefits from genetic resources in Nigeria (Federal Ministry of Environment, 2015). Through Nigeria's commitment to CBD, the country prepared a National Biodiversity Strategy and Action Plan (NBSAP) that has suffered poor implementation, resulting to poor management of the country's biodiversity (Federal Ministry of Environment, 2015).

Changing rainfall patterns wreak havoc on the rain-fed agriculture that feeds so much of Nigeria's population. Water supplies are also affected, notably through variations in temperature and rainfall (Oladipo, 2010). All sectors of Nigeria's socioeconomic development, including natural ecosystems, are vulnerable to climate change, using the scenario analysis for temperature and rainfall for the vegetation zones of Nigeria, which was extensively discussed in the First Communication of Nigeria to the United Nations Framework on Climate Change Convention reported in 2003 (UNFCCC). Evidence of Nigeria's vulnerability to climate change was also revealed in a recent document by HBS Nigeria (2009).

2.5 Disaster Risk Management

Disasters from climate change are becoming more complex, with societal and environmental consequences growing increasingly interwoven (Ezemonye and Emeribe, 2014; Wijaya, 2018; Aznar-Crespo *et al.,* 2021; Chowdhury *et al.,* 2021). Disaster Risk Reduction (DRR) is a systematic mechanism for reducing disaster risks by analyzing and managing disaster causative elements, such as vulnerability reduction and increased preparedness for harmful climate events (Djalante and Lassa, 2019). It is a comprehensive approach to long-term community development that integrates disaster preparedness and mitigation efforts (Cuthbertson *et al.,* 2019).

Disasters associated with climate change are socially influenced phenomena, which is the outcome of a natural disaster's influence on individuals or societies who are susceptible to climate change due to social, economic, and political factors (Ndah and Odihi, 2017a; Diana *et al.*, 2021; Mason *et al.*, 2021; Nikkanen *et al.*, 2021). As a result, resilience and, more recently, adaptation to climate change, should be socially mediated.

2.5.1 Disaster risk reduction

There are structural and nonstructural actions that can be implemented to prevent or lessen the effects of floods and droughts as climate-induced disasters. To lessen the impact of floods, common structural methods such as retention ponds, dams, river improvement, urban drainage systems, and levees or dikes are used to reduce peak stage, and retain floodwater (Kita, 2017). Early flood warning, flood emergency preparation and response, and environmental education are examples of nonstructural approaches (Kita, 2017; Bajracharya *et al.*, 2021). Structural measures are technical structures designed to limit or eliminate flood volume. Some studies such as Kreibich et al. (2015), Kita (2017), Ndah and Odihi (2017) and Bajracharya et al. (2021) believe that structural solutions are essential for resolving most flood problems, although they are both costly and ineffective at resolving the most complex issues. Nonstructural measures such as acts, laws, standards, and programs are used to prevent and decrease damage. Structural strategies decrease flood damage more effectively than nonstructural strategies. However, the advantages of these procedures based on avoided damages must be weighed against their costs. For further evaluation, it is crucial to do a cost-benefit analysis. Examples of disaster risk reduction strategies are;

Nonstructural methods are more proactive and easier for the public to use and understand. Nonstructural initiatives, on the other hand, are generally inexpensive, take little ability to execute, and are an excellent complement to structural measures (Kita, 2017; Ndah and Odihi, 2017). Prevention, readiness, and emergency response, as well as recovery and rehabilitation, are all part of a normal disaster-reduction cycle. Flood disaster prevention, for example, may begin with the development of a monitoring network, which would then provide forecast and warning information to decision-makers, allowing them to take appropriate response actions (Adnan and Kreibich, 2016; Ndah and Odihi, 2017).

2.5.2 Integration of climate change adaptation in disaster risk reduction

Climate change exacerbates some of the risks that influence social systems globally, weakening resilience in the face of uncertainty and disasters. It also contributes to more intense weather and exacerbates their negative consequences. Climate change is only one factor impacting particular hazards; it can play a role in disasters where susceptibility and exposure exist, but it is not always the most important component (Forino *et al*., 2015). Globalization, social and socio-economic injustice, a lack of livelihood prospects, depletion of resources, and epidemics are all non-climatic elements that merge to disproportionately harm individuals with little resources to deal with climate change-related difficulties (Forino *et al.,* 2015). Given that disaster initiatives completely encompass climate change and associated processes, climate change adaptation (CCA) can be considered as a subset of disaster risk reduction (DRR).

CCA and DRR both aim to: (1) manage hydro-meteorological hazards by reducing vulnerability and exposure, increasing resilience, transferring and sharing risks (IPCC, 2021); (2) mitigate the severity of climate-related crises and potential consequences; and (3) encourage preemptive, comprehensive, and long-term strategies to disaster management. International organizations have worked to encourage the merging of CCA and DRR. The Hyogo Framework for Action 2005–2015 (HFA) was adopted at the World Conference on Disaster Reduction (WCDR) (UNISDR, 2005) in 2005, which asks for multidisciplinary and future-oriented approaches to disaster risk reduction when considering climate change. The Bali Action Plan, adopted by the United Nations Framework Convention on Climate Change (UNFCCC, 2007), stresses the importance of utilizing DRR solutions for extreme weather events. In the framework of poverty reduction and development, UNISDR (2009) also proposed a functional relationship between CCA and DRR.

Current principles for CCA and DRR integration are presented in IPCC publications (IPCC, 2021). The Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR) updated the HFA and established a voluntary path for future DRR plans (UNISDR, 2015). Nigeria signed the Sendai Framework in 2015 and 9 years after, disasters of various magnitudes have plagued the country resulting to different scales of injuries, damages, and losses to vulnerable persons because Nigeria places more emphasis on disaster responses than on risk prevention and mitigation (Olasunkanmi, 2021). As new hazards and correlations emerge, climate change-related risk reduction necessitates unique approaches to sustainable development

that view complex connections between climate, political, social, and ecological systems as a process rather than an outcome (UNDRR, 2019). To achieve the aims of sustainable development, these approaches should incorporate current and growing understandings of climate change implications, as well as conventional and alternative growth trajectories (IPCC, 2014).

Climate change manifests itself most visibly through shifting weather extremes, and as a result, disaster risk reduction and adaptation are now widely acknowledged as critical for long-term development (IPCC, 2021). Climate change is expected to result in more frequent and intense climate and weather extremes, as well as higher damage to human and environmental systems as a result of increased exposure (Birkmann, 2011; Dumenu and Obeng, 2016; Kais and Islam, 2016; Chowdhury *et al.*, 2021). Therefore, climate change adaptation and disaster risk reduction have been presented as two distinct but related concerns with communities of practice dedicated to common objectives of increasing the resilience and adaptive capacity of rural residents (Nalau *et al*., 2016). DRR agencies and policies were created to respond quickly but not for long-term strategic planning (Nalau *et al.,* 2016). Climate change adaptation, on the other hand, arose from science and forecasts of probable climate change consequences.

This integration of DRR and CCA is considered desirable in contemporary academic and policy debates because it may deliver dividends at all levels by reducing vulnerability and focusing on a multi-hazard strategy (Forino *et al*., 2015). By combining DRR with CCA, practical benefits such as improved access to a broader range of knowledge, increased use of expanding international funds for adaptation, and the incorporation of a more forward-thinking approach in DRR by addressing longer timescales can be realized. The majority of disaster risk management measures, frameworks, and institutional structures are well-established and hence may serve as a reference for incorporating and managing climate change adaptation (Forino *et al*., 2018).

Several integration barriers and facilitators have been discovered, which are used to explain why the integration agenda is not moving forward and what can be done to help. However, several scholars have questioned whether the distinctions between the CCA and DRR communities are more philosophical than pragmatic. This is because different and overlapping frameworks, financing sources, and activities have resulted in the formation of separate work streams with little collaboration between agencies and departments, a lack of capacity and experience to successfully implement the work streams, and a lack

of rigorous Monitoring and Evaluation methods to record the advantages deriving from both CCA and DRR operations, to name a few common restrictions (Costa, 2020). The DRR's continual focus on current disasters, where CCA may not be prioritized due to its focus on long-term strategic planning, is a significant impediment. Better weather and climate information, increased synergies between sectors and agencies, enhanced access to finance, and linking CCA and DRR initiatives with the larger development agenda are all enabling factors for integration. Finding appropriate entry points is particularly critical for integration because CCA and DRR are important to a wide range of challenges, including food security and water management.

2.6 Social Vulnerability

The degree to which a system is sensitive to, or unable to cope with the detrimental consequences of climate change, particularly climatic variability and extremes, is referred to as vulnerability. It is determined by exposure, sensitivity, and adaptive ability (IPCC, 2007; Adger, 2003). The Intergovernmental Panel on Climate Change (IPCC) describes vulnerability as "the degree to which a system, including climate instability and extremes, is vulnerable to or incapable of dealing with adverse effects of climate change" (IPCC, 2014). Vulnerability can have some effect on physical and socio-economic characteristics that are not static. This implies that vulnerability is unique to those evaluating it in a place, context, time, and perspective. Vulnerability is a fluid concept that changes throughout time and space. Socio-economic, regional, demographic, cultural, political, and environmental factors all play a role (Kita, 2017; Salami *et al.,* 2017; Jamshed *et al.,* 2021). Individuals and groups are vulnerable in diverse ways due to disparities in wealth and education, disability, health, gender, age, class, and other social and cultural factors (IPCC, 2012).

Vulnerability may be divided into two categories: physical and social. Vulnerability as a physical concept focuses on exposure and is a measure of natural hazards or environmental stress factors (Babcicky and Seebauer, 2021). Social theories of vulnerability place a premium on system capacity and call attention to socio-economic aspects that define vulnerability (Adger *et al.,* 2003; Ndah and Odihi, 2017; Müller *et al*., 2019; Tauzer *et al*., 2019). Social vulnerability is similar to system capacity and is mostly influenced by socioeconomic characteristics such as distribution of income, wealth, culture, sexuality, impoverishment, and means of livelihood (Mabuku *et al.,* 2018).

2.6.1 Social vulnerability of rural communities

Vulnerability in the first case refers to both susceptibility and adaptive capacity (IPCC, 2015). Social vulnerability is a result of social inequalities, marginalization, and poverty which are the social elements that impact or shape a group/community's susceptibility to harm as well as their capacity to adapt (Cutter *et al*., 2003). Individual/community status, economic assets, and political status are frequently used to describe social vulnerability such as age, race, health, income, type of dwelling unit, and employment status (Cutter *et al*., 2003).

The extent to which the loss, injury, or damage caused by the effects of a climatic risk affects a population, physical infrastructure, economic assets, and social well-being is referred to as social vulnerability (Ekanem and Umoh, 2021). The characteristics of social relationships, organizations and institutions, and cultural values all have a role in these outcomes. The term "social vulnerability" refers to the combination of demographic, social, economic, political, and cultural elements that exacerbate the impact of climatic hazards on rural residents. Rural residents most commonly vary in terms of education, gender, income, health status, access to credit and information technology, formal and informal (social) capital, political influence, and so on; these variables also cause differences in their degrees of vulnerability. Since less educated persons are likely to come from poor backgrounds (households) who earn lower incomes, they may be more vulnerable during climate related disasters. Akpe and Solomon (2017) argued that inequality, uneven access to resources, poverty, inadequate infrastructure, lack of representation, and insufficiency of social security, early warning, and planning all contribute to the capacity of individuals or communities to handle stress and therefore increase the vulnerability of rural residents. Because of the socio-economic framework, damages caused by climate events are of different scales. Akpe and Solomon (2017) further reported that the poor frequently live in flood and drought-prone urban and rural environments; they lack insurance to help them recover from losses; and they have little power to demand that governments offer protective infrastructure, interim relief, or reconstruction assistance. This explains why, depending on their characteristics, a socioeconomic variable is utilized to determine an individual's adaptive potential.

The lack of some basic and essential requirements for survival will expose communities to climate change and therefore, render them socially vulnerable. In addition, marginalization which entails a community's social, political, economic, and legal disadvantage also intensifies social vulnerability

(Gibb, 2018). For example, political marginalization may intensify societal vulnerability where rural communities will be deprived of essential infrastructure capable of improving their social resilience to climate change. Therefore, it is pertinent to address people's marginalization in rural communities while formulating adaptation strategies.

Due to low adaptive capacity and heavy reliance on climate-sensitive economic activities such as agriculture, Africa is among the most vulnerable continents to climate change in the world (Asrat and Simane, 2017). Certain social factors are likely to determine Africa's vulnerability to climate change in different geographical and socio-political contexts (Ayodotun *et al.,* 2019). For example, in Zimbabwe's Muzarabani district, social vulnerability is influenced by a variety of economic, social, and institutional factors that vary by location (Mavhura *et al.,* 2017). Similarly, parts of Africa, such as the Sudan and Guinea Savanna ecological zones, as well as Nigeria, are vulnerable to climate risks due to socio-economic factors such as high illiteracy, lack of alternative income sources, and little or no access to climate change information (Dumenu and Obeng, 2016). These social vulnerability variables may take the form of developmental characteristics such as poverty, poor health, economic disparity, and governance components (Brooks *et al.,* 2005; Mavhura *et al.,* 2017). Therefore, poverty, access to healthcare, income are among the fundamental indicators of social vulnerability, as opposed to specific determinants relevant to a specific context (Brooks *et al.,* 2005). Agriculture and food security, water resources, public health, and habitat are the sectors in Nigeria that are deemed most vulnerable to climate change (Oladipo, 2010).

In a typical African community, women, children, and the disabled are most vulnerable to climate change events (Forino *et al.,* 2015). Women's vulnerability is shaped by marginalization and limitations in accessing resources, education, healthcare, religion, and labour in particular circumstances, which leads to abuse, isolation, and inequality. However, women's abilities to manage climate change-related risks and dangers are becoming more widely recognized around the world. A study undertaken in Benue State of Nigeria concluded that female household heads are more vulnerable to climate change impacts because they are more exposed to extreme weather/climate events as a result of their engagement in climate sensitive occupations such as farming yet they have lower adaptive capacity (Onah *et al*., 2023). Children and youth are considered sensitive to climate change and related disaster risks (Forino *et al.,* 2015). Disabilities amongst rural residents are influenced directly or indirectly by changes in extreme events

and climate change-related impacts. Also, climate-related events can exacerbate existing disabilities (IPCC, 2012). This implies that persons with disabilities may report more injuries or damages to health during extreme weather/climate events.

A social group's vulnerability is essentially defined by its current state or condition (capacity) concerning a hazard event (climate change), which is facilitated by socio-economic, demographic, and institutional variables, among others (Dumenu and Obeng, 2016). As a result, societal vulnerability is critical in determining the magnitude of a climatic disaster's impact on a system or people (Dumenu and Obeng, 2016). In this study, social vulnerability to climate change is defined as the degree to which a system is vulnerable to the consequences of climate change due to the interaction of social, economic, and demographic element (Mavhura *et al.*, 2017; Tauzer *et al*., 2019; Muller *et al*., 2019; Martins and Gasalla, 2020) . These characteristics describe the current situation (capacity) of rural communities, which makes them vulnerable to the effects of climate change in rural communities of Imo state, Nigeria. This definition can be expressed as follows:

$$SV = f.\ [1/n\ (M_{DF}+M_{EF}+M_{SF})] \quad (2)$$

where, SV = social vulnerability, DF = demographic factors like age, gender, education, EF = economic factors like income SF = social factors like access to health, and n = number of social vulnerability factors.

Following this description, this study combines demographic, economic, and social aspects to measure societal vulnerability to climate change using a set of indicators that represent the vulnerability elements.

Social vulnerability is an area that is less explored in climate change studies probably due to the difficulties in identifying what it is and how it could be measured. However, examining the root causes of social vulnerability is a critical area of vulnerability research that has been overlooked and is taken into account in this study. Evaluating the interplay between societal and social vulnerability will also help to identify areas that need to be addressed by policymakers in rural communities.

2.6.2 Social vulnerability indices

It is critical to know what to measure in terms of social vulnerability. Over the years, a consensus has emerged on the primary factors that determine social vulnerability (Shiferaw *et al.,* 2014; Rufat *et al.,* 2015; Nkiaka *et al.,* 2019). Lack of resources; limited access to political power and representation; connectedness with supportive people; beliefs and customs; building stock and age; frail and physically limited individuals; and type and density of infrastructure, including energy supply and transportation routes, are among the most frequently mentioned factors. While there are a variety of approaches for assessing social vulnerability at various sizes and systems, the indicator-based approach has been widely used in many nations to address specific hazards (Bizimana *et al.,* 2015; Tesso *et al.,* 2015; Ncube *et al.,* 2018; Jamshed, 2020). Age, race, health, poverty, income, kind of dwelling unit, and job are all contributing social vulnerability factors.

There are ongoing debates about which indices of social vulnerability should be used. Siagian *et al*. (2014) used age, gender, income, education, family structure, infrastructure, and population growth as variables in their study on social vulnerability to natural hazards in Indonesia. Similarly, Bizimana *et al.* (2015) used population pressure, population movement, household size, livelihoods, poverty index, pregnancy, age, HIV and AIDS, malnutrition, education, housing condition, access to media, and access to health services in a study on assessing social vulnerability to malaria in Rwanda. The indicators used by Cutter *et al.* (2003) and Siagian *et al.* (2014) are useful in African social vulnerability studies.

Social vulnerability indices have become a major technique for quantifying and mapping human components of disaster risk over the last decade (Jamshed, 2020; Babcicky and Seebauer, 2021). Social vulnerability modeling research has evolved from a series of foundational studies to include concerns of magnitude, time change, specific disasters, unpredictability, validation, and integration with physical vulnerability (Rufat *et al.,* 2015). Despite these divergent trends, index construction methodologies for social vulnerability indices remain remarkably consistent (Rufat *et al.,* 2015). This uniformity shows a rising methodological agreement among modelers, but it also highlights the constraints of translating social vulnerability processes into composite indicators. If elements of social vulnerability relevant to specific hazards are removed, or if weakly influential factors are overrepresented, such uniformity may lead to incorrect conclusions. Better incorporating the context in which social vulnerability develops is one of the primary issues.

Context separates generalized conceptions of social vulnerability, such as those found in indicator research. Contextual factors interact to explain, underpin, enhance, and diminish vulnerable groups' exposure, susceptibility, and coping capacity (Rufat *et al.,* 2015). The disaster's geographic setting, pre-existing social, economic, and political conditions, hazard characteristics, degree of exposure, scales of impacts and reactions, and disaster phase are all part of the context (e.g., before, during, and after disaster events). Cultural and institutional norms, societal networks, governance, and historical processes are all relevant aspects to consider (Jamshed *et al*., 2020; Babcicky and Seebauer, 2021).

Despite their design and context flaws, quantitative indicators have numerous advantages for vulnerability reduction efforts. Quantifying social vulnerability can aid in determining which areas or people are most vulnerable and which aspects of social vulnerability are the most important drivers (Rufat *et al.,* 2015; Babcicky and Seebauer, 2021). Ideally-designed indicators are well suited for use in decision-making, resource allocation, and project prioritization because they can simplify multidimensional complexity into aggregate measures (Dumenu and Obeng, 2016; Martins and Gasalla, 2020).

The use of indicators also poses difficulties in verifying social vulnerability because there are limitations to quantifying social states that are not readily observable. The indicator approach may also fall short of fully capturing the vulnerability circumstances of a given location. Despite this difficulty, the indicator approach is suitable for comparing locations. The indicator technique provides a more accurate estimate of baseline vulnerability at the local level, which is critical for policymakers in disaster risk reduction (Mavhura *et al.,* 2017). This should help to accelerate efforts in eliminating the socio-economic inequities that cause vulnerability.

2.6.3 The interplay between societal and social vulnerabilities

The degree to which societies and communities are affected by climate change is largely determined by their vulnerability. Climate change vulnerability is a complex and ever-changing phenomenon that arises from the interplay of historical and modern marginalization processes in politics, socio-economic circumstances, and culture (Mavhura and Andrew, 2017; Pongponrat *et al.,* 2018). Inequality-ridden societies are less able to withstand the effects of climate change since inequality among rural residents

encourages social vulnerability. For instance, households headed by women, with low incomes, and who are younger are at higher risk during climate-related disasters (IPCC, 2022).

Societal vulnerability is concerned with the weaknesses of communities, government structures, infrastructure, agencies, governance frameworks, and policies (Table 2.1) that reduce the resilience of individuals and social organizations to climate disasters. Rural residents may be more vulnerable to extreme weather/climate events due to non-functional community institutions, inappropriate and poor implementation of government policies, and inadequate basic and social amenities in their localities. For example, government requests for assistance will be delayed, and aid may not always reach those who need it most, as a result of weak or corrupt institutions producing ineffective and inadequate responses to disaster situations (Akpe and Solomon, 2017). Social vulnerability refers to the susceptibility of individuals and social groups to the negative impacts of climate disasters due to their gender, age, disability, household size, income, and sources of livelihood (Adger *et al*., 2003; Frazier *et al.,* 2010; Martins and Gasalla, 2020). As a result, in addition to their traits like sex, age, income, household size, and sources of income (Table 2.1), rural residents' susceptibility to the effects of climate stressors is also influenced by societal vulnerabilities that are intrinsic to them and their communities.

Lowering social vulnerability also involves improving societal resilience by empowering individuals to influence social decisions that support equitable, gender-neutral, and climate-resilient developments through the growth of local democracy (Pongponrat *et al.,* 2018; Thomson *et al.,* 2018). To comprehend societal vulnerability, one must look at the material and financial aspects that affect how much a person, group, or system is at risk. This vulnerability is frequently expressed as a function of a system's exposure to, sensitivity to, and ability to adapt to a hazard (Frazier *et al*., 2010; Ekanem and Umoh, 2021). Therefore, it is necessary to review certain institutions and structures to help rural residents cope during and after climatic disasters to minimize the social vulnerability of rural areas. Less developed nations such as Nigeria experience an unequal distribution of adaptive capacity due to the political marginalization of poor people, leading to varying degrees of societal and social vulnerability in rural areas (e.g. Akpe and Solomon, 2017). It is crucial to improve health, education, and fundamental social services to raise population well-being, reduce societal vulnerability, and encourage climate-resilient development.

Table 2.1: The key contributors towards social and societal vulnerabilities

Social Vulnerability		**Societal Vulnerability**	
Factors	Indicators	Factors	Indicators
Socio-economic	Income, Sources of livelihood, access to healthcare	Infrastructure	Healthcare system, road networks/modes, evacuation shelters, educational facilities, water schemes, housing, electricity supply, sanitation, communication networks (Patnaik and Narayanan, 2009; Thomson *et al.*, 2018; Abrams *et al*., 2021)
Characteristics of individuals	Gender, Age, disability, education, household size	Political	Governance frameworks, agencies, policies, programs, decisions, marginalization (Chaffin *et al.,* 2016; Akpe and Solomon, 2017; Pongponrat *et al.*, 2018; Thomson *et al.*, 2018)
Community based	Land tenure	Cultural	Community structures, social networks, traditional knowledge (Cummins, 2016; Logan *et al.*, 2016)

Climate change vulnerability is shaped both by a result of governance processes and how governments and other organizations address social issues. The idea of governance encompasses "the relationships between government and society including the mechanisms by which private actors, markets, and interest-based networks affect policy decisions" (Chaffin *et al.*, 2016, p. 401).

Infrastructure systems including road/transportation networks, healthcare systems, electricity, water schemes, and schools are vital to people, the economy, and society in both urban and rural areas; their reliability and availability directly or indirectly affect achieving the Sustainable Development Goals (Patnaik and Narayanan, 2009; Abrams *et al*., 2021). Because infrastructure systems are interconnected, the effects of climate change, such as floods or severe storms that disrupt energy and transportation networks, can spread beyond the boundaries of the hazard footprint, resulting in larger impacts and widespread disruptions such as the destruction of infrastructure for everyday living like roads, services, telecommunication networks, water systems, electricity supply, and sanitation. In their examination of India's Eastern Coastal Districts, Patnaik and Narayanan (2009) found that the most vulnerable areas are

also the clusters of districts with poor population development and infrastructure. They concluded that any extreme event will probably have a more disastrous effect on the residents in these districts. Similarly, Abrams *et al.* (2021) concluded that inadequate transport infrastructure in rural areas of South Africa heightens the risks associated with flooding since highways leading to essential supplies are vulnerable to damage.

Resource availability such as water, energy, minerals, forest resources, or the capability to profit from human and natural resources, can exacerbate societal vulnerability through varying exposure, sensitivity, and capacity for adaptation. Disaster warning systems, emergency response, private capital, liquid assets, insurance, food stores, support for migrants, resilient infrastructure, transportation, and information and communication networks are a few of these resources (Thomas *et al.,* 2018). Marginalized and impoverished communities find it difficult to negotiate the complex social relationships and power structures necessary to gain access to these resources (Thomas *et al.,* 2018). Even in the wealthiest nations, disparities in resource availability exist between different areas and even within the same communities and neighborhoods. Similar, disparities also exist in adaptive capacity: some communities bounce back from hurricanes and floods faster than others (Logan *et al.,* 2016) implying that rural communities having high societal vulnerability are likely to experience slower recovery from climate-induced disasters. A person's access to resources is influenced by both their position in the social group and the resources that are available in their immediate localities (Cummins, 2016). Sharing resources with relatives (kin) is more common than it is with non-relatives (non-kin). Additionally, they are more inclined to reciprocate resource sharing (reciprocal altruism) with unrelated parties if those parties have previously shared resources with them (Cummins, 2016).

People suffer social discrimination based on mutually exclusive, ordered groupings known as castes in several countries such as Nigeria. These social categories, though rarely officially acknowledged, can nevertheless have a significant impact on people's exposure to the effects of climate change as well as their access to resources like food, water, land, education, and government services, such as disaster relief (Mustafa *et al.*, 2010; Ray-Bennett, 2009). Caste could disrupt societal networks by making rural residents lose ties with relatives and social groups severing associations with certain members which may deprive the affected individuals of access to support systems during climate-induced disasters. For example, in southeastern Nigeria, caste is practiced and the outcasts are referred to as "Osu" which

disqualifies them from participating in any social gathering (Ugobude, 2018). This implies that such persons may have lower resilience to climate change since they cannot access support from other members of the community during climate disasters due to their social status.

One important element influencing vulnerability to climate-related effects is gender. Women's susceptibility is increased and their capacity to deal with the aftermath of disasters is weakened by elements like a lack of privileges, control, and access to basic resources (Denton, 2002; Sultana, 2014). Al Nahian *et al.* (2013) conducted a study in coastal Bangladesh that looked at the immediate effects of cyclone Aila in 2009 in addition to more slow and long-term changes like working the fields in increasing heat, getting water from wells contaminated with seawater, and fixing infrastructure damaged by frequent tidal flooding. These circumstances made it harder for women to obtain resources daily, which in turn led to a rise in hunger. When women are unable to flee rising floodwaters because of cultural and religious prohibitions against traveling alone without male guardians, this may be the most dramatic illustration of women's acute social vulnerability (Sultana, 2014).

Disasters caused by climate change frequently combined with low adaptive capacity (the ability to cope on an everyday basis with climate variability) cause the highest losses to befall the poor and developing countries (Roberts and Parks, 2006). Poverty has a complex impact on vulnerability by affecting access to resources (Thomas *et al.,* 2018). A multitude of groups may experience a mix of inadequate institutional, political, and economic resources. For instance, creating disaster or emergency plans, gathering supplies, getting insurance, and gathering information are all standard components of disaster preparedness. Poor households and communities often find it more difficult to prepare for climate hazards because they lack the necessary resources and understanding about how to obtain them, as well as the necessary time, money, and language skills (Thomas *et al.,* 2018; IPCC, 2022). These families are vulnerable because they lack the resources to prepare for the effects of climate change and the institutional capability to guarantee that resources for disaster preparation are available in a way that will be helpful to them. Poor localities are less resilient to the effects of climate change since climate risks are frequently greater in less attractive and less expensive housing areas, such as floodplains and on unstable slopes.

2.7 Societal/Community Resilience

The ability of dynamic systems to withstand external stressors without changing their function is referred to as resilience (Borsekova *et al.,* 2018). Resilience also refers to the ability of an actor to formulate and implement climate change adaptation strategies and functional mechanisms in reaction to external perturbations that reduce shocks' long-term effects and may result in the recovery of the original balance or the realization of a new stable state (Borsekova *et al.,* 2018). Similarly, societal/community resilience is the capacity of a group or community to deal with external stressors and disruptions produced by social, political, and environmental changes (Deshingkar, 2012). Community/societal resilience is therefore defined in the context of this study as a community's endowments such as social capital, physical infrastructure, and culturally established patterns of interdependence that allow it to recover from drastic change, maintain adaptation, and promote new growth that incorporates knowledge gained in response to stressors including weather and climate extreme events (Furlow *et al.,* 2011; Ungar, 2011; Kais and Islam, 2016).

Resilience improves a community's ability to prepare for, withstand, recuperate from, and react to current or anticipated adverse occurrences in a timely and effective manner, including the restoration and improvement of essential operations and structure (Cutter *et al*., 2014). This is why, rather than just relying on government actors, an emphasis is placed on creating robust resilience through community collaborative activities. For African rural communities to resist the impacts of climate change, they must strengthen and improve their resilience (Mikulewicz and Taylor, 2020). Enhancing resilience among African communities will lower their levels of vulnerability to climate risks.

Enhancing resilience entails improving a system's ability to predict, tolerate, or recoup from a shock and effectively adapt to such conditions to make the system better and more secure in the future (Mehryar and Surminski, 2021; Wijsman *et al.,* 2021). At a societal level, this includes principles of social justice, fairness, and resource access to avoid favoring a particular group, sector, or institution over another (Cutter *et al.,* 2014). With this, marginalization will be reduced, and African rural communities especially in Nigeria will be less vulnerable to climate risks.

The term "societal resistance" employed in this study refers to a social system's ability to effectively avoid crossing into an undesirable system regime, or succeed in crossing back to a desirable one after a

climate disaster. This contrasts with "transformative resilience," which describes a social system's ability to "build a fundamentally new system" in the wake of a climate disaster. A social system with adaptive resilience will typically recover from a disaster in a state of equilibrium that is similar to the one that existed before the disaster, though not the same because a resilient system will change to reduce future risk, whereas a social system with transformative resilience will fundamentally alter its pre-disaster social system to achieve a new state.

The body of research on social resilience to disaster is extensive and expanding. The idea that the capacity to absorb shocks should be viewed through the perspective of organisms functioning within a complex adaptive system is the foundation of the concept of resilience (e.g. Meerow *et al.*, 2016). Holling first articulated the fundamental notions of resilience in a pivotal study in 1973, and during the subsequent years, Holling's concepts have expanded into an active but incredibly diverse set of specific theories regarding resilience (Folke, 2006). The research on social resilience to climate-related disasters has increasingly focused on two key topics. The first is the significance of vulnerability, which states that societies frequently construct institutions (both social and physical) that amplify the effects of disasters and hence contribute to the impact of a climate-related disaster (Comfort *et al.* 2010; Tierney, 2014). The second is that less rigid social structures have lower adaptive capacity than more flexible social structures (Aldrich, 2012). Both of these concepts imply that the secret to social resilience to climate-related disasters is flexibility or freedom to adjust.

Gelfand *et al.* (2011), on the other hand, advanced the theory that communities experiencing frequent natural disasters and hazards (conflict, pandemic disease, and disasters connected to climate change) will tend to acquire strong social norms and lack of willingness to accept variation. They contend that strong social norms give society the chance to coordinate more effectively to deal with disasters (Gelfand *et al.* 2011).

2.8 Adaptive Capacity

Adaptive capacity is the ability of a system to adapt to climate change or alter to best meet climatic conditions (Abaje *et al.*, 2015). In the context of climate change adaptation, the definition of adaptive capacity has evolved throughout time. Adaptive capacity was defined in the IPCC Fourth Assessment Report (AR4) as a system's ability to react to climate change (including climate variability and extremes)

to mitigate possible harms, take advantage of opportunities, or cope with the consequences (IPCC, 2007). 'Adjustments' are defined as responses to variability and extremes in this IPCC report, and the 'capacity to make adjustments' is related to a broad entity known as a 'system.' Adaptive capacity, on the other hand, is defined as "the ability of systems, organizations, humans, and other species to adjust to possible damage, to take advantage of opportunities, or to respond to consequence" (IPCC, 2014, p 118). The IPCC 5th Assessment Report (AR5) included 'gradual changes' as well as 'climate change-induced variability' and 'extremes' as triggers for adjustment processes. Furthermore, the AR5 adjustment processes included responses from humans, institutions, and any other living organisms to the consequences of climate change and weather/climate extreme events. Furthermore, the AR5 indicates that 'climate change consequences' are substituted with possible damages, which are dependent on the adaptive capability and adaptive response types. In climate change adaptation and development discourse, the framing of adaptive capacity has changed in connection to the stimuli, impacts, and ability to adjust. In addition, climate change adaptive capacity refers to the ability of individuals, households, or societies to respond to climate change, limit possible alterations, seize opportunities, or cope with the implications (Abaje, 2017). It is contingent on having adequate education, assets, information, and income (Madu, 2016).

A system's adaptive capacity is determined by some factors that are neither independent nor mutually exclusive, but rather the outcome of a combination of them (Abdul-Razak and Kruise, 2017). However, vulnerability research has influenced many of its present determinants. Adger et al. (2007) identified two aspects of adaptation capacity in IPCC's AR4, namely the general and impact-specific dimensions. While the adaptive capacity examines the system's ability to respond to a broad range of climate change stimuli, the impact-specific dimension, as the name implies, examines the system's ability to respond to a specific climate change stimulus.

Factors that influence a system's functioning determine the system's adaptive capacity. Economic development, education, technology, knowledge, infrastructure, institutions, equity, and social capital have all been recognized as factors of adaptive capacity in certain research (Brooks *et al.*, 2005, 2005; Tesso *et al.*, 2012). Some determinants of adaptive capacity are scale-specific, and at the local level, factors such as managerial ability, access to financial, technological, and information resources,

infrastructure, the institutional environment in which adaptations occur, political influence, social capital, and social networks all influence the capacity to adapt (Abdul-Razak and Kruise, 2017).

Understanding a community's adaptability to climate change is crucial for efficient adaptation planning (Chepkoech *et al.,* 2020). As a result, boosting adaptive capacity decreases the susceptibility of a community, or household to adverse climatic conditions (Abaje *et al*., 2015). Livelihood assets, which comprise funds, physical, natural, social, and human capital, influence the ability of communities to respond and reduce risks associated with climate change (Abaje *et al*., 2015; Abdul-Razak and Kruse, 2017). Adaptive capacity, on the other hand, varies throughout countries, states, communities, homes, and households, as well as within social groups and people across time (Abaje *et al.,* 2015).

Poor communities are more susceptible to climate risks, particularly when they are located in high-risk regions, since they have lesser adaptation ability and rely primarily on the natural environment, which is climate-sensitive, for their livelihoods (Abaje *et al.,* 2015). It has been discovered in Nigeria, for example, that adaptive capacity to climate change decreases with community sensitivity to climate change, implying that communities with higher reliance on rain-fed agriculture will have lower adaptive capacity (Abaje *et al.,* 2015; Abdul-Razak and Kruise, 2017). According to research conducted in Kenya, farming communities had higher access to social capital but limited access to funding, and natural, and human capital (Kepchoek *et al.,* 2020). This means that their adaptive capacity is low, suggesting that these persons may improve their adaptive capacity by using their access to social capital.

When evaluating farmers' adaptive capacity, it is social capital that often determines their ability to acquire workers. This is directly related to the farmers' ability to cope with or adapt to the effects of climate change (Yaro *et al.,* 2015). Regional, local, and sector-specific indicators are utilized to assess adaptation capability (Abdul-Razak and Kruise, 2017). As a result, it is vital to create and mimic such indicators in other spatial contexts, and they must be tailored to local environmental and societal contexts.

Countries in sub-Saharan Africa are among the most vulnerable to climate change due to their low adaptative capacities (Abdul-Razak and Kruse, 2017). Therefore, improving adaptative capacity in this region will enhance their resilience and in turn reduce their vulnerability to weather/climate events. In

Nigeria and other African countries, the adaptive capacity of vulnerable individuals, and communities to climate change impact is dependent on the following;

i. **Knowledge and abilities:** Nigeria and other developing countries lack adequate awareness, understanding, and access to information – of what climate change is, how it affects them, and how they may adapt to incorporate climate change adaptation into every element of national life. Individuals and community members are not well-trained with specialized skills to confront climate change threats. Many people, particularly the most vulnerable, have limited access to information and ability to share knowledge (Abaje, 2017). Nigeria has failed to recognize and implement education as an effective counter-strategy to climate change impacts (Amanchukwu *et al*., 2015). Nigerian children and teens have not yet been effectively taught about these topics, and as a result, they lack sufficient knowledge of how to deal with climate change-related events (Amanchukwu *et al.,* 2015; Duru and Emetumah, 2016). For better adaptability, climate change must be included and integrated into Nigerian educational curricula as well as university courses. Inadequate teacher qualifications and infrastructure are among the issues in the education sector (Amanchukwu *et al.,* 2015). Climate change poems, social media and interactive blogs are examples of effective unconventional teaching and awareness-raising strategies (Amanchukwu *et al.,* 2015).

ii. **Information and public awareness:** The amount, quality, understanding, and knowledge of information available has an impact on people's understanding of climate change issues (Duru and Emetumah, 2016). Farmers, households, and communities can create and change coping or adaptation methods with access to specialized weather information, early warning, and forecast technologies.

iii. **Advancements through agricultural extension programs:** Farmers' production, productivity, resource efficiency, and profitability improve as their engagement with agricultural extension workers and services increases (Zamasiya *et al.,* 2017; Nkiaka *et al*., 2019). Farmers who have better access to climate change knowledge through extension services are more likely to employ adaptation strategies. However, recognition of the need for agricultural extension services has not been matched with extension professional competence. To act as educators and information/service providers, they must be trained (Dimelu *et al*., 2014).

iv. **Indigenous knowledge:** The importance of indigenous knowledge and its value for environmental management and sustainable development is becoming more widely recognized. Adaptive agricultural systems, for example, contain a significant amount of indigenous knowledge (Federal Ministry of Environment, 2014). Indigenous knowledge must be documented to prevent its extinction (Dimelu *et al.,* 2014). It should also be incorporated into agricultural education and extension curricula, as well as climate change policy recommendations.

v. **Institutional capacity:** Nigeria's government and other agencies have made insufficient attempts to increase climate change adaptation capacity in the country (Abaje, 2017). All institutional stakeholders involved in climate change adaptation in Nigeria would require institutional capacity building (Abaje, 2017). The Federal Ministry of Environment's Special Climate Change Unit, National Emergency Management Agency, Nigerian Meteorological Agency, National Hydrological Services for example, need to be enhanced (Olapido, 2010). New organizations, such as Public-Private Partnerships, are also required to take research findings into the field and assist farmers and community people in adapting to a changing environment (Abaje, 2017).

The socio-economic factors of households or communities determine their adaptive potential. As a result, increasing adaptive capability minimizes a community or household's susceptibility to the effects of climate change, and supports long-term growth (Abaje, 2016).

2.9 Adaptations to Climate Change

Adaptation is a strategy for lowering the risks caused by resource constraints, environmental change, and increasingly, climate change (Forino *et al*., 2015; Yaro and Hesselberg, 2016; Shrestha *et al*., 2017; Selseng *et al.,* 2021). Adaptation can be spontaneous, in which case it is automated response, or it can be planned with conscious intervention. Autonomous adaptation may not occur naturally; rather, it is dependent on how climate change affects people's livelihoods; for example, an adaptation measure is adopting water conservation during periods of water scarcity as a result of climate change to mitigate negative climate change impacts (Shrestha *et al.,* 2017). Numerous adaptation studies analyzing the effects of climate change on crop yield have been done, and empirical evidence shows that climate change adaptation allows for a decrease in impacts and prevents potential damage to farmers and their

livelihood (Thornton *et al.*, 2010; McCarl *et al.,* 2021). Socio-economic factors such as farmers' adaptive aptitude and traditional practices may influence farmers' adaptation to climate change.

In recent years, research into the natural and anthropogenic drivers of climate change, the character and severity of the changes, their implications on human living conditions and ecosystems, and viable adaptation and mitigation strategies has increased, and also the complex relationships that characterize the climate system, the ecosystems that interact with it, and human responses to climate change. Although the rich industrialized and post-industrial countries are primarily responsible for anthropogenic greenhouse gas emissions connected with the use of fossil fuels, the repercussions of climate change are more severe in poor developing countries and rural communities (Mertz *et al.*, 2009; Paul *et al.,* 2016; Gyimah *et al*., 2020; Bacha *et al.,* 2021). This is because (1) the physical impacts are predicted to be quite severe in developing country regions, where, for example, increases in already high temperatures are likely to lead to high evaporation losses, and precipitation is unlikely to increase as much as is expected in many high-latitude regions, and (2) many developing countries rely largely on agriculture, which is directly affected by climate change (Thornton *et al.*, 2010; Dumenu and Obeng, 2016; Bacha *et al*., 2021).

Adaptation to climate change was not given adequate attention in the early years of international climate change studies, which focused more on mitigation and impacts, but adaptation has recently received increasing attention and has an important role in IPCC AR4 (2007). Climate change is becoming a mainstream issue, which means that vulnerabilities and adaptation methods are related to the development of poverty reduction strategies (Mertz *et al.*, 2009). Although Poverty Reduction Strategy Papers (PRSP) growth and poverty reduction targets, as well as the Millennium Development Goals (MDGs), are critically dependent on successful adaptation to climate change, environmental concerns have not been highly profiled in the underlying conceptual frameworks and policy advice on these issues provided by multilateral agencies (Todd and Todd, 2021).

IPCC (2007) describes climate impacts with increasing confidence. These effects could be direct (e.g., changes in agricultural potential owing to changes in rainfall, inundation of towns and infrastructure due to sea level rise, and increased disease burden) or indirect (e.g., changes in agricultural potential due to changes in rainfall, through effects of climatic change on world market prices of agricultural and fisheries

products). Adaptation will be required regardless of how well nations manage to curb emissions increase because the climate system's inertia will result in climate change, with consequences for natural and managed systems (Millner, 2012). Direct interventions include dike construction to prevent floods, large-scale farmer relocation, new crop selection, and dam construction to expand irrigation, as well as capacity development in public administration, civil society, and research (Kreibich *et al.,* 2015; McCarl and Attavanich, 2021; Mwinkom *et al.,* 2021). There are particular concerns in the agricultural sector, and it is thought that adaptation in developed countries with temperate climates will not only reduce vulnerability but also allow for the realization of opportunities and the strengthening of production, as cold weather risks will be reduced (Mertz *et al*., 2009). Farmers' agricultural expertise, farm revenue, training, social capital, and good climate adaptation communication all enhanced the likelihood of farmers' adaptation to climate change, according to a study done in northern Thailand (Shrestha *et al.,* 2017). Understanding how farmers perceive, experience, and respond to climate change at the household level is critical for developing suitable adaption strategies and support policies to manage the anticipated changes (Ozor *et al*., 2012; Zamasiya *et al.,* 2017; Sardaro *et al.,* 2021).

Farmers may change agriculture practices depending on crop types in response to perceived impacts. Rice, corn, and beans have all been proven to benefit from delayed planting of one to four weeks, as well as shifting crops in some situations (Shrestha *et al.,* 2017). While some farmers had tried various agronomic approaches in cherry, lychee, and other fruit trees, such as increasing fertilizer application, practicing mixed cropping and delayed harvesting, constructing water harvesting structures in the catchment, water rationing, and forest protection, there had been attempts by the farmers to deal with the problem of declining water supply (Dimelu *et al.,* 2014; Shrestha *et al*., 2017; Mwinkom *et al.,* 2021).

The use of fertilizer/animal dung on farms to boost crop productivity is one of the most important adaptation tactics implemented by rural populations in northern Nigeria, such as in Kaduna State (Abaje *et al.,* 2016). Other key adaptation tactics implemented by rural populations in northern Nigeria include selling cattle to supplement the costs of crop production and other household activities, and then irrigation farming on flood plains during the dry season to have excess food crops (Abaje *et al*., 2016; Haider, 2019). Selling animals to supplement crop production costs is not a long-term solution for addressing climate change's effects (Abaje *et al*., 2016). This is because most rural people, particularly in the country's north, rely on these animals (donkeys, cattle, and camels) for plowing, transporting

animal dung (manure) to farms, and harvesting crops from farms, among other things. They also provide people and commodities with transportation to markets and other areas. When these animals are sold, however, most communities are forced to resort to manual farming, especially if they cannot afford to hire tractors or oxen for draught power (Abaje *et al.,* 2016).

Climate change is becoming more common, both in terms of severe weather events and gradual climate changes, worsening the effects on rural people's main sources of livelihood (crop and livestock production) and other climate-sensitive livelihood assets (Abaje *et al*., 2016; Dumenu and Obeng, 2016). Vulnerability, adaptive capability, and adaptation are greatly linked to each other. People's ability to control the variables that affect vulnerability may transfer into their adaptability. People who have a stable income and a diverse food supply, for example, are less likely to be impoverished and hungry (Dumenu and Obeng, 2016; Shrestha *et al.,* 2017; Kuchimanchi *et al*., 2019). This, in turn, allows them to respond to stress by distributing resources differently or abandoning/relocating farming areas, in other words, they have a greater capacity to adapt to stress, which is determined by the degree of vulnerability. Adapting to stress, on the other hand, may exacerbate vulnerability; if, for example, the necessary adaptive actions to drought lead to reliance on credit schemes to purchase drought-resistant crops and crop varieties, then a complete crop loss will not only cause hunger but will also leave people with debts they cannot repay (Ncube *et al.,* 2018). As a result, the true vulnerability of individuals and households can only be appraised after adaptation has occurred, and in some cases, it may be necessary to "adapt to the adaptation," as some measures may solve one problem while creating another; for example, credit schemes and new crops may need to be accompanied by "weather insurance," as has been tried experimentally in some developing countries (Adger *et al*., 2003).

When impacts from extreme weather/climate events exceed the coping range, the adaptive capacity may be exceeded, posing a threat to the system, implying that adaptation is currently beyond the capacity of those who are threatened, and aid is required. A more functional interpretation of the coping range notion says that system adaptation occurs only when the coping range's thresholds are exceeded and that the coping range thus represents a system's resilience (Adger *et al.,* 2009). In other words, coping is a short-term response to variability, but adaptation is a more fundamental system change that allows for the establishment of a new coping range. As a result, the coping range can be thought of as the system's "headroom" or "room for maneuvering," and the goal of successful adaptation in poor communities is to

guarantee that an adequate coping range is established after adaptive activities have been taken (Adger *et al.,* 2003; Forino *et al.,* 2015; Babcicky and Seebauer, 2021). People's vulnerability will eventually be lessened, and in an ideal world, a "good loop" of reduced vulnerability-enhanced adaptive capacity–appropriate adaptation will be closed.

Following these lines of reasoning, policies on climate change adaptation must be carefully crafted to avoid complications for the poor and vulnerable (Mertz *et al.,* 2009; Jamshed *et al.,* 2020). They must be an important element of a development policy process that ensures climate adaptation is mainstreamed throughout all relevant sectors of governance institutions while also taking into account the other various factors (social, economic, and environmental problems) (Hung *et al.,* 2016; Nalau *et al*., 2016; Kundo *et al.,* 2021).

In practice, national policies should consist of specialized investments in physical and institutional assets that minimize climate vulnerability and boost coping ranges without having negative consequences. More resilient infrastructure for transportation, energy, and water supply, as well as new agricultural techniques, are examples of physical assets, whereas institutional assets include information systems, financial and risk-sharing systems, insurance, education, and warning systems that directly or indirectly address local, national, or regional vulnerability to climate change and variability.

It is also worth considering whether policies should be proactive (adapting before a change takes place) or reactive (adapting in response to a change). The choice between these options must be based on confidence in local climate predictions, as investments in adaptation to projected change could be wasted or even detrimental if predictions are incorrect. This is especially important in underdeveloped countries because investment and subsequent corrective steps to address mistakes are limited. On the other hand, basing long-term adaptation strategies on observable climatic trends, as is commonly done in National Adaptation Programs of Action (NAPA), for example, in Sahelian nations, where the average annual precipitation decline since the 1960s is likely to continue or at least remain low, can be problematic (Schultz and Adler, 2017; Ferreira Costa, 2020). A growing interest in adaptation and development policy was sparked by the need for a better knowledge of the present and potential adaptation demands in developing countries (Mechler *et al.,* 2020). Furthermore, the creation of analytical frameworks for investigating the linkages between vulnerability, poverty, and the complexity of climate change

adaptation, which is frequently difficult to distinguish from adaptation to other factors that may encourage change, has piqued attention.

Climate change is already having a significant impact on major poverty alleviation goals in developing countries (Thornton *et al*., 2010), which means that the links between climate vulnerabilities and development policies are becoming more widely discussed in the literature, as well as in international climate policy debates and development assistance. Climate change mainstreaming concerns connected to vulnerability and adaptation were discussed at the Conference of the Parties (COP) 7 in Marrakech, Morocco, in 2001, where it was resolved that a group of Less Developed Countries (LDCs) should be given special assistance in developing NAPAs. COP 7 also bolstered adaptation efforts by emphasizing the importance of developing countries' unique requirements (Adger *et al.,* 2003). The NAPAs are part of the adaptation policy framework (APF), which is a five-step process for assessing risk and developing adaption plans to improve national planning (Adger *et al.,* 2007). Even though the NAPAs are only small-scale initial attempts to undertake full-scale adaptation planning in underdeveloped nations, they must be regarded as key aspects of the APF. Although mainstreaming climate adaptation in development policies and programs is vital for adaptation, growing focus on the Clean Development Mechanism (CDM) and mitigation may risk overshadowing other perhaps more critical poverty reduction and development goals.

Climate change vulnerability and adaptation were stressed at the COP 12 and COP 13 summits in 2006 and 2007. Various funder mainstreaming efforts, such as the development of an Organization for Economic Cooperation and Development–Development Assistant Committee (OECD-DAC) framework, the Danish Climate Action Programme, and the United States Agency for International Development (USAID) and UK Department for International Development (DfID) guidelines, have backed the COP decisions on climate vulnerability and adaptation.

2.9.1 Adaptation to social vulnerability

Climate change adaptation is a process of modifying a community's or individual's system to minimize the impacts of climate change, exploit new opportunities, or deal with the consequences (Adger *et al*., 2003). Social vulnerability to climate change risks in rural communities requires adaptation measures that have societal components to enable households to remain resilient for a longer time. Climate change

adaptation is the process of modifying a community's or individual's system to mitigate the effects of climate change, capitalize on new opportunities, or deal with the consequences (Adger *et al.,* 2003). Social vulnerability to climate change risks in rural communities necessitates adaptation measures with societal components to allow households to remain resilient for a longer period. Adaptation is a response to how changes are interpreted, debated, and assessed in society, as well as how legislated initiatives are bargained (Conway and Schipper, 2011).

Climate change responses by the most vulnerable socio-economic groups may necessitate resource redistribution and increased access to funding, land, technology, water, and other investments, as well as improved decision-making and leadership (Eakin and Patt, 2011). For example, wealth, as assessed by household ownership of critical assets, is shown to be a crucial driver of adaptation in Ethiopia and South Africa (Yaro and Hesselberg, 2016). African communities have low adaptation capacity, making them the most exposed to climate change and variability (IPCC, 2013). The capacity to adapt to climate change in African communities is a function of synergy among social and community actors (Yaro and Hesselberg, 2016).

To respond to climate change through adaptation initiatives, Nigeria will need to make a concerted effort, both short and long-term, to identify opportunities and design actions to reduce communities' vulnerability to climate change impacts (Oladipo, 2010). However, some of the most effective adaptation strategies used by rural households in Imo state, Nigeria, include the use of drought-resistant crops, deep planting, increased weeding, and changing the timing of preparation prior to planting (Umunakwe *et al.,* 2015). These strategies may not address the social vulnerabilities of individuals and communities to climate change effects in the study area due to the complexity of challenges facing rural people.

Climate change and variability-induced effects have evolved as one of the most serious issues confronting Sub-Saharan Africa's development and poverty reduction efforts. According to the IPCC AR4, between 75 million and 250 million people will be exposed to greater water stress as a result of climate change by 2020, and crop output in some African countries might be reduced by 50% in 2020 as a result of climate change (IPCC, 2007; Conway and schipper, 2011; Shiferaw *et al*., 2014; Mumsamy, 2019). The Sustainable Development Goals (SDGs) (2015–2030), for example, have prioritized pre-emptive measures to tackle climate change and its consequences in their 13th aim (Kelman *et al.,* 2015,

2017). The program's first target asks for all countries to improve their resilience and adaptive ability in the face of climate-related threats and natural disasters. Conversely, the third goal focuses on strengthening climate change mitigation, adaptation, impact reduction, and early warning capacity through education, awareness-raising, and human and institutional capacity. Both objectives highlight the importance of strengthening adaptive capability at the national and local levels to mitigate the effects of climate change on poverty reduction and sustainable development.

The scientific literature on climate change adaptation recommends that communities and households improve their adaptive ability to reduce climate change-related risks. To this effect, many developing nations have implemented various policies and initiatives aimed at strengthening vulnerable communities' adaptive capacities in the face of climate change-related risks (Matewos, 2020). Household adaptive capacity is crucial not just because it increases resistance to gradual climate change, unpredictability, and extremes, but also because it gives households options for responding to these difficulties (Matewos, 2020). Building household adaptive capacity, on the other hand, has proven difficult because it is a function of multiple context-specific characteristics.

Managerial ability, access to financial resources, usage of technology, infrastructure, information and skills, governance, institutions, and social networks are some of the variables that contribute to adaptive capacity to climate change-related effects. Households and communities can adapt to smaller climate changes and moderate deviations from the norm most of the time, but dealing with major occurrences and large-scale deviations is usually outside of the coping range. Shorter endurance is referred to as coping ability, whereas longer endurance is referred to as adaptive capacity (Matewos, 2020).

2.9.2 Climate change adaptation framework

Individuals, communities, non-governmental organizations, research sectors, and State and Local Government Areas (LGAs) can use the climate change adaptation framework to design a well-informed and timely adaptation strategy that will lessen rural people's vulnerability to climate change. Adequate funding for research, skills, innovations, and workforce development can increase a community's adaptive capacity to not only mitigate the negative effects of climate change but also to provide new opportunities for communities and the economy (Abaje, 2017). For different countries, there are a variety of adaptation frameworks meant to decrease the impacts and susceptibility of vulnerable people to

climate change. This is because each country or region has a distinct and possibly unique geographical environment as well as socio-economic characteristics that influence its climate change sensitivity (Abaje, 2017).

Ozor *et al.* (2012) developed a paradigm for agricultural adaptation to climate change in the southern portion of Nigeria, in which mitigation and adaptation choices integrate indigenous and modern techniques, processes, practices, and technologies. Similarly, Udeh (2014) used a bottom-up method to build a model of perception and adaptation in a traditional farming community in the dry land area of Kano State based on the experiences of individual local farmers. The model is focused on stakeholder participation and the development of adaptive capability in farmers.

2.9.3 Climate change and adaptation in Africa

Due to its size and position, Africa is a continent with great natural resource potential and different climatic zones, but it is also one of the most susceptible due to its low adaptation capacity in the face of climate change, which varies from country to country (Thornton *et al.*, 2010; Yaro and Hesselberg, 2016). A high degree of sensitivity to water, food, and health; susceptibility to natural disasters (droughts, floods, and storms); and a weak socio-economic profile relating to assets, livelihood methods, agriculture, and social capital/network all contribute to Africa's vulnerability (Brooks *et al.,* 2005; Shiferaw *et al.*, 2014; Salami *et al.*, 2017). Agriculture employs 98% of the people in Sub-Saharan Africa's rural areas, with a poverty rate that has decreased from 64.9% in 1998 to 61.6% in 2008, but still double the global average (Abdul-Razak and Kruse, 2017). Any small variation in rainfall is likely to have a significant impact on African populations' livelihoods. The confluence of these elements poses a multifaceted and multi-sectoral danger to Africans' livelihoods.

Agricultural production in most African zones is expected to decrease by 10% to 50% by 2050 due to declining and low rainfall under current farming practices, with 70% of Africa's population relying on rain-fed agriculture (Thornton *et al.*, 2010; Ozor *et al.*, 2011; Abdul-Razak and Kruse, 2017). Furthermore, functional changes are occurring across Africa's deserts, grasslands and shrublands, savannas, woodlands, and forests, with main causes linked to climate change.

Furthermore, climate change and variability are likely to jeopardize agricultural potential, food security, and nutrition in most African regions, as well as exacerbate the water stress that some countries are currently experiencing, while others that have never experienced water stress will be put at risk (Conway and Schipper, 2011). West Africa is likely to see severe food production impacts, including a drop in marine productivity, posing serious food security problems as well as negative consequences for human health and jobs (Shiferaw *et al.*, 2014). Faced with this difficulty, scientists are expanding on the numerous benefits of crop diversification approaches such as using varietal diversity in monocultures, combining crops with non-crop vegetation, crop rotations, polycultures (including wild varieties), agroforestry and mixed landscapes, and water and soil conservation techniques such as half-moon, Zai, and stone lines, particularly in Sub-Saharan Africa (Gyimah *et al.*, 2020). Pest and disease control, higher productivity, increased production stability, and climate stress buffering are all advantages of these climate adaptation measures (Gyimah *et al*., 2020). Although efforts have been made, based on climate projections, these technologies are unlikely to be effective.

2.9.4 Community adaptation

Many researchers believe that community adaptation promotes climate risk resilience (Van Aalst *et al.*, 2008; Kais and Islam, 2016; Carro *et al*., 2018; Haas *et al.*, 2021). Unfortunately, the concept of resilience is handled irregularly in Community Based Adaptation (CBA), leading to a perplexing debate about the constraints and advantages of resilience thinking and hampered evaluation of resilience results in vulnerable communities (Ensor *et al*., 2018).

Community-based adaptation arose from the necessity to address the vulnerability at the grassroots level as rural communities become increasingly affected by climate change and variability (Ensor *et al*., 2018). Many researchers have argued that community collaboration is the most efficient mechanism for reducing vulnerability and increasing resilience, but most communities lack the necessary social capital (due to poor leadership, inadequate social structures, and religious and cultural inclinations) and instead choose short-term adaptations rather than developing longer-term adaptive strategies (Kais and Islam, 2016; Carro *et al*., 2018; Ensor *et al*., 2018; Faulkner *et al*., 2018).

The participatory approaches of CBA tools are a crucial strength in building community resilience to climate risks since they should incorporate local knowledge, voices, and norms into the adaptation

planning process, as well as diversify into many of the evaluation processes (Ensor *et al.,* 2018). However, expert facilitation is required to ensure that all perspectives are represented in participatory approaches, and in particular to ensure that intra-community power dynamics do not suppress the opinions of particular groups even when they are represented (van Aalst *et al.,* 2008; Reid, 2009; Carro *et al*., 2018). In a typical African community, these power dynamics are evident among traditional leaders, stakeholders and religious leaders. African communities such as those of Imo State in Nigeria with strong ties are expected to develop high adaptive capacity.

2.9.5 Community-based initiatives

Community-Based Initiatives (CBIs) are nonstructural actions taken by local communities to achieve CCA and DRR goals (Reid, 2009; Ensor *et al.*, 2018). CBIs give chances for individuals and communities to learn practical problem-solving skills, strengthen social capital, address local scale concerns, exploit local resources, increase community engagement, and highlight context-specific variables in CCA and DRR integration for governance (Tumbo, 2015; Ensor *et al.*, 2018b; Kirkby and Huq, 2018). Community-based initiatives (CBIs) promote community empowerment and idea transmission from the ground up. In fact, CBIs are thought to be successful only if they are linked to local development goals such as water, ecosystems, education, and health, and if they focus on contextual and subjective experiences of vulnerability and resilience.

Social innovation, such as community-based adaptation experiences or programs that foster a low-carbon economy transition, such as those created in the United Kingdom, could be useful examples of CBIs pursuing adaptive goals when linked to DRR (Reid, 2009; Tumbo, 2015; Ensor et al., 2018). These projects test socio-technical transitions and change in the areas of energy, transportation, food, agriculture, and environmental management.

2.10 The General Concept of Social Capital

Social capital is a notion that relates to the inquiry of what binds societies together and is used to explain why certain civilizations progress more rapidly than others (Adger, 2010). In this sense, the idea has found use in development studies and human geography, which are important for institutional policy and public discourse, most notably accepted by the World Bank. Social capital has been seen to offer

explanatory power for how social networks and collective action might promote community resilience, particularly in the context of resource management and climate change (Adger, 2003).

Putnam *et al*. (1993) defined social capital as aspects of social organization like trust, norms, and networks that might increase societal efficiency by promoting coordinated actions. In addition to Putnam, who utilized the idea to examine the growth of civic involvement in the United States and the regionally distinctive performances of democratic institutions in Italy. Bourdieu and Coleman also discussed social capital. Contrary to Putnam, both authors emphasize social capital's individual qualities rather than its collective viewpoint. According to Bourdieu (1983), social capital includes all the potential benefits of participation in social networks.

Similar to the human, physical, and cultural types of capital, social capital is seen as a complement to them (Narayan and Cassidy, 2001; Adger, 2010; Petzold and Ratter, 2015; Yaméogo *et al.*, 2018; Saptutyningsih *et al*., 2020). In general, it is possible to distinguish between cognitive, structural, and other social capital levels (Figure 2.1). Norms of solidarity and reciprocity, as well as levels of trust within a society, are examples of cognitive traits (Petzold *et al.*, 2015). So-called "networks of civic participation" make up the majority of the structural components of social capital. Even though the associations themselves have no impact on either the politics or the economy, membership in them increases political and economic efficiency (Narayan and Cassidy, 2001; Paul *et al*., 2016; Saptutyningsih *et al.*, 2020).

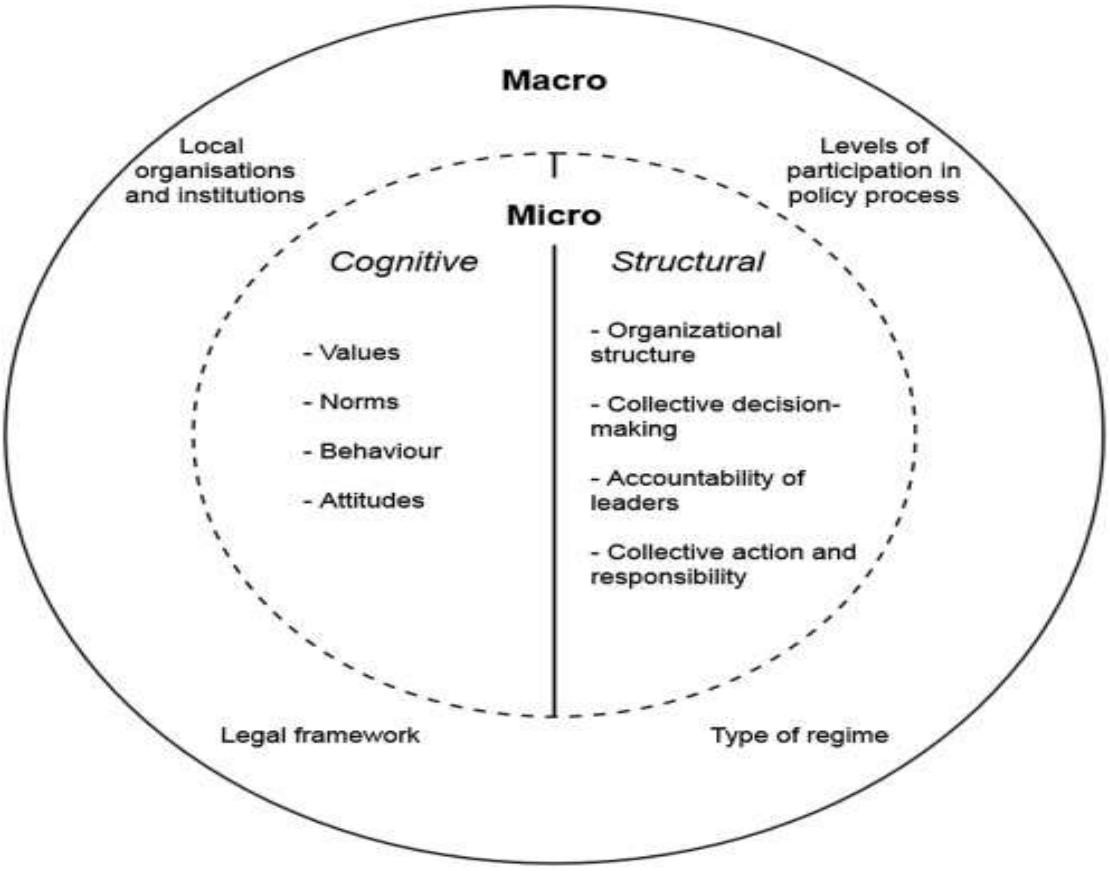


Figure 2.1 Social capital levels and types: conceptual framework (from Petzold *et al.*, 2015)

Additionally, it distinguishes between horizontal and vertical networks as well as bonding and bridging relationships (Putnam *et al.*, 1993; Adger, 2003). Clubs and political organizations are examples of bridging and bonding linkages in horizontal networks, but vertical networks typically link unequal agents in asymmetric relations of hierarchy and reliance (Putnam *et al.*, 1993). The latter are frequently thought to have both positive and bad consequences on people and societies because they might result in exploitation and exclusion (Häuberer, 2011).

Social capital can be measured in several ways. Analysis of membership in various forms of groups, participation in policy processes, and involvement in civil society organizations are typically used to measure the structural components of social capital. According to "resource generator", which takes into consideration the quantity and variety of a person's social connections and friendships, social capital can be evaluated on a micro level (van der Gaag and Snijders, 2005). The creation of such instruments to gauge social capital is ongoing and largely ad hoc. Several authors attempt to focus on the notion of

social capital as the resources that may be gathered via networks to differentiate the concept from social networks. Contrarily, rather than being an actual component of social capital, trust and reciprocity standards are more like pre-conditions (as well as consequences) for social networks (Häuberer, 2011).

The distinction between social capital access and social capital usage, or mobilization, is a crucial analytical component that is sometimes overlooked. It is not necessary that a person or group of people rely on or even find these resources relevant for a particular goal just because they have access to them through a social network. After all, it can be challenging to quantify the mobilization of social capital at the individual level because it depends on a variety of variables, such as an individual's abilities and need for collaboration (Häuberer, 2011).

Social capital is important in underdeveloped areas because people depend on one another and work together to respond to disasters. But because it encourages traits like self-organization and an increased capacity for learning and adaptation by facilitating flows of information and reducing transaction costs, promoting civic engagement and public participation in decision-making processes. These elements boost communication and learning processes between governmental organizations and the populace, and promote public acceptance of increased expenses for adaptation efforts. Networking social capital and co-management institutions, increase the potential to adjust to the effects of climatic changes (Adger, 2003). Collective action may also provide an avenue for community members to voice, discuss, and solve problems (Ireland and Thomalla, 2011). Without bridging or networking actors, local traditional knowledge may not have been accessible to all persons or communities. Social capital also enables the essential transfer of outside expert knowledge and fresh information into the system (Ireland and Thomalla, 2011). Additionally, social networks that link individuals from various community segments who would not otherwise be in contact with one another and foster community trust help to develop resilience (Walker and Salt, 2006). Therefore, even without taking into account governmental adaptation techniques, such networks boost the effectiveness of collective action.

The relationship between society and government, and civil society networks with political institutions have been intertwined which is a key factor in the connection between social capital and adaptive ability (Petzold *et al*., 2015). The role of the individuals, their level of knowledge, and their acceptance remain at the forefront while on the one hand, this leads to approaches like adaptive co-management from an

institutional perspective. As recommended by social capital theory, one area of focus should be on the role of bridging organizations and an analysis of both their contribution to the selection of adaptation measures as well as their influence on individual knowledge, involvement, and action (Petzold *et al.,* 2015). These bridge organizations like town unions, traditional leaders' councils can also be thought of as "nodes," which link actors at various levels and facilitate the reciprocal flow of knowledge, capital, and human resources.

2.10.1 Social capital review and their links with adaptation to climate change

Various definitions, interpretations, and applications of the idea of social capital have been explored in earlier studies. Following the contributions of Bourdieu (1983), Coleman (1988), and Putnam (1993, 2002), it gained popularity. The volume of a person's social capital is correlated with the size of the network of connections that they can effectively mobilize as well as the volume of the other forms of capital they have accumulated, according to Bourdieu (1983). Economic capital, cultural capital, and social capital are all interrelated (Narayan and Cassidy, 2001; Wolf *et al.,* 2010; Paul *et al.,* 2016). Coleman (1988) defines social capital as anything that can support either individual or group action. Coleman also sees social capital as a conceptual bridge between two major schools of thought in the description and explanation of social action: sociological theory, which holds that the actor is socialized and that his behavior is governed by social norms, rules, and obligations, and economic theory, which holds that the actor is "homo economicus" or the economic man, rational and narrowly self-interested. Meanwhile, social capital, in contrast, is described by Putnam (1993) as properties of social organization, such as networks, norms, and trust, which allow coordination and cooperation for mutual gain.

The majority of empirical investigations have revealed a favorable relationship between social capital and the uptake of fertilizers, technologies for managing soil fertility, sustainable farming methods, forest resource management, new technology, and climate change adaptation measures (Yameogo *et al.*, 2018). In the north-eastern region of Burkina Faso for example, farmers' natural resource management efforts, such as reforestation and erosion control, were found to benefit from social capital (in the form of cooperation) (Yameogo *et al.,* 2018). The social capital of the inhabitants in Burkina Faso's Sahelian region increases their capacity to work together in the management of communal pastures used to graze animals, which boosts livestock productivity (Yameogo *et al.,* 2018). In 20 rural communities in the Ethiopian Rift Valley, Paul *et al*. (2016) investigated the link between social capital and behaviors related

to climate change adaptation. The researchers discovered a negative relationship between social capital and individual-level adaptive actions. However, according to Adger *et al.* (2009), cultural and societal norms and values may make adaptation more difficult. The authors claim that these elements, along with perceptions, define what is thought to be a limit to adaptation in a given civilization on both an individual and social level. Strong social networks may serve as a channel for false information, which could skew household decision-making and reduce the need for incentives to adopt new technology (Agrawal, 2010).

2.10.2 Influence of social capital on adaptation to climate extreme events

Social capital is the characteristics of a social organization, such as trust, norms, and networks, that might improve society's efficiency by promoting collective actions (Onyx and Bullen, 2000; Cannon and Mahn, 2010). A strong community is built on the foundations of trust, networks, norms, and reciprocity (Onyx and Bullen, 2000).

Because social capital is embedded in the structure of people's interpersonal and societal relationships, unlike economic and human capital, which is found in their banks, it only exists when it is shared. When relationships are among heterogeneous groups, however, social capital has a greater influence in communities since it is measured not by the number of connections between people but by the quality of those connections (Narayan and Cassidy, 2001). Trust and membership in organizations are two of the most well-known indicators of social capital (Narayan and Cassidy, 2001). In Africa for example, membership in social groups like farmers-based organizations is crucial to farmers' access to credit facilities and weather/climate information which improves their resilience to climate change impacts (Mwinkom *et al*., 2021). Social capital characteristics include participation in the local community, proactive behavior in a social context, emotions of trust and fairness, neighborhood interconnection, community structures, family/friends' connections, acceptance of variety, the value of human life, and work interconnections (Narayan and Cassidy, 2001). This includes ethnic, linguistic, cultural, and social groups, as well as religious and traditional identities in Africa.

A community with low literacy, a high death rate, limited access to economic resources, political instability and violence, a lack of political accountability, ineffective government, and political exclusion is socially vulnerable (Thornton *et al*., 2010). Therefore, such a community requires strong social capital to withstand stressors like climate-related disasters. Meanwhile, relationships of trust, reciprocity,

exchanges, shared rules, standards, sanctions, connection, and networks, are fundamental characteristics of their social capital (Ebi and Bowen, 2016). Most vulnerable communities have social capital that must be harnessed to build strong resilience in times of weather/climate extreme events.

Social capital is a factor of vulnerability to climate extreme events, demanding the development of strong community resilience. Social capital has the power to influence collective activities, safeguard livelihoods, and improve access to common resources, and where they are developed within a community system, climate risk adaptation becomes easier and more effective (Kais and Islam, 2016; Melore and Nel, 2020; Nasrnia and Ashktorab, 2021). It can increase societal resilience. As a result, a community with low social capital is said to be socially sensitive to respond to climatic risks.

To connect climate change adaptation and sustainable development, the concepts of social capital and adaptive governance should be used (Freire *et al.,* 2016a; Müller *et al.,* 2019). Social capital improves the capacity of the poor to adapt to climate risks in a particular setting. The significance of social capital in climate change adaptation discourse arises from its critical function in risk management (Kais and Islam, 2016; Omolo and Mafongoya, 2019; Tauzer *et al.,* 2019). Furthermore, it is a prerequisite for any form of collective efforts because it is an integral part of adaptive capacity, and effective adaptation is highly dependent on a community's ability to organize decision-making, actively collaborate, and provide some stability to mass bargaining through an institutional framework (Tauzer *et al.,* 2019; Martins and Gasalla, 2020; Rolsted and Raju, 2020). To enhance resilience among communities in Sub-Saharan Africa, collaboration between various stakeholders and relevant social organizations must be encouraged (Nkiaka, 2019).

Social capital may be especially crucial for facilitating adaptation to new challenges from climate change by fostering collaboration and group action in the absence of other types of capital (Paul *et al*., 2016). People must undertake difficult adaptation decisions that decide the effects of climate change on ways of life under conditions of growing uncertainty, such as those brought on by changes in water availability, fluctuation in crop yields, and more catastrophic natural disasters. Constraints on adaptation, which depend on capital in the form of money, people, and other resources, would logically be greatest for underprivileged groups (Paul *et al.,* 2016).

Individuals, households, communities, and higher institutional sizes can all experience different types of adaptation (Adger *et al*., 2005). The two potential degrees of adaptation in this study are at household and community level. At the household level, adaptation may take the form of acceptance of new technology, migration/relocation, early planting, early harvesting, rain water harvesting, or changes in livelihood. At the community level, adaptation may happen through collaborative effort, community based organizations (formal and informal), societal networks, the achievement of a shared goal, and the provision of public goods (Paul *et al*., 2016). Collective action enables the coordination of resources, knowledge, and efforts for community responses. Without the participation of households and communities, external interventions like government programs and initiatives can have an impact on adaptation, but they do not always assist rural areas due to a lack of infrastructure, state reach, lack of coordination with local stakeholders and actors, and the ability of governments to exercise authority (Paul *et al.,* 2016). Therefore, the level of cooperation in rural regions may have a greater impact on the results (Paul *et al*., 2016).

Along with human and physical capital, social capital is an important factor in determining how farmers make decisions. For instance, numerous academics recognize the significant influence this capital has on farmers' decision-making (Abdul-Razak and Kruse, 2017; Thamaga-Chitja and Tamako, 2017; Yameogo *et al.,* 2018; Saptutyningsih *et al.,* 2020). The degree of social and societal connectedness is what it refers to more generally, and it can influence a person's decision in both good and bad ways.

According to Yameogo *et al.* (2018), structural social capital (SSC) and cognitive social capital (CSC) are the two ways that social capital manifests. The structural form is external, observable, and connected to several types of social organization, including roles, laws, customs, practices, social networks, and relationships. The internal (subjective) and invisible nature of the cognitive type of social capital (norms, shared values, attitudes and beliefs). People of this kind are more likely to work together and make decisions as a group (Yameogo *et al.,* 2018).

In the context of rural Africa, social ties like kin, cultural, ethnic (reciprocity, cooperation, solidarity, etc.) and local area dynamism (perception, beliefs, norms, etc.) influence farmers' day-to-day activities in a way that can help them respond to disasters more quickly and expose themselves to fewer risks from the outside world. Therefore, it is crucial to consider these characteristics when introducing new

technology or knowledge into a particular society; otherwise, they might impact on adaption choices. Farmers' social networks are another crucial pillar to take into account in rural life. Indeed, social networks, family relationships, and friendship networks can operate as conduits for communication, knowledge exchange, and interpersonal engagement (Wolf *et al.,* 2010; Petzold and Ratter, 2015; Thamaga-Chitja and Tamako, 2017). These networks may connect people to unofficial or reputable money resources (Yameogo *et al.,* 2018). In this regard, the argument is made that the availability of credit relaxes the financial restrictions and enables farmers to afford the cost of adaptation. For instance, a farmer can more easily have access to an informal source of credit (from their friends and kinsmen) or formal credit (through farmers' associations).

2.10.3 How social capital link to collective actions and community interactions

Traditional resource-dependent societies will be particularly affected by future climate changes due to a variety of primary and secondary consequences cascading through social and environmental systems (Adger, 2010). There is a pressing need for managers to learn from historical and contemporary adaptation strategies to understand both the methods by which adaptation occurs and the constraints of the different entities of change - states, markets, and civil society - in these processes. This is because the world is increasingly confronted with risks of climate change that are at the limits of human experience (Adger *et al.,* 2003; Forino *et al*., 2015).

Social capital primarily refers to the development of social norms, the function of networks, and relationships based on reciprocity, trust, and exchange (Narayan and Cassidy, 2001; Petzold and Ratter, 2015; Thamaga-Chitja and Tamako, 2017; Yaméogo *et al.,* 2018). It aims to explain varied spatial patterns of societal interaction and assigns a role to civil society and collective action for both democratic and practical grounds (Adger, 2010). It has long been understood that social capital plays a crucial role in the lived experience of managing risk, from the civil society's response to extreme events to the networks of reciprocity and exchange in pastoralist economies (Adger, 2010). The idea of social capital, however, also has the potential to explain how civil society interacts with market and government institutions in a systematic way that is pertinent to the nature of the dangers associated with climate change that were previously mentioned.

Societies have the innate ability to adapt to climate change, and this ability is tied to their capacity for collective action (Adger, 2010). Adaptation decisions are made by individuals, groups within society, organizations, and governments on behalf of society (Paul *et al.,* 2016). But all decisions privilege one set of interests over another and create winners and losers especially where there is already socio-economic and other disparities. Thus, the effectiveness of strategies for adapting to climate change depends on the social acceptability of options for adaptation, the institutional constraints on adaptation, and the place of adaptation in the wider landscape of economic development and social evolution (Adger, 2010).

The process of adaptation involves a range of actors and scales (Jha and Gupta, 2021; Mwinkom *et al*., 2021). Individuals engage in different sort of adaptations in response to climatic hazards, which are frequently brought on by specific extreme events. Governments often engage in other activities on behalf of society, frequently in response to particular events but occasionally in anticipation of change. The public management of hazards associated to climate change frequently excludes disadvantaged groups (Forino *et al.*, 2015; Hung et al., 2016; Ndah and Odihi, 2017). Poor households, for instance, are routinely disregarded when the infrastructure is intended to address such vulnerabilities, forcing them to remain in risky places on the outskirts of metropolitan populations where they are susceptible to flooding (Adger, 2010).

There is a fragmented understanding of the value of networks, connectivity, and the function of institutions (Adger, 2010). Some economic and political science models' proponents contend that institutions are essentially the result of interpersonal interactions and the state's provision of legal frameworks to ensure the stability of these interactions (Adger, 2010). Different explanations have been offered for such phenomena as economic performance, societal resilience and stability, and cultural perspectives on the environment.

Collective action is needed to adapt to the effects of climate change, such as rising sea levels and more intense storm surges, as adaptation is not only a technical requirement but also a social and political problem (Petzold *et al.,* 2015). Community resilience to these events can only be effectively promoted by understanding how social factors are incorporated into local actions and decision-making, and which role collective memory and civil society play in the effectiveness and acceptance of adaptation strategies

(Petzold *et al.,* 2015). Despite the concept's controversial interpretation and lack of clear definition, it provides insight into how civil society and collective action affect different scales of adaptation to climate change (Petzold *et al.*, 2015).

The significance of cooperative social ties and how precisely they form remain crucial and unknown, despite explanations for the emergence of collective action focusing on elements like group size, interpersonal relations, leadership, and incentives. Institutions, trustworthiness, and social networks are the three facets of social capital that moderate interactions and affect how individuals and groups behave (Paul *et al*., 2016). Thus, the web of connections that social networks contain creates opportunities for cooperation. Bonding, which refers to intimate ties within a group, bridging, which refers to ties across groups, and linking, which refers to vertical linkages across hierarchies, are popular categories for the relationships in these networks (Paul *et al*., 2016). Generalized reciprocity and "trustworthiness," which are all qualities that foster trust, are made possible by dense and stable networks (Putnam *et al.*, 1993).

Farmers must rely on social capital in addition to other forms of capital to survive when faced with environmental concerns like deteriorating growing conditions (Yameogo *et al.,* 2018; Saptutyningsih *et al.,* 2020). For instance, a farmer must learn about best practices and find other people to contribute, either by hiring them or through social networks, if more labour and tools are required to terrace a field to be resilient to larger rainstorms. In the given example, these network connections serve as a conduit for information opportunities, such as new or best practices. Information sharing across groups is made possible by social capital bridges. By connecting social capital across vertical levels to the government or external organizations, one can gauge the extent of informational confidence. By fusing the social capital of networks with the human capital of knowledge, information exchange fosters adaptation (Paul *et al.,* 2016). Additionally, trust is necessary for evaluating and acting on information.

Given that they might be horizontal amongst peers within a community or vertical across hierarchies, social networks in particular perform a variety of different types of roles for adaptability and collective action (Putnam *et al.,* 1993). The networking function of social capital promotes local institutions and collective action responses that are required for addressing community difficulties, especially those brought on by shocks or crises, particularly when higher-level (e.g. state-level) institutions are missing or not functional (Adger, 2003). As a result, social networks are valuable because they make it easier to

be trusted and because they make it possible to access various resources maybe collective ones through a variety of channels (Woolcock and Narayan, 2000).

The distinction between the social capital of households within communities and the vertical linking of social links outside of communities is crucial. By replacing or enhancing the function of the state, bridging social capital can assist in connecting people and households to fresh perspectives and resources outside of their local area (Adger, 2003). Communities that bind together and work together during adaptation are better able to receive outside assistance. These kinds of connections can improve communication with outside groups and government representatives, leading to better resource allocation. Social capital affects how well-equipped households are to adapt to change. This is because the components of social capital and access to methods for collective action affect the standard and range of alternatives (or limitations) that households face when they are endangered by climate change. Particularly, trust needs to be linked to teamwork and heightened adaptive behaviours, potentially as a result of information exchange, knowledge mobilization, and resource management. Higher trust levels are thought to increase social capital and the amount of adaptive activities that households engage in (Paul *et al.,* 2016).

2.11 Theoretical Framework

This study espoused two theories of Planned Behaviour and Generalized Resistance Resources to support the investigation.

2.11.1 The Theory of Planned Behaviour (TPB)

The idea of reasoned action from the 1980s gave rise to the theory of planned behaviour (TPB), which aims to predict an individual's intentions for taking specific action at a given time and location especially against climate change (Masu *et al*., 2016; Zhang *et al.,* 2020). One of the main tenets of the theory is behavioural intent, which is impacted by the subject's assessment of the risks and rewards of a particular outcome as well as their attitude towards the likelihood that a particular activity will produce positive effects. According to this idea, behavioural efficiency is a function of behavioural control's skill and intention. The six constructs of TPB collectively represent a person's true level of control over their actions. Based on these notions, this study looked at how rural households intended to act during extreme weather or climate events.

1. Attitude – An attitude involves thinking about the results of engaging in the action. The attitudes of rural residents are crucial during climate-related disasters. Rural residents need the right attitudes as to get a better adaptation results against climate change impacts.
2. Behavioural intention: This concept suggests that the more strongly an activity is intended to be performed, the more probable it is to be carried out. Positive intention in carrying out climate change adaptation actions can help to strengthen rural residents' resilience.
3. Subjective norms: A person's perception of whether peers and influential figures believe they should exhibit the conduct is referred to subjective norms.
4. Social norms. In a group of individuals or a broad cultural setting, social norms relate to the accepted regulations of conduct. In climate change adaptation, rural residents need to adopt social norms that promote social resilience.
5. Perceived behavioural control: This is a person's assessment of how easy or difficult it is to carry out the targeted conduct. There is need to encourage personal evaluations of adaptive behaviours to ascertain pros and cons of such actions before engagement.

The theory of planned behaviour tries to explain the behavioural intentions of rural residents during weather and climate events since attitudes towards climate change, subjective norms, and perceived behavioural control may positively influence climate change adaptation actions (Masud *et al.,* 2016).

2.11.2 Generalized Resistance Resources (GRR)

Generalized Resistance Resources (GRR) as defined by Antonovsky (1979, 1987), are traits of an individual, a group, or a community that enable that person to deal with stressors in an effective manner and support the growth of that person's sense of coherence (SOC). Antonovsky (1979, 1987) states that some examples of these resources include the following: (1) financial resources, (2) knowledge and intelligence, (3) ego identity, (4) coping mechanisms, (5) social support, (6) commitment to and cohesion with one's cultural roots, (7) cultural stability, (8) ritualistic activities, (9) religion and philosophy, (10) preventive health orientation, (11) genetic and constitutional factors. In the context of this study, the stressor here is from climate change which can be resisted by rural residents using GRRs.

Generalized Resistance Resources-Resistance Deficits (GRR-RDs) is a notion that Antonovsky (1987) paired with his prior idea of the "stressors" to create a more parsimonious model. Each of these GRRs was afterward shown as a continuum. The higher on the continuum a person is, the more constant and well-balanced their life experiences are, and the more active they are in making decisions. A person who is lower on the continuum, in comparison, is more likely to have unreliable, unbalanced life experiences and less involvement in decision-making. According to these presumptions, people who are higher on the continuum regard GRR-RDs as GRRs, whereas people who are lower on the continuum view GRR-RDs as Generalized Resistance Deficits (GRDs). According to these hypotheses, both GRRs and GRDs affect how an individual's SOC develops. Being on the higher continuum or having higher GRRs implies that such individual or community is likely to have higher resilience against climate change impacts. This is because individuals on the higher GRRs have more resources to resist climate change adverse effects.

Studies have looked at potential characteristics of communities that may contribute to collective SOC to move away from the personal to the collective SOC, based on the concept that each individual is a member of a broader community. Sense of community coherence has the same three elements as an individual's SOC notion. Manageability refers to the community's capacity to assist its members in times of need; comprehensibility refers to the extent to which a community is intelligible and the members' sense of predictability and security (Idan *et al.,* 2016). Additionally, meaningfulness refers to a community's members' capacity for self-expression to increase their sense of pleasure and interest. Studies on community ecology have shown that it may be used to forecast SOC development. Being a minority group member was associated with lower SOC than being a majority group member (Idan *et al*., 2016). Developing a higher SOC can foster collective actions against climate change, implying that every community member must belong to a group if the individual must benefit from support rendered by other community members during climate disasters.

2.12 Chapter Summary

Climate change is a global phenomenon that impacts more of developing countries that contributes lesser to it. Climate change has triggered disaster risks in form of floods, droughts, sea rise, temperature rise and other weather and climate extreme events. These disasters or climate crises require adequate adaptation strategies to help lower their impacts on environment, human health, and the economy of

countries. Leaders of different countries signed agreements such as the Sendai Framework to help to mitigate the effects of climate change through disaster risk reduction. Nigeria signed these agreements but implementing them became a problem. However, efforts towards climate change adaptation in rural communities of developing countries are greatly influenced by the social and societal vulnerabilities at household and community scales. This aspect of vulnerability has been neglected by researchers and climate actors yet its study is crucial in developing climate change resilience amongst rural communities. Using indicator approach for this study is a key to understanding the elements of social vulnerability that contribute to lowering resilience to climate change impacts. However, the knowledge or assessment of these social vulnerability elements may not be enough to provide a pathway for climate change adaptation in rural communities. Therefore, rural residents may need to synergize through social networks that provides relationship of trust and reciprocity. Having this bonding social capital in rural communities can help household heads and farmers to access support during climate related disasters.

CHAPTER THREE: STUDY AREA

3.1 Introduction

This chapter describes the geology, topography, climate, ecosystems and human and economic activities of the study area. This study area is part of the coastal lands of Nigeria within the southern part of Imo State.

3.2 Study Area

The study area of this research is Egbema in Ohaji/Egbema Local Government Area of Imo State (Figure 3.2). Egbema is found in Imo State's southwestern axis, sharing borders with Ohaji in the east, Oguta Local Government Area in the north, and Rivers State's Ogba/Egbema/Ndoni Local Government Area in the southwest. Three rural communities from Egbema (Etekwuru, Mmahu, and Opuoma) were selected for the study. These communities are of different political wards (Etekwuru in ward C, Mmahu in ward A, and Opuoma in ward D). These communities were selected due to their similarities in social structure, similar farming types, infrastructure, governance/leadership, and differences in topography, population, land size and microclimatic conditions. At the Local Government level, the study area is administered by elected and appointed leaderships while at the community level, leadership is by kingship inherited from generation to another (Ahukaemere *et al*., 2017). The communities were selected based on the following characteristics: Etekwuru community was selected due to its higher topography that does not support flooding; Mmahu community was selected due to its table land, and Opuoma community was selected due to its lower topography (floodplain). However, the communities are considered to be socially vulnerable.



Figure 3.1: Map of Nigeria showing Imo State (Source: Ministry of Lands survey and Urban planning, Owerri)

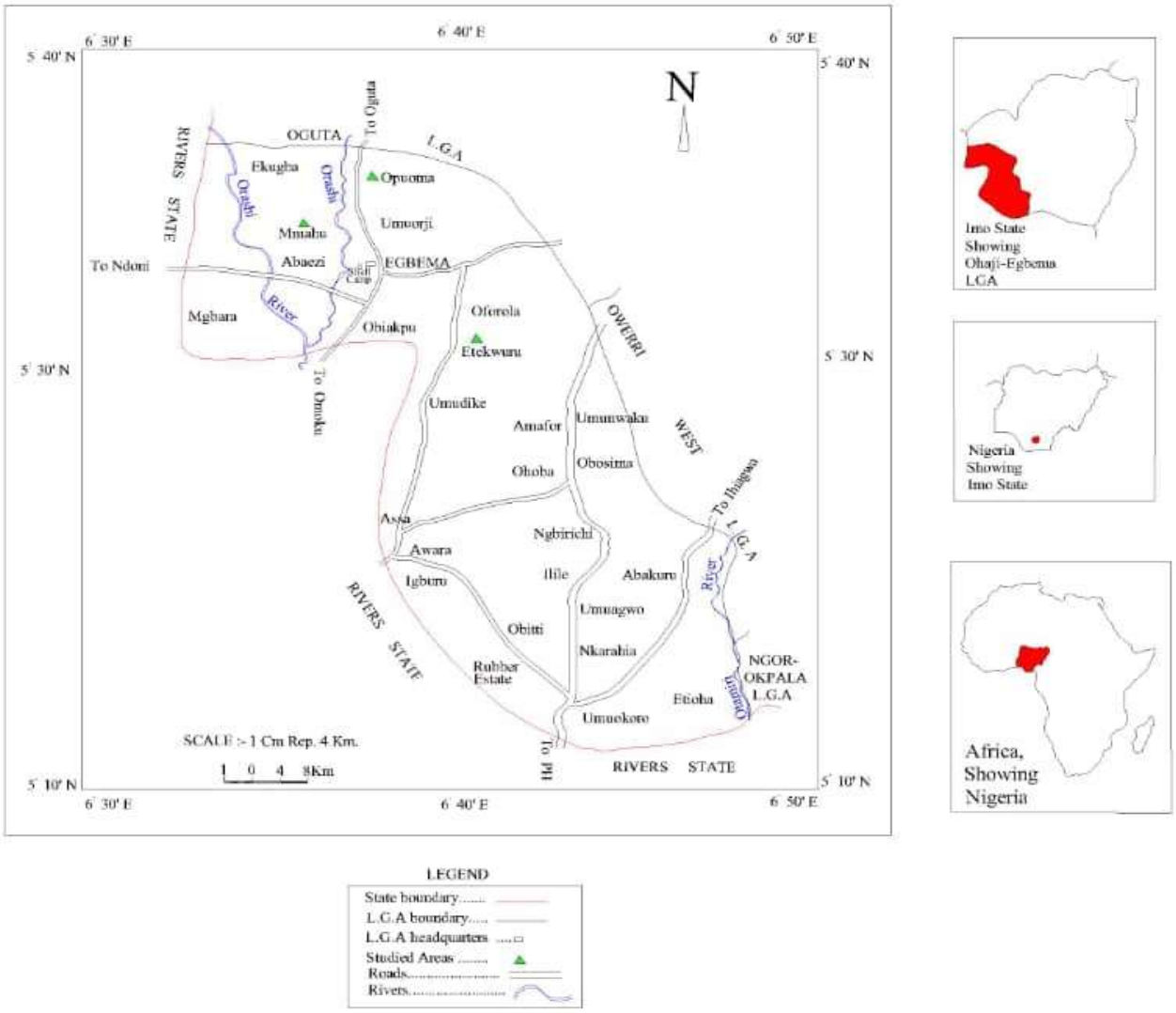


Figure 3.2: Map showing the study area (Source: Ministry of Lands survey and Urban planning, Owerri)

3.2.1 Climate

The study area has a humid tropical climate. The rainy season, as experienced in the rest of Imo State, begins around the month of March till October or early November. It is bimodal, peaking in July and September and decreases in August (Ibifubura and Uzoma, 2020). Rainfall is normally at its highest at night and early in the morning (Iheke and Agodike, 2016). The average annual rainfall in the study area ranges from 2000 to 2250 mm, with an average annual temperature of 26^{o}C to 32^{o}C due to change in

altitude. Imo State is experiencing an increase in minimum and maximum temperatures, as well as irregular annual rainfalls, which is cause for concern given the people's reliance on rain-dependent agriculture (Okorie *et al*., 2020; Ajiere *et al.*, 2021). Relative humidity changes with the seasons, ranging from 80% to 90% percent in the rainy season and 60% to 70% in the dry season. The dry season, which sets in around late November, is frequently accompanied by a dry, cold harmattan period that lasts for about nine weeks during the months of December and January (Amangabara, 2015; Chikere-Njoku, 2019). According to the IPCC, the humid tropical zone of southern Nigeria where the study area is situated, is already hot and wet, and will see an increase in both precipitation (particularly during the rainy season) and temperature. Temperature increases of 0.2-0.3^{o}C every 10 years have already been recorded in the country's various ecological zones (Oladipo, 2010). In Nigeria's tropically humid zones, where Imo State is located, precipitation increases by 2-3% for each 1^{o}C of temperature rise (Umunakwe *et al*., 2015).

3.2.2 Topography and drainage

The study area is within the coastal plain sands of the Benin geological formation underlain by the freshwater alluvial zone (Osumgborogwu et al., 2017). The topography of Egbema is a low lying plain with an altitude of about 50 m above sea level (Nwagbara and Irondi, 2016; Ahukaemere *et al.*, 2017). There are rivers like the Orashi, and Ogbuide which have their sources from the Njaba River and Oguta Lake. However, Orashi River is the largest known river that crosses almost all the communities in Egbema. This river connects the study area to other riverine states in Nigeria like Rivers State, Delta State and Bayelsa State. Orashi River discharges into the Atlantic Ocean.

3.2.3 Soil

In Egbema, the type of soil found are utisols formed from coastal plain sands (Nwagbara and Irondi, 2016). The soils are highly acidic with low variability. The soil of the study area also has high silt/clay content which increases with depth. The top soils in Egbema are very rich in organic matter due to the vegetation of the area (Okorie *et al*., 2020*)*. The soils support the growth of arable crops like cassava, yam, maize, cocoa yam etc.

3.2.4 Vegetation

The natural vegetation in the study area is tropical rainforest. The tropical rainforest vegetation has almost entirely been replaced by secondary forest, which consists mostly of wild oil palm trees of varying densities, as well as woody shrubs such as *Chromolaenu odorata* (Siam weed) and diverse grass undergrowth. The vegetation of the study area is dominated by a mixture of cassava (*Manihot esculentum*), oil palm (*Elaeis guineensis),* and bamboos (*Bambusa vulgaris*) in the upland while in the lowland areas are climax vegetation of raffia palm (*Raphia farinifera)* and riparian forest (Uzoho and Okechukwu, 2014). Human activities such as continual cropping, grazing, and bush burning have changed the region's original forest into secondary and grasslands, however, there are some dispersed distributions of forest lands in the area (Okoro *et al.,* 2021).

3.2.5 Population

The total population of Egbema according to the 2020 population projection is 69,695 (National Population Commission, 2006). The population census of 2006 (the last census in the country) and the 2020 projections indicate that Egbema has more males than females with many polygamous families. The communities with the highest population are Obiakpu with a total population of 12,862, followed by Etekwuru with 8931, Mmahu with 7726, Abacheke with 7585 and Opuoma with 6731.

3.2.6 Economic activities

Subsistence agriculture is the mainstay of the economy in Egbema because it is located in the state's fertile agricultural zone (Osumgborogwu *et al.,* 2017). Farming, fishing, hunting, palm oil production, and animal husbandry are all common economic activities in the study area (Ellah and Onyeagocha, 2023). Cassava, maize, yam, potatoes, palm oils, plantain, banana, and vegetables are the most common crops grown in these communities. The people practice more subsistence agriculture and sell excess in the market. However, the inhabitants at the farmsteads cultivate more than 1.2 hectare of land on the average and are majorly interested in selling to towns within and outside the state (Eze *et al*., 2023). The farmers practice shifting cultivation to allow farmlands to replenish their lost nutrients and make use of simple farming tools like hoe, cutlass, family labour for farm practices (Eze *et al*., 2023).

Egbema's settlements mainly of clusters with at least 230 people per square kilometer, supply food to the state's urban areas, including processed cassava, snails, bush meats, and vegetables, and are known

as Imo State's food basket (Osumgborogwu *et al.,* 2017; Eze *et al*., 2023). The people's livelihood is based on their agricultural economy, which explains why the people have farmsteads. These farmsteads have a fraction of the area's population comprising mostly farmers and fishermen who only return to the communities during market days to sell their agricultural products, during festive periods or events of weather/climate like floods. There are three major market days for each community to sell their goods. However, Nkwo-Mmahu, Orie-Abacheke, and Eke-Opuoma are the three main marketplaces in the area.

The study area has poor road networks linking it to nearby cities like the road from Opuoma community to Owerri, Etekwuru community to Owerri, Mmahu community to Owerri (Ogugbuaja, 2017). Many infrastructures like roads, water schemes, schools, and healthcare centers under constructions have been abandoned for years (Oguagbuaja, 2017). Electricity supply has long being cut off from the study area due to lack of maintenance of existing facilities and other factors.

3.2.7 Cultures and traditions

Egbema's inhabitants have a rich cultural legacy that reflects their respect for tradition. The Nze-Obi, the highest traditional seat of power, oversees the activities of the area until his death. The people have recently become autonomous communities with separate traditional rulers (Ezes) whose council members include other minor Ezes (Ezealis) from various villages within the communities and other palace chiefs who are carefully selected and installed by the king to assist in governing the people (Ogubguaja, 2017; Ellah *et al.,* 2023). The people of Egbema have a well-organized leadership structure, but the politics in Imo State has affected the leadership style by influencing who becomes the next king and leader which has hampered critical decision-making at the community level.

3.3 Chapter summary

The study was carried out in Egbema district of Ohaji/Egbema Local Government Area of Imo State in Nigeria due to its location along the coastal area of Nigeria. The weather and climate of the study area makes it an interesting place to study the vulnerability of households to impacts of climate change. Also, their main economic activities may likely expose them to the negative effects of climate and weather events or climate related-disasters.

CHAPTER FOUR: RESEARCH APPROACHES, PROCEDURES AND METHODS

4.1 Introduction

This chapter focuses on the study methodology and data collection procedures. The methodologies, data collecting tools, and methods covered in this chapter were used to satisfy the study objectives, achieve the stated goals, and answer the research questions. The researcher visited the study area twice, once during the planting season and once during the harvest period, which was accompanied by high floods that restricted travel in many parts of the communities.

4.2 Research Approach

Several research methodologies or approaches may be used to collect and analyze data. This can be achieved by employing quantitative, qualitative, or mixed methods. Thus, whether the collection instrument is appropriate for collecting data that can address the study objectives and answer the research questions determines the researcher's methods. A quantitative approach uses objective, systematic techniques and statistical analysis to describe hypotheses and variables (Bryman, 2012; Creswell, 2012; Neuman, 2014). A qualitative research method focuses on conducting in-depth analyses of individual situations that occur in context and gathering data from people in order to obtain detailed participant perspectives (Bryman, 2012; Creswell, 2012; Neuman, 2014). A mixed methods approach to data collection and analysis employs both quantitative and qualitative data collection strategies. Therefore, this study employed mixed methods as the most appropriate research method to achieve its stated aims and objectives.

Previous studies on social vulnerability and climate change have used both quantitative and qualitative approaches, resulting in mixed methods (a combination of quantitative and qualitative approaches). Some of the mixed methods used in social vulnerability and climate change studies such as Paul *et al.* (2016), Pongponrat and Ishii (2018), Kuchimanchi *et al*. (2019), included questionnaires, interviews, focus group discussions, and field observations to gather information about people's perceptions of vulnerability, climate change adaptation strategies, and disaster risk management. Understanding how people used their various social capital in climate change adaptation during past and current weather/climate events could be accomplished by understanding participants' experiences within their natural settings. For instance, Abaje *et al*. (2016) employed mixed methods to evaluate the impact of climate change and

adaptation measures in rural communities in Kaduna State, Nigeria. To obtain data, the researchers employed questionnaires and focus group discussions. For example, Paul *et al*. (2016) also utilized mixed methods to study how rural households, individually and collectively adjust to the effects of climate change.

In the context of this study, questionnaires were used to determine the socio-demographic and socio-economic characteristics of rural communities, their relationships, and social capital, while interviews, focus group discussions, and field observations were used to understand the nature of connectedness, relationships, collective efforts (collaborations), experiences with weather/climate events, impacts, awareness creation, and support/interventions. Therefore, the integration of quantitative and qualitative methods in this study makes it a mixed research methods study.

4.2.2 Researcher's positionality

Positionality here means the positioning or stance of the researcher with relation to the social, cultural and political context of the study, study area and its study participants. The researcher is positioned in the communities of the study in ways that help the seamless collection of data. For example, the researcher took steps to align with the ways rural communities communicate, relate and interact. As a native Nigerian, the researcher recognized the significance of these rural communities' social-cultural context. Having field assistants, knowing rural life and speaking the same language (Igbo) as the participants made it easier for the researcher to be accepted and trusted as an insider, and it allowed the participants to feel at ease during casual and formal interviews.

My insider status provided me with privileged access to important informants' thoughts, feelings, and behaviour, helping me to gain a better knowledge of how individuals interacted with their surroundings, with one another, and with various stakeholders, including government officials. Making appointments with respondents helped me avoid being too "native" and losing sight of my duty as a researcher. As an outsider, I was able to observe and question the distinct variances in climate change adaptation measures. I also tried to dress appropriately for the social group being examined. In this study, changing, mediating, and adjusting to an insider-outsider perspective offered me a better knowledge of how people use and have used their social capital in the past and present to build social resilience against climate change. This also helped me address concerns about how and why people engage with each other and different

stakeholders in rural communities when dealing with weather/climate events. However, certain participants (government officials) withheld some information from me. For example, participants who worked in government agencies avoided answering questions on the obstacles they experienced in handling climate-related disasters in Nigerian rural communities in order to avoid being questioned or fired by the government.

Obtaining permission to conduct interviews with rural households, stakeholders, and government officials, was less difficult because the researcher had been granted permission before the start of the interviews, observations, and focus groups. However, in some situations, the researcher was suspected of working for the government and had to deal with queries about what the government had provided to help communities suffering from weather/climate events such as flooding.

4.2.3 Research design

A convergent parallel mixed methods design was utilized in this study. It is a type of mixed methods design in which the researcher converges or merges quantitative and qualitative data in order to provide a full understanding of the research subject (Creswell, 2012). In this strategy, the investigator often gathers both quantitative (data obtained via questionnaires) and qualitative data (data obtained using Focus Group Discussions and interviews) at around the same time and then incorporates the information into the overall results interpretation (Creswell, 2012). In this design, contradictions or incongruent findings are explained or investigated further.

In this mixed methods approach, the researcher spent a month on the first visit and a week on the second visit undertaking fieldwork in the rural areas of Egbema on a full-time basis (Etekwuru, Mmahu, and Opuoma communities). While in the field, the researcher collected data using various tools such as questionnaires, which assisted in understanding the vulnerability of rural people by emphasizing their socioeconomic and demographic features. Also, the researcher used focus group discussions and interviews to collect data to achieve the goals and objectives of the study.

4.3 Data Collection Processes and Analysis

This section describes how the research was conducted. It explains how the researcher identified participants, gained field access, and the various tools used to gather and analyze data.

4.3.1 Sampling strategy

Rural household heads, the Director General of the National Emergency Management Agency (NEMA), the Director General of the National Environmental Standard and Regulations Enforcement Agency (NESREA), the Chairman of Ohaji/Egbema Local Government, traditional leaders, town union members, and farmers took part in this study.

According to the population projection for 2020 by the National Population Commission of Nigeria, Egbema district has a total population of 69,695 people. From this total, Etekwuru has 8931 while Mmahu and Opuoma communities have 7726 and 6731 people respectively. The sample size (240) was determined using the Fisher formula:

$$\text{Sample size} = \frac{(\text{z-score})^2 \times \text{std} \times (1 - \text{std})}{(\text{confidence interval})^2}$$

where confidence level = 95%, confidence interval = +/-5, standard deviation (std) = 0.5.

Using the sample size of 240 for the study, Etekwuru community got 100 copies of the questionnaires, while Mmahu and Opuoma communities got 80 and 60 copies respectively. In total, the study sampled 240 household heads, 18 farmers involved in focus group discussions, three traditional leaders and 15 town union members who were interviewed making a total of 276 participants. Furthermore, key informants were also selected among two concerned government agencies (National Emergency Management Agency and National Environmental Standard and Regulations Enforcement Agency) where their Director Generals (Executive Secretaries) were interviewed. Lastly, the chairman of the local council was also interviewed.

The NEMA was purposively selected as the government agency in charge of disaster management in Nigeria. They are in charge of preparing for, raising awareness about, acting on, and responding to natural disasters like flooding. Also, through purposive sampling, the NESREA was chosen since it is Nigeria's major statutory government body in charge of ensuring sustainable natural resource management and environmental preservation. The selection of NESREA was crucial to assess how they have been

implementing environmental legislation and aiding rural communities in guaranteeing the sustainable use and management of their natural resources.

As a connection between local stakeholders and the state government, the chairman of the local government council was purposively selected. This is because support during extreme weather/climate events is typically requested through the council chairman's office since he has strong relationships with officials from the ministries of agriculture, environment, and health, all of whom are critical in supporting rural populations in surviving climate-related disasters.

The traditional leaders from each community were also selected through a purposive sampling strategy because they have more information on weather/climate occurrences, ties between community members and local stakeholders, and assistance from the government, oil companies, and non-governmental organizations (NGOs). Traditional leaders are the heads of the communities with the ideal platform to communicate information and create awareness about climate change in their local communities because of their roles.

The executive members of town unions were purposively sampled because they are the cornerstone of leadership and important stakeholders in every community in Egbema. They are in charge of maintaining community peace and order, attracting development and support from various sources, and assisting rural households during disasters.

The researcher included both male and female household heads above 18 years resident in the communities at the time of the research. After the traditional leaders provided permission letters, the researcher found three research assistants (field assistants) who helped to create relationships and trust between the researcher and other community members. The researcher with the help of field assistants who are indigenes of the study area with a good knowledge of the culture and tradition of the rural residents was able to administer questionnaires randomly to household heads, explain and retrieve them successfully. Because the majority of these family heads interacted with one another regularly, they possessed a plethora of important expertise and information on how to use social capital to adapt to climate change. By gathering information from these household heads, the researcher was able to assess how vulnerable the people may be when weather/climate events occur.

Because farming is the primary economic activity in these communities, the researcher also focused on farmers to learn about the major weather/climate events that have affected them, the most affected portion of their farms, experiences, responses, support received, collaborations, and challenges in dealing with the climate disaster. Heads of farmers' group from each selected community were identified by the help of field assistants. Through the snowball sampling technique, other smallholder farmers involved in the cultivation of food and cash crops such as cassava, yam, and maize were selected for the study. The farmers were assembled in an open field were the focus group discussions took place.

The communities for the study were selected using a stratified sampling method that gave every community non-zero chance of being selected. Number of households for each community was therefore determined using an estimation formula for the sample size:

$n_h = (z^2)\ (r)\ (1\text{-}r)\ (f)\ (k) / (p)\ (\dot{n})\ (e^2)$

where n_h is the parameter to be calculated and is the sample size in terms of number of households to be selected, z = is the statistic that defines the level of confidence desired, r = is an estimate of a key indicator to be measured, *f* = is the sample design effect, *deff*, assumed to be 2.0 (default value), k = is a multiplier to account for the anticipated rate of non-response, p = is the proportion of the total population accounted for by the target population and upon which the parameter r is based, ṅ = is the average household size (number of persons per household), e = is the margin of error to be attained. After determining the sample size for each community using the above formula, household heads were selected using probability sampling technique based on the probability of 1/5 (that is 1 in 5 sampling rate).

Further, farmers were purposefully selected for the FGDs and snowball sampling method was used to select participants for the FGDs where selected participants helped to recommend other participants with similar traits and experience relevant to the study, who in turn recommend further respondents and the process is repeated (Cohen *et al.,* 2007; Bryman, 2012; Creswell, 2012; Neuman, 2014). The participants for the focus group discussions included 6 persons for each of the three focus group discussions with the farmer's group. Finally, Purposeful sampling method was used to select participants for key-informant interviews due to their in-depth knowledge or experiences relevant to the study. These key-informants

include three traditional leaders (each from the three communities), 15 town union members (five from each of the communities), two directors of relevant government agencies (NEMA and NESREA) and the council chairman of the Local Government Area.

Two farmers each from the selected communities participated in field observations. These farmers were voluntary participants who are experienced and have ongoing farm activities. The observations were necessary to elicit information from the farmers that were difficult to access through other methods (Creswell, 2012). The observations also helped to validate data obtained through other methods.

4.3.3 Gaining access

After receiving ethics clearance (Appendix 1) from the university, permissions to NEMA Director General, NESREA Director General, and the local government chairman as key informants were acquired in writing prior to the start of data collection. They were, however, notified via information sheets (Appendices 2), and interview dates were scheduled differently. Prior to receiving ethics clearance from the University, letters (Appendix 3) were written to traditional leaders requesting permission for access into the communities to conduct interviews with rural households. Access to Etekwuru, Mmahu, and Opuoma communities was also secured through traditional leaders, depending on their status in the communities.

4.4 Data Collection Instruments and Methods

This section discusses the data collection instrument schedules used in this investigation. Depending on the instruments used, data were acquired in a variety of methods.

4.4.1 Questionnaires to household heads

This study used the questionnaire as the most appropriate tool to collect data on the socio-economic and demographic characteristics of respondents as well as to elicit information such as response mechanisms to climate extreme events, awareness and perception of climate risks, and indicators of social vulnerability (Shrestha *et al.*, 2017; Ncube *et al.*, 2018; Mabuku *et al.*, 2018).

The questionnaires were structured in simple English language for easy comprehension and were carefully administered on face-to-face basis by the researcher and his field assistants to 240 household

heads in the communities selected for the study. English was the language of communication during the questionnaire survey. However, where participants had difficulties in understanding English, the researcher and field assistants explained the questions in the local language. The questions were on the socio-economic and demographic characteristics of household heads (section A), risk awareness, perception and preparation (section B), adaptation and coping strategies (section C) and questions on community adaptation (section D).

The majority of the questionnaires were given to household heads at their residences, while others were given out in public areas. Before giving the respondents the questionnaires (Appendix 4), the researcher and his assistants provided them with the information sheets (Appendix 5), which were adequately explained to them in their native language (Igbo), and then the consent forms were delivered and explanations were given in their native language before they signed them (Appendix 6). Each survey session lasted approximately 30 minutes, although it was occasionally longer because the researcher and his assistants required time to explain to the illiterate participants. At the end of the process, the researcher and his field assistants distributed and collected 240 completed questionnaires. The questionnaires were completed by rural household heads (both male and female) above the age of 18.

4.4.2 Pilot survey

The questionnaires were pre-tested to ascertain their reliability in achieving the desired goals of the study, detect errors or mistakes, and ensure that respondents fully understood the questions. The participants for this pre-test were randomly selected. A pilot survey was carried out in Abacheke community which is about 5km away from Mmahu community. This survey involved 24 respondents (10%) of the total sample size (240) randomly selected. Two questions were drawn from each section of the questionnaire for this purpose. The data obtained were analysed using descriptive statistics. These pilot studies were conducted in a different area from the study area. Based on the results of the pilot research, changes were made to the instruments.

Table 4.1 Pilot survey

Questions	**Responses (f)**	**Percentage (%)**
How many family members do you have?		
2-4	7	29.2

5-7	9	37.5
8-10	5	20.8
11 and above	3	12.5
What form of transportation system do you use?		
Taxi	3	12.5
Bicycle	11	45.8
Motorbike	6	25
Personal vehicles	4	16.7
Have you noticed any changes in the weather of your community?		
Yes	19	79.2
No	5	20.8
What are the climate-related disasters you have experienced here?		
Flood	18	75
Temperature rise	6	25
If you are to ask for help during climate disasters, who renders such help?		
Government	5	20.8
Family members/friends/neighbours	16	66.7
NGOs/Oil companies	3	12.5
Do you have any other place to live if your home get affected by climate disaster?		
Yes	10	41.7
No	14	58.3
Do you think getting help from other community members can help you recover?		
Yes	15	62.5
No	9	37.5
Do you think social organizations in your community can help you cope with climate change impacts?		
Yes	13	54.2
No	11	45.8

Since there were other modes of transportation like the use of canoes and boats in the study area, the questionnaire was modified to accommodate such gap. Similarly, question on climate-related disasters was modified to elicit more responses from the proposed participants of the main study by changing the tone of the question.

4.4.3 Focus group discussions

In addition to key informant interviews, focus group discussions (FGD) were held with groups of farmers (n = 18). Focus group discussions allowed for group interactions, allowing the researcher to investigate

the differences and similarities of different perspectives on the impacts and adaptation to climate change, whereas interviews focused on individual perspectives stated by the individual's experiences. Focus groups were chosen because they allowed respondents to challenge each other's opinions (Bryman, 2012). Focus groups were also used since they provided data on various ideas and sentiments that participants had about certain situations, as well as their personal opinions on such subjects (Rabiee, 2004). The focus group schedule included 18 open-ended questions for the farmers' group (Appendix 3). There were three focus group discussions involving 18 farmers (six participants in each group of farmers) from the three communities. Farmers' interactions with other community members, collaborations among rural farmers, inter-community linkages, interactions with seed, stem, fertilizer, and tool sellers, training, major weather/climate events affecting farmers, impacts, coping strategies, and challenges in adapting to climate change were all covered in the discussions. Some of the questions include; tell me about the weather events you often experience in this community? If there is a flood, drought, excess rainfall, or heat wave, how does it affect your crops? How does this weather event affect your planting system? Which section of your farm is affected the most? For gender sensitivity, all communities had three males and three females participate in each focus group. Finding participants for the discussions was challenging because the farmers were preoccupied with farming activities. As a result, the researcher waited patiently until the farmers returned and, with the assistance of some of the farmers, others were brought to the location of the FGDs. These discussions took place primarily in open locations on people's compounds. When they all assembled, the researcher distributed information sheets (Appendix 7), which were explained in Igbo language because many of the participants could not understand English. Following their agreement to continue the discussions, consent forms were distributed (Appendix 8), and they all signed them. When the participants were settled, the researcher served as the moderator and allowed the farmers enough time to speak. The allocated time scheduled for the FGD was 45 minutes but was sometimes exceeded because participants delved into other topics. The researcher made notes and used a recording device to record the discussions with their permission.

4.4.4 Key informant interviews

This study used interview schedules to elicit further information from some key informants from the communities and concerned government agencies. Before this, permission letters were obtained from relevant authorities. The key informants included community stakeholders comprising traditional leaders and town union members of each of the communities. Furthermore, the council chairperson of

Ohaji/Egbema Local Government Area was also interviewed. In the same vein, two director generals of the National Environmental Standard and Enforcement Agency (NESREA) and the National Emergency Management Agency (NEMA) were interviewed. In all these, the researcher presented information sheets and consent forms to the participants and used a recording device to capture their responses with their permission. The interviews focused on climate extreme events, climate change impacts at household and community levels, social capital for building adaptive capacity, collective efforts and inclusiveness in government's decision-making processes, interventions, climate risk awareness creation, preparations for future climate events, disaster risk reduction and management practices, and climate change policies.

Each informant had a semi-structured interview schedule with open-ended questions. The open-ended questions also enabled respondents to express their opinions and experiences without being constrained by the researcher's assumptions (Creswell, 2012).

4.4.4.1 *Key informant interviews with the NEMA and NESREA Director Generals*

The semi-structured interview schedule for NEMA included 14 open-ended questions (Appendix 9) were on management issues such as whether policies and laws were protecting NEMA's activities and policies for climate change adaptation, collaborations in disaster management, challenges they faced in implementing these laws and policies, support they provided to victims of climate-related disasters in rural communities, and whether they were engaging rural communities. NESREA Director General's semi-structured interview schedule included eight open-ended questions (Appendix 10). These inquiries centered on whether the agency was ensuring that laws and guidelines in ecosystem management in rural communities, environmental education for rural communities, warning systems against climate risks, institutional barriers to implementing climate change policies and promoting useful dialogues among climate change actors were followed.

Interviews with NEMA and NESREA were done through appointments at the agencies' headquarters. Before beginning the interview, each participant was handed a participant information sheet. This was followed by the consent forms (Appendix 11), which they signed, indicating their willingness to participate in the interview. Interviews with the NEMA and NESREA Director Generals lasted about 45 minutes. With consent from the interviewees, the researcher took down notes in a field notebook while audio recording the interviews with a recording device.

4.4.4.2 *Interviews with the local government chairman*

The interview schedule for the local government chairman included 11 questions (Appendix 12). The questions were on the local government chairman's interactions with local stakeholders, including how they discuss and share climate change information, agricultural programs for farmers, interventions during and after weather/climate events, and local government council support for victims of climate disasters.

Only the chairman of the local government was interviewed in one day, inside his executive office at the Mmahu community's local government headquarters. After two failed appointments, this one was kept. The participant information sheet (Appendix 13) was delivered to the local government chairman on the day of the interview, and he completed the consent papers (Appendix 14) after agreeing to participate in the research. With permission, the respondent's comments were audio-recorded, and the researcher took notes during the 45-minute interview.

4.4.4.3 *Interviews with traditional leaders*

A semi-structured interview schedule with 13 open-ended questions was designed for the traditional leaders of the three communities chosen (Appendix 15). These questions were on issues such as their perspectives on community members' relationships, links with stakeholders, sources of weather/climate information and how they are shared, types of weather/climate events, support received, and the government's inclusion of traditional leaders in decision-making and policy formulation.

On different days, three traditional leaders from three different communities (Etekwuru, Mmahu, and Opuoma) were interviewed. The interviews were well-planned, with appointments kept and interviews done in their respective palaces. Before the interviews, the traditional leaders were also handed information sheets (Appendix 16). There was no need to clarify the facts because they could all grasp English pretty well. The respondents signed the consent form after agreeing to be interviewed (Appendix 17). Each interview lasted around 45 minutes, and the researcher audio-recorded and took notes during the interviews with permission from the respondents.

4.4.4.4 *Interviews with town union members*

For town union members (5 members from each town unions) in the three communities chosen for this study (n=15), a semi-structured interview schedule with eight open-ended questions was developed (Appendix 18). The questions were on the town union's efforts to bring community members together, how they share the outcomes of stakeholder meetings, their responses to weather/climate events, the assistance they provide to vulnerable households, situations that expose people to climate disasters, and community coping strategies.

Each community had five respondents who were interviewed on various days and in different locations. For example, one of the Mmahu town union member was interviewed as he was about to take a taxi, while another from the Etekwuru community was interviewed inside his saw mill. The researcher had a tough time locating these town union members because many of them were not at home during the interviews. Participants were given information sheets (Appendix 19) before the interview began consent forms were signed if they decided to participate (Appendix 20). Each of the town union members was interviewed for at least 45 minutes. The researcher took notes with their permission and recorded the interview using an audio device.

4.4.5 Observations of the physical environment and peoples' activities

Data were also gathered through researcher observations of farmlands and farming activities in order to provide insight into information such as the nature of the communities' terrain and farming systems practiced that were difficult to acquire during formal interviews and focus group discussions.

4.4.5.1 *Field observation of the study area's physical environment*

During the field observation, the researcher examined the physical surroundings as well as how people interacted with one another and with the environment. For example, during the observations, the researcher took note of the topography of the three communities, infrastructural facilities like hospitals, and schools and as well as noted the modes of transportation and economic activities. The researcher toured the communities, watching and conversing with the locals informally. The researcher was able to comprehend the rural people's culture, traditions, religious beliefs, economic activities, and social lives. The researcher took notes on these features and community characteristics.

4.4.5.2 *Participant observations*

Two farmers from each of the three communities were chosen for field observations. Before going to the farms, the farmers were given information sheets that were conveyed in Igbo because most of the farmers were having trouble understanding. After everyone decided to participate, the consent form was distributed and explained in Igbo, and they all gave their approval before the field observations began. Permission was granted to photograph the farmlands. These photographs were preserved in a digital camera so that they could be used to supplement the interviews and focus group data. However, the farmers refused to allow the researcher to photograph them on the farm.

The researcher would go around the farms with the research assistants, observing, taking notes, and photographing the nature of the farms, as well as what the farmers do to mitigate the effects of weather/climate occurrences. For example, the researcher observed that farmers practice slash and burn, cultivating mostly cassava and maize while some do selective clearance of the farm (leaving some shrubs standing). The researcher took descriptive field notes on the various activities seen and how they were carried out. As a result, field observations were conducted during the planting season (early April to June).

Field observation was used in this study because it provided the researcher with direct access to what farmers were experiencing and how they were coping with the conditions. The observation schedule (Appendix 21) featured a set of actions that helped the researcher in making notes. The checklist included the nature of the farmlands, people involved in various activities in the physical space, activities that people do when those events occurred, emotions expressed by farmers when they do different activities, and the various issues and different things that farmers were attempting to do to survive harsh-weather conditions.

While the researcher observed farmers performing various tasks such as weeding, excavating, and nurturing crops, he would chat with them, asking open-ended questions. These informal interactions assisted the researcher in understanding why and how some of the activities on the farms were carried out. Informal interactions were held in Igbo, and the researcher jotted down some field notes and wrote comprehensive field notes in the absence of the participants at night.

Appropriate images obtained using a digital camera by the researcher during field observations were chosen. Photos obtained via direct and participant observation were organized into categories based on the various significant features associated with the images. To describe how rural households responded to weather/climate events, these photographs were combined with textual data from interviews and FGDs.

4.5 Data analysis

The questionnaire data were analyzed using descriptive statistics and SPSS version 27. Thematic analysis was used to analyze data acquired from key informant interviews and focus group discussions.

In this study, interviews and focus group discussions were analyzed using thematic analysis. Thematic analysis is an inductive research approach for evaluating qualitative data that involves detecting, analyzing, and interpreting patterns of meaning within qualitative data. The thematic analysis uses the researcher's data to determine the themes identified in the study (Braun and Clark, 2006).

The researcher transcribed the responses from the interviews and focus groups from audio format to text to conduct a thematic analysis. This was accomplished by briefly listening to the audio files of each interview and FGD before writing down what was said and keeping in mind the questions that were asked. This procedure was repeated to ensure that no audio was missed. To retain the true voice of the participants, the words of the participants were typed exactly as they were uttered, without alteration. To prevent missing crucial information, the FGDs that were not in English were initially typed in their original language before being translated into English. Before conducting a thematic analysis on the audio, the researcher played them back while reading the transcripts to confirm that everything was in order.

Thematic analysis is an effective method for assessing people's perspectives, opinions, knowledge, experience, or beliefs based on qualitative data such as interviews and focus group transcripts (Caulfield, 2019). In this study, the following steps were taken to implement the thematic analysis adopted by Caulfield (2019):

1. Familiarization; the researcher became acquainted with the data by carefully reading the transcripts and comprehending what the data said while also taking notes on what the participants implied in their responses.
2. Coding; this is the researcher's second phase, in which detected points in words, sentences, and phrases were highlighted in different colors to represent different data contents.
3. The next stage was to discover patterns within the highlighted codes to produce themes. As a result, the researcher detected comparable patterns within various codes and grouped them under broader themes.
4. Themes were thoroughly examined to ensure that nothing was missing and that they accurately represented the data.
5. Theme definition and naming; the researcher analyzed the meanings of each theme and how they contributed to comprehending the data. At this phase, the researcher determined that some themes were not a proper representation of the data, therefore they were replaced with more appropriate ones.
6. Writing up; this is the final stage of thematic analysis in which the researcher describes and interprets the findings in written form.

Therefore, the thematic analysis of the responses on weather/climate events and experiences of rural households in the selected communities produced the following themes: Major weather/climate events in rural communities of Egbema; impacts of weather/climate events; sources of weather/climate information and communication; rural communities' weather/climate events coping strategies; challenges to coping/adaptation; and climate change adaptation decision-making.

Even though thematic analysis was used to analyze interviews and focus group discussions, the interpretations were not the same. Individual interviews reflected one person's point of view, whereas focus group discussions reflected a composite of points of view.

4.7 Ethical Considerations

The research procedure was regulated by ethical norms for data collection and analysis, as well as report writing (Creswell, 2012). It is critical to provide participants with a clear explanation of the reasons for doing the research, why they are being requested to participate, and the potential benefits, risks, and stresses that may come from their participation in the research (Smith *et al.,* 2015). The permission to

conduct this research was granted by the University of the Witwatersrand Research Ethics Committee (Non-Medical) via an ethics certificate (Protocol Number: H22/01/24) obtained in March 2022 (Appendix 1) following a rigorous process of ensuring that the research instruments, participation information sheets, and participation consent forms complied with the ethical guidelines.

Potential participants were therefore provided with different participant information sheets explained in their local language (Appendices 2, 5, 13, 16 and 19) to describe the goal of the study and the nature of their participation. Participants were also informed regarding confidentiality and anonymity, as well as that their participation was entirely voluntary and that they might withdraw at any time without penalty. By allowing participants to sign informed consent forms, informed consent was obtained (Appendices 6, 8, 11, 14, 17, and 20). Informed consent allowed respondents to fully understand the nature of the research and the significance of their involvement in the study (Creswell, 2007).

4.8 Chapter summary

Despite the constraints described above, the research approach (mix-methods research strategy) and research design that utilized a variety of data collection methods allowed for the acquisition of 'rich' and 'thick' data for this study. The questionnaires and interview guides were designed for easy understanding to aid seamless data collection process. Thematic analysis was utilized to assist in identifying meaningful themes to answer the research questions and achieve the stated aims and objectives of the study. As a result, this chapter sets the tone for Chapter 5, which will deliver the analyzed data.

CHAPTER FIVE: RESULTS

5.1 Introduction

To satisfy the research goals of this study, the data gathered between March 2022 and July 2022 through questionnaires, interviews and FGDs are presented separately in this result section. The research findings are given following the aforementioned research goals (Chapter 1). This section of the result makes use of tables, and direct quotes from anonymized participants to display pertinent material that has been examined and categorized by thematic analyses. To comprehend the roles played by socioeconomic and demographic attributes, social capital, and collective efforts of rural households in adaptation to climate change, data obtained through open questions were categorized using thematic analysis. Furthermore, the results for the three selected communities are presented separately in tables but analyzed together in the text because these communities gave almost the same responses due to their similarity to each other and there is no need to split the results according to communities in the text. However, quotes are identified for communities.

5.2 The Socio-Economic and Demographic Structure of Respondents

5.2.1 Gender

In the three communities, questionnaires were done. In total, 240 questionnaires were distributed according to the population sizes of the three selected communities (Etekwuru having 100, Mmahu with 80, and Opuoma with 60). All 240 of the administered questionnaires were collected after eliciting responses from participants. In total, 51.2% of the respondents are female while 48.8% are male (Table 5.1).

5.2.2 Age

Table 5.1 shows that 80% of the respondents were between the age of 18-59 years, that is 18-29 (17.9%), 30-39 (21.7%), 40-49 (21.2%), 50-59 (19.2%), while those above 60 years were only 20% (that is 60-69 (12.5%), 70-79 (4.6%), and only 2.9% were above 80 years. The younger household heads especially those between the ages of 18-29, 30-39, and 40-49 years were mainly males whilst older ones between 50 years and above were mainly females because many of them were widows. The youngest participant was a male household head in the Mmahu community who was 20 years old while the oldest participant was a female household head who was 84 years old in the Etekwuru community. The seven categories

of age brackets suggest that the household heads have a wide range of experiences with weather/climate events in their respective communities.

5.2.3 Education

The respondents' education qualification ranges from primary to tertiary with only 8.3% not having any formal education. Most of the respondents attained only secondary education (60%) and primary education (20%) while only 11.3% attained higher education. This implies that 60% of the respondents have secondary education as their highest level of education in the study area. Also, 50% of those who had no formal education were between 60-79 years and were mainly female participants. However, only one participant who is above 80 years had no formal education. The highest number of participants who had primary education as their highest level of education are between 50-59 years old, representing 33.3% of the total households with primary educational qualification. More so, 66.7% of those with tertiary education were between 18-39 years of age and were mostly male household heads. The result therefore shows that, the male respondents are more educated than the female ones and the younger household heads are more educated than the older ones. The implication is that there is at least an average literacy level amongst the rural residents which may ease understanding of climate risks.

Table 5.1: Respondents' socio-economic and demographic structure (n=240)

Variables	Etekwuru Community	Mmahu Community	Opuoma Community	Total	Percentage (%)
Demographic Factors					
Sex					
Male	42	49	26	117	48.8
Female	58	31	34	123	51.2
Age					
18-29	18	15	10	43	17.9
30-39	15	25	12	52	21.7
40-49	24	16	11	51	21.2
50-59	22	11	13	46	19.2
60-69	14	8	8	30	12.5
70-79	5	3	3	11	4.6
80 and above	2	2	3	7	2.9
Education					
No formal education	12	5	3	20	8.3
Primary education	14	15	19	48	20.0
Secondary	63	50	32	145	60.4
Tertiary	11	10	6	27	11.3
Number of people in household					

2 – 4	30	22	13	65	27.1
5 – 7	34	39	30	103	42.9
8 – 10	22	12	12	46	19.2
11 – above	14	7	5	26	10.8
Years lived in the community					
Less than 10yrs	13	10	8	31	12.9
10yrs and above	34	25	11	70	29.2
Life time	53	45	41	139	57.9
Do you have relatives in this community					
Yes	82	72	50	204	85.0
No	18	8	10	36	15.0
Household head's relationship with other community members					
Good	81	72	46	199	82.9
Not Good	19	8	14	41	17.1
Means of transportation					
Personal Vehicle	12	9	7	28	11.6
Bicycle	41	25	27	93	38.8
Motorcycle	14	23	9	46	19.2
Foot	19	13	10	42	17.5
Others (eg. Taxis, canoes/boats)	14	10	7	31	12.9
Disability in household					
Yes	16	7	8	31	12.9
No	84	73	52	209	87.1
Social Factor					
Access to Healthcare					
Hospital	38	30	15	83	34.6
Clinic	9	5	0	14	5.8
Chemist shop	45	39	40	124	51.7
Herbalist	8	6	5	19	7.9
Economic Factors					
Sources of livelihood					
Farming	66	54	40	160	66.7
Hunting	10	3	5	18	7.5
Fishing	9	14	10	33	13.7
Others such as government jobs, and trading	15	9	5	29	12.1
Household heads' income per month in naira					
Less than 10,000	3	5	2	10	4.2
10,000 – 20,000	25	11	20	56	23.3
20,000 – 30,000	15	8	5	28	11.7
30,000 – 40,000	11	5	11	27	11.3
40,000 – 50,000	26	13	11	50	20.8
50,000 – 60,000	10	23	8	41	17.1
60,000 – 70,000	1	5	0	6	2.5
70,000 – 80,000	0	2	0	2	0.8
80,000 – 90,000	1	1	0	2	0.8
90,000 – 100,000	0	1	0	1	0.4

100,000 – and above	8	5	4	17	7.0

5.2.4 Household size

When household heads were interviewed about the size of their households, it was discovered that 27.1% have 2-4 members, 42.9% have 5-7 members, 19.2%, have 8-10 members, and 10.8% have 11 members or more. The average number (mode) of people living in these households is seven (7) while the highest number of household is 25, with 15 females and 10 males as members and the household head was above 80 years who attained only secondary school. The smallest household size found during this survey was two (2). Furthermore, 69.9% of households with 2-4 members are between 18-39 years while 35.3% of the same age group have 5-7 household members. Also, 20.9% of them have 8-10 household members and only 16% of those with 11 and more household members are between 18-39 years. Similarly, 50.4% of those household heads with 5-7 members in their homes were between 40-59 years, 51.1% of them with 8-10 household members are between 40-59 years while 52% of the same age bracket have 11 and more household members. Also, 23.2% of those with 8-10 household members are between 60-69 years.

Further, 9.1% of household heads with 2-4 members have no formal education, 10.9% have only primary education, 54.5% of them attained secondary school and 25.5% have tertiary educational qualifications. In the same vein, 7.8% of the household heads with 5-7 members in their homes, have no formal education, 29.1% of them have primary educational qualifications, 53.4% have only secondary education and 9.7% have tertiary educational qualifications. Also, 17.9% of the household heads who indicated to have 8-10 household members have no formal education, 21.4% of the same group have only primary education, 46.4% have secondary education and 14.3% have tertiary education. For the households with 11 or more members, 11.5% of the household heads are illiterates, 19.2% have only primary education, 57.7% of them have secondary education and 11.5% have tertiary education. This result shows that household size is influenced by age and education because the more educated household heads have a lower number of household members. This may be because educated persons tend to be more economically productive and hardly practice polygamy.

5.2.5 Sources of livelihood

Table 5.1 shows that, out of the 240 respondents, 66.7% are farmers. The majority of these farmers (66.8%) are between 40-59 years, only 14.4% are within the age bracket of 18-39 years while 18.8% are

60 years and above. The youngest farmer in the study area was a male participant of 24 years while the oldest was a female participant who was 84 years. Also, 8.7% of the farmers have no formal education, 22.5% have only primary education, 58.8% have secondary educational qualifications and only 10.0% have tertiary educational qualifications. 16.9% of these farmers have between 2-4 household members, 35.0% have 5-7 members 30.0% have between 8-10 members and 18.1% have 11 and more household members. This result implies that the majority of the farmers have more than five (5) household members.

Among the household heads are also hunters who constitute 7.5% of the respondents. The hunters survive by selling bush meat caught through traps, bush burning, and guns. In total, 38.9% of these hunters are between 18-29 years, 27.8% of them are 30-49 years, 22.2% are between 50-59 years while only 11.1% are 60 years and above. The hunters are relatively young male participants with 44.4% of them having no formal education, and 22.2% and 33.3% having only primary and secondary education respectively. The data on sources of livelihood further show that 11.1% of those involved in hunting have only 2-4 household members, 50.0% have between 5-7 members 22.2% have 8-10 members, and 16.7% have 11 and more household members.

Further, 13.7% of the household heads engage in fishing activities. Due to the study area being within the coastal region, many of the fishermen and women build houses close to the rivers to enable them to catch commercial quantities at night. The majority (57.5%) of those engaged in fishing are young male participants between the age of 18-39 years, while 33.4% of them are 40-59 years. Among these fishermen/women, 18.2% have no formal education, 27.3% have only primary education 51.5% have secondary education, and 3.0% have tertiary education. Only 12.1% of these respondents engaged in fishing activities, have 2-4 household members, 45.4% of them have 5-7 household members while 27.3% have 8-10 members and 15.2% have 11 and more members.

Finally, 12.1% of the households claimed they earn their income from other sources such as formal employment (government jobs), crafts, and trading of agricultural products. Out of the 29 participants who claimed other sources of livelihood, 19 (65.5%) are between 18-39 years, while 27.5% are between 40-59 years. Only 4 (13.8%) of them have no formal education, 6 (20.7%) have primary education, 12 (41.4%) have secondary education and 7 (24.1%) have tertiary educational qualifications. Furthermore, 8 (27.6%) have between 2-4 household members, 12 (41.4%) have 5-7 household members, 6 (20.7%)

have between 8-10 household members, and 3 (10.3%) have 11 and more members in their households. The main source of livelihood of the household heads in these communities is farming practiced mainly by females. The highest educational qualification for most of the farmers is secondary education and the majority have five and above members of household. Those whose source of livelihood is either a government jobs, crafts, or trading of agricultural products are more educated and have fewer household members than the farmers, hunters, and fishermen/women and were mainly male participants.

5.2.6 Income of household heads

In Table 5.1, household heads reported their monthly income from their various economic activities. However, the household heads did not report having several income streams. In total, 4.2% have a household income of less than 10,000 naira per month, which indicates extreme poverty when compared to the national minimum wage of 30,000 naira in Nigeria. A higher percentage (35%) earn between 10,000-30,000 naira per month, 32.1% earn between 30,000-50,000 naira every month, 19.6% earn between 50,000-70,000 naira currently less than a hundred dollar, while 1.6% of household heads earn between 70,000-90,000 naira per month, and only 7% earn 100,000 naira and above. Of the lowest earners who get less than 10,000 naira every month, 20% are between 18-39 years, 60% are 40-59 years and 20% are above 60 years. In total, 20% of this group have no formal education, 20% have only primary education, 60% have secondary education and none have tertiary educational qualifications. In total, 30% of household heads earning less than 10,000 naira per month are male participants while 70% are females. These people live below the average national income of 30,000 naira in Nigeria (Akintayo *et al*., 2020).

Of the household heads who get 10,000-20,000 naira every month, 26.7% are between 18-39 years, 53.6% are 40-59 years and 19.5% are 60 years and above (Figure 5.1a). Further, 17.8% of these people have no formal education, 25% have only primary education, 28% have secondary education and 7.1% have tertiary education (Figure 5.1b). Similarly, 21.4% of those who earn 20,000-30,000 naira monthly are between 18-39 years old, 53.6% are between 40-59 years and 25% are 60-69 years old. Also, 4 (14.3%) of them have no formal education, 3 (10.7%) have only primary education, 19 (67.8%) have secondary education and 2 (7.1%) have tertiary education. Also, this group lives below the national minimum wage (that is 30,000 naira) in Nigeria.

Of the participants who earn 30,000-40,000 naira monthly, 14 (51.8%) of them are 18-39 years old, 9 (33.4%) are between 40-59 years old, and 4 (14.8%) are 60 and above years (Figure 5.1a). Among these people, 18 (66.7%) attained secondary education while 9 (33.3%) have tertiary education (Figure 5.1b). Also, 13 (26%) of participants who get 40,000-50,000 belong to the 18-39 years age group, 30 (60%) are between 40-59 years, while 6 (12%) are between 60-69 years and only 1 (2%) is above 80 years. In total, 5 (10%) of these people have no formal education, 8 (16%) have only primary education, 28 (56%) have secondary education and another 9 (18%) have tertiary education.

Of household heads who claimed they earn 50,000-60,000 naira monthly, 11 (26.8%) are between 18-39 years, 18 (43.3%) are between 40-59 years old, and 12 (29.3%) are between the age of 60 and above years (Figure 5.1a). 9 (21.9%) under this category have only primary education, 13 (31.7%) have secondary education and 19 (46.3%) have tertiary educational qualifications (Figure 5.1b). Only 10 (2%) of the total sample population earn between 60,000-90,000. However, the highest earners are those who get 100,000 naira and above monthly where 52.9% are between 18-39 years, 29.4% are between 40-59 years old, and 17.7% are 60 years and above. Among these people, 2 (11.8%) have only primary education, 6 (52.9%) have secondary education while 9 (35.3%) have tertiary education. Also, 10 (58.8%) are male participants while 7 (41.1%) are female participants.

Income earned by participants varied with household sizes (Figure 5.1c). For example, 7.3% of participants who have 2-4 household members earn less than 10,000 naira monthly, 38.3% of them earn between 10,000-30,000 naira, while 29.4% of them earn between 30,000-50,000 naira monthly and only 7.3% of them earn 100,000 and above. Further, 7.7% of households with 5-7 members earn less than 10,000 naira monthly, 38.4% earn between 10,000-30,000 naira while 28.8% of them get between 30,000-50,000 naira and 14.4% earn 100,000 and above. Similarly, 11.4% of households with 8-10 members earn less than 10,000 naira monthly, 31.8% of them earn between 10,000-30,000 naira on a monthly basis while 29.6% earn between 30,000-50,000 naira and only 11.4% of the earn 100,000 and above. Finally, only 4.2% of the households with 11 and above members earn less than 10,000 naira monthly, 41.7% of this group get 10,000-30,000 naira monthly while 29.8% earn between 30,000-50,000 and 16.7% earn 100,000 and above.

A total of 3.7% of farmers earn less than 10,000 naira monthly, 38.1% of them earn between 10,000-30,000, 36.9% of the farmers earn 30,000-50,000 naira monthly, only 7.1% earn between 50,000-90,000 naira while 11.9% earn 100, 000 naira and above (Figure 5.1d). 16.7% of the hunters earn less than 10,000 naira, 50% of them earn 10,000-30,000 naira monthly, while 27.8% earn between 30,000-50,000 naira. For those who engage in fishing activities as a source of income, 15.1% earn less than 10,000 naira, 36.4% earn 10,000-30,000 naira, 36.3% earn 20,000-30,000 naira, monthly while none of them earn 100,000 naira and above.

Finally, for those who engage in other economic activities such as government jobs, trading, and crafts, only 6.9% earn less than 10,000 naira monthly, 37.9% get 10,000-30,000 naira monthly while 17.2% get 30,000-50,000 Naira monthly and 27.6% earn 100,000 naira and above (Figure 5.1d). The hunters earn the lowest while the highest earners are those who engage in other economic activities outside farming, hunting, and fishing.

The majority of the household heads are living below the poverty line (i.e. earning less than $1.25 per day) and what they earn is below the national minimum wage in Nigeria. The result also suggests that younger people (between the ages of 18-49 years old) earn more income than the elderly ones and the more educated people (those with higher educational qualifications) earn higher than the less educated ones. The lowest earners in these communities are mostly females. The household heads with more members earn less than those with small household members and those who engage in other economic activities earn more than those in primary economic activities like farming, hunting, and fishing. For example, some of these people who engage in welding works, and transportation business may earn at least 2,000-5,000 naira daily which could be about 60,000-150,000 in 30 days.

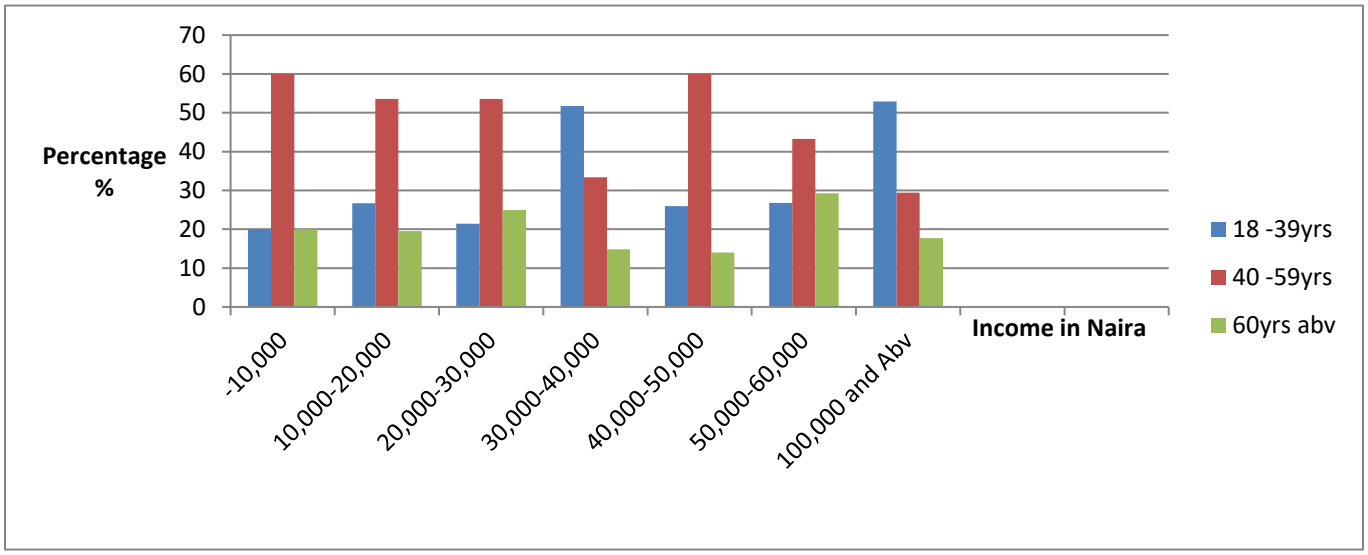


Figure 5.1a: Distribution of income according to age of household heads

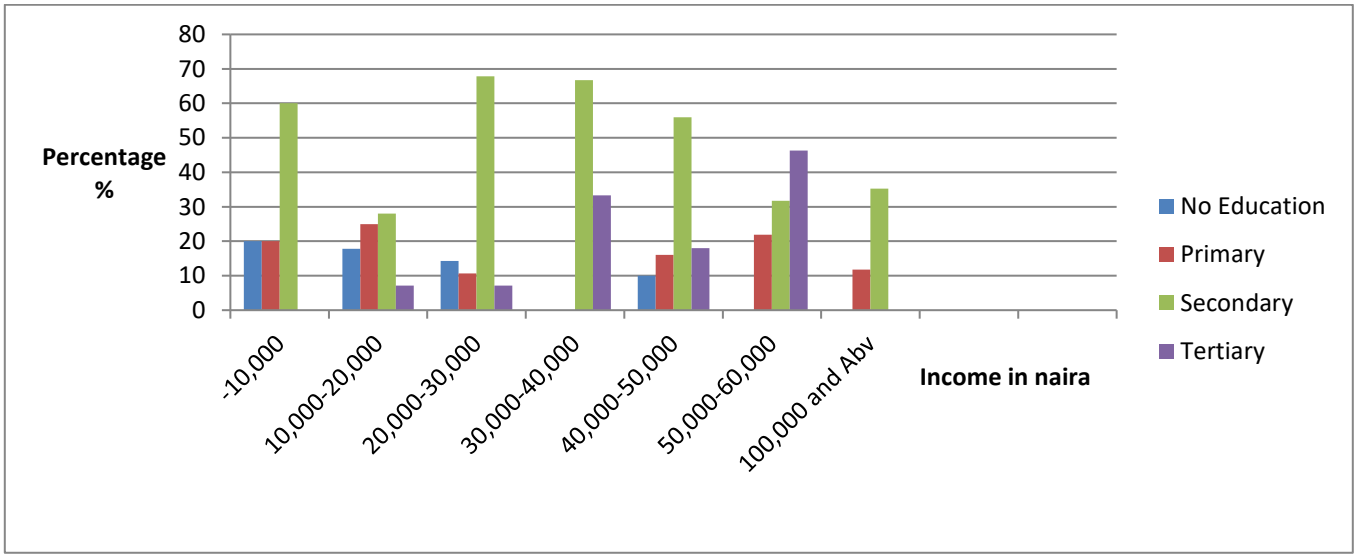


Figure 5.1b: Distribution of income according to educational background of household heads

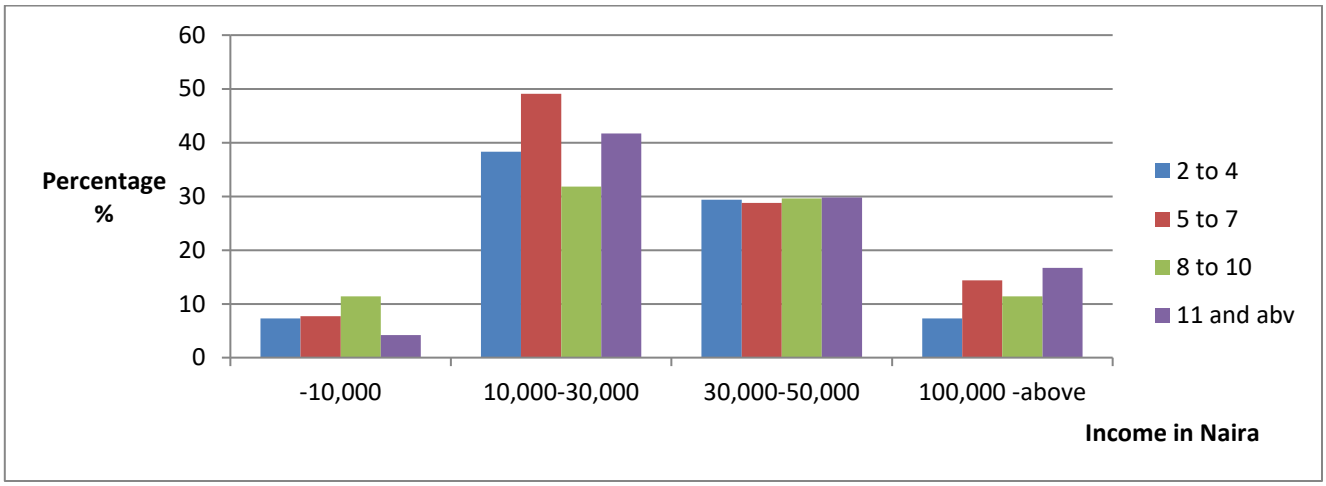


Figure 5.1c: Distribution of income according to household sizes

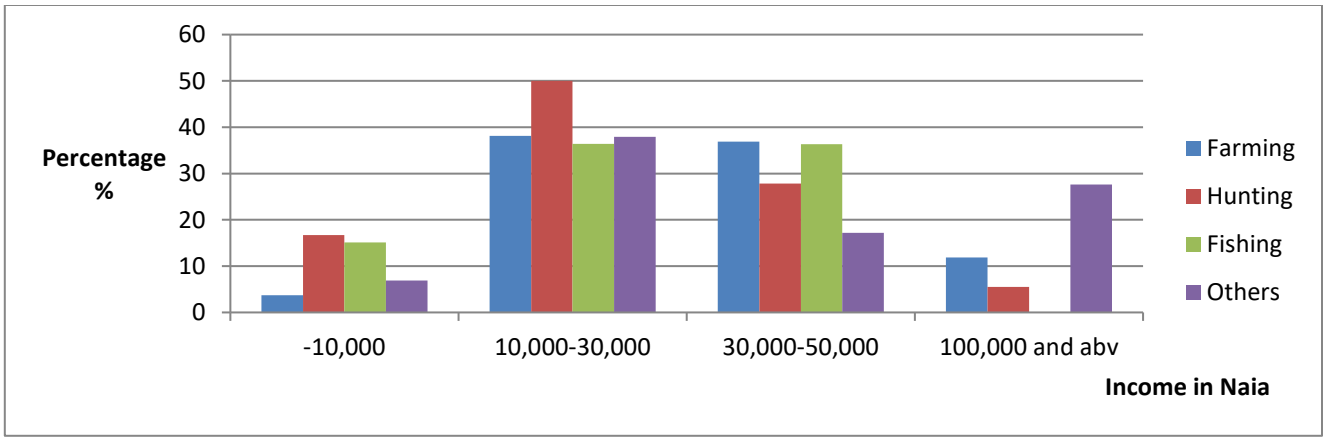


Figure 5.1d: Distribution of income according to sources of livelihood

5.2.7 Years lived in the community

To ascertain the respondents' familiarity with local climate change trends, the researcher wanted to know how long the respondents had resided in the communities. On this basis, it was found that 57.9% of the household heads had lived in these localities their whole lives. Only 12.9% of the respondents have resided in these communities for less than ten years, compared to 29.2% who have lived there for over ten years. This implies that 87.1% of these household heads have stayed in these communities for more than 10 years and should provide adequate and reliable information on weather/climate conditions in their local areas, their societal interactions, and support network. In total, 64% of these people are farmers, 7% of them are hunters, 13% of them are into fishing and 16% engage in other economic

activities in these communities. The result shows that people who have lived a long time in these communities are mainly farmers because they have more access to farmlands for cultivation. This implies that such farmers may be more experienced in farming practices and indigenous climate change adaptation knowledge. The longevity of these people in this study area allowed them to build strong ties, associations, and relationships with family, friends, and neighbours who are ready to assist in times of need.

5.2.8 Family relationships in communities

As seen in Table 5.1, a large percentage of respondents (85%) claimed that they have family relationships and ties in the communities. The majority of them marry within the same locality, attend schools, join the same social groups, and share farmlands and farm tools. Only 15% of those living in these communities do not have any family relationships. These are among the fraction of persons (12.9%) who have lived less than 10 years in the study area (Table 5.1).

5.2.9 Relationships with other community members

Regardless of kinship connections, it is important to gauge the degree of closeness among community members. Table 5.1 shows that 82.9% of the participants have friendly and positive relationships with one another, while only 17.1% reported having no such relationships. The majority of households reported getting assistance from others when things are tough, which is crucial for coping with and adapting to climate change. It aids in increasing community resilience to extreme climate change events. For example, respondent 33 from the Mmahu community said; *"In my community, we share things in common, especially around our neighbourhoods and everyone looks out for one another whenever certain evil happens. Most times we do not consider blood relationships because we have been living closely for a long time and act like brothers and sisters".* Respondent 15 from the Etekwuru community said; *"We survive here by helping one another due to the beautiful relationship our community people share. My relationship with others in this community has been superlative and very helpful"*. Good community relations promote individual involvement in community growth and development, which is a real tool for coping with climate change as people work together to create resilient communities using their social capital.

5.2.10 Means of transportation

The household heads can move in and out of the communities using a variety of transport means. According to their responses, 28 (11.6%) use personal vehicles, and of this number, 16 (57%) are young people (18-49 years old) while 43% are 50 years old and above. In total, 28.6% of these household heads with personal vehicles have only 2-4 household members, 50.0% of them have between 5-10 household members, and 21.4% have 11 members and above.

Most household heads 93 (48.3 %) use bicycles for transportation. Out of this number, 44 (47.3%) are between the age of 18-49 years, while 49 (52.6%) are between the age of 50 years and above. Also, among those that use bicycles as a means of transport, 19 (20.4%) have 2-4 household members, 45 (48.4%) have between 5-7 members in their households, while 23 (24.7%) have 8-10 members and only 6 (6.4%) have 11 and more household members. People in this category are among the lowest income earners as 53 (56.9%) of them earn between 10,000-30,000 naira monthly, while 40 (43.1%) earn between 30,000-50,000 naira monthly.

Further, 46 (19.2%) of the household heads move around on motorbikes. Among this population are young people of 18-49 years old who constitute 73.9% of that proportion while only 26.1% are above 49 years old. Also, 26.1% of them have 2-4 members in their households, the majority (47.8%) have between 5-7 members, 10.9% have 8-10 members and 15.2% have 11 household members and more. Among this group, 6.5% earn less than 10,000 naira monthly, 39.1% of them earn 10,000-30,000 naira monthly, 32.6% of these participants get 30,000-60,000 naira monthly and 21.7% earn 100,000 naira and above.

For those who do not have access to vehicles, bicycles, or motorcycles but use foot (17.5% of the household heads), only 16.7% are between 18-39 years old, majority of them (73.8%) are between 40-59 years old while 9.5% are above 59 years old. Also, 16.7% of these households who use their feet as a means of transport have 2-4 household members, 33.3% have 5-7 members, whereas the majority of them (45.2%) have 8-10 household members and only 4.8% have 11 members and more. Also, the results show that these people are among the lowest earners as 19.0% earn less than 10,000 naira monthly, 47.6% of them earn between 10,000-30,000 naira monthly, and 33.2% earn between 30,000-60,000 naira monthly.

Finally, 31 (12.9%) use other means of transport like taxis, or canoes/boats (Table 5.1). Out of this number, 64.4% are between 18-49 years old while 35.5% are above 49 years old. Also, 32.2% of these participants have 2-4 household members, the majority (48.4%) have 5-7 members while 12.9% have 8-10 members and only 6.4% have 11 members and above. 9.7% of them earn less than 10,000 naira every month, 22.6% earn between 10,000-30,000 naira, 48.3% earn between 30,000-60,000 naira monthly and 19.3% earn 100,000 naira and above. The results also show that 73.0% of those who use personal vehicles are male household heads, 68.0% of those who use bicycles are female participants, 52.6% of those who use motorcycles are male household heads while 58.0% of those who use foot are females and 51.0% of those who use other means of transport are also female participants. More of the younger household heads use personal vehicles and motorbikes, probably because of their higher income per month, and the majority of them have at least five (5) members of their household while most of those who use bicycles and feet are older participants who earn less yet have more household members. Most of the farmers belong to this category and use bicycles and foot for transportation. Furthermore, those who use other means of transport like taxis, canoes, and boats were mainly younger household heads.

5.2.11 Disability in Household

Any household with a disabled member is likely to be more vulnerable to the effects of climate change (King and Gregg, 2021). In total, 12.9% of these households have disabled members, compared to 89.1% without disabled members. This is slightly higher than 10% for Nigeria (National Bureau of Statistics, 2019). Further, 52.0% of those with disabilities are people who have fractured legs and hands, while 20% of them are blind, 15.0% of them are deaf and dumb, and 13.0% others have either poliomyelitis, mental illness, or autism. Most (75.0%) of these disabled persons are male members of the households. 58.1% of these households with disabled people have 5-7 members and the highest number of disability per household is 2 in the Etekwuru community with 5 household members. These households are poor because 12.9% earn less than 10,000 naira, 51.6% earn 10,000-20,000 naira every month which is below the national minimum wage of 30,000 naira, and 35.5% get a maximum of 50,000 naira monthly. While disabled persons require special care and needs, these households cannot afford them.

5.2.12 Access to healthcare

Because of high levels of poverty in these communities, only 34.6% of household heads go to hospitals for treatment, 5.8% of them go to clinics for medical care, 51.7% of them choose to patronize chemists

(patent medicine dealers) because they cannot afford better medical care when they are ill while 7.9% turn to herbalists (retailers of traditional medicine) for treatment when they are sick (Table 5.1).

Out of the 83 (34.6%) who have access to the hospital, 54.2% are male participants while 45.8% are females, 66.3% are young people 18-49 years old, and 36.1% of them have 2-4 household members. In total, 50.6% of these people earn between 40,000 – 80,000 naira monthly, and 24.1% earn 100,000 naira and above as monthly income. This implies that higher-income earners in these communities have more access to hospitals than others.

Of the 14 (5.8%) who have access to clinics, 71.4% of them are also young people aged 18-49 while the rest are elderly people. Among this category of participants are 64.3% females and 35.7% males, and 42.9% have 5-7 household members. While 28.6% of them earn less than 10,000 naira monthly, the majority (57.1%) earn as little as 10,000-30,000 naira monthly.

The majority of the participants patronize patent medicine dealers and out of this proportion, 58.9% are females while 41.1% are males. Also, 51.2% are people above 49 years, and 39.5% of them have 5-7 household members while 24.2% have 8-10 household members. In total, 15.3% do not get more than 10,000 naira every month, 48.3% earn between 10,000-40,000 naira monthly while only 4.8% earn 100,000 naira and above per month.

Out of the 7.9% that go to traditional healers (herbalists) for treatment, 63.1% are males 36.8% are females, and 57.9% are people above 50 years old. The majority of these people (36.8%) have 11 or more household members, and they earn the least as 26.3% get less than 10,000 naira every month while 42.2% earn between 10,000-20,000 naira. The highest earner among them gets 60,000 naira monthly.

Male household heads have more access to hospitals than female household heads, and the majority of them were younger household heads with mostly 2-4 household members. Also, more female household heads patronize clinics and patent medicine dealers when sick because they are cheaper to afford.

5.2.13 Climate change awareness

The knowledge of climate change is paramount in adaptation studies hence the respondents were asked about their awareness of climate change. On this point, 164 (68.3%) of the household heads claimed to have heard about climate change while 76 (31.7%) claimed they had not heard of it (Table 5.2). Out of these 164 respondents who have heard of climate change, 46.5% are between 18-39 years, 42.6% are 40-49 years and only 10.9% are 50 years and above. The result of the data collected also shows that out of the 76 respondents who are not aware of climate change, only 24.9% are between 18-39 years, 35.5% are between 40-59 years and 35.6% are 50 years and above. This result is an indication that climate change awareness level is influenced by age in these rural communities because the younger population is more aware of climate change than the older population. Further, 73.8% of those who are aware of climate change attained secondary education which is also 83.4% of the total number of participants who have secondary educational qualifications while 15.8% of them have tertiary education (representing 96.3% of the total respondents with tertiary educational qualifications). However, 90% of those who do not have formal education are not aware of what climate change entails, 68.7% of those with only primary education have no idea of climate change and 16.6% of those with secondary education do not know what climate change is and only 3.7% of people with tertiary education have no idea of what climate change entails. This result suggests that climate change awareness is also influenced by educational level because educated people have more awareness of climate change as opposed to uneducated people who have less. Also, 50.6% of those who claimed they have heard about climate change are males (70.9% of the total population of male respondents) while 49.4% are females (65.8% of female respondents). The result indicates that male respondents are more aware of climate change than their female counterparts, therefore females in these communities may be more vulnerable to climate change impacts than males because they are less informed, educated, and the majority of them are farmers.

Table 5.2: Climate change awareness (n=240)

Have you heard about climate change?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	Percentage (%)
I have heard about it	70	58	36	164	68.3
I have not heard about it	30	22	24	76	31.7

5.2.14 Climate change description by respondents

In their own words and based on their understanding, the respondents described what they think climate change means. The question was an open one and the researcher used thematic analysis to categorize responses elicited from the participants. Among the 240 respondents, 142 (59.1%) said it refers to a shift in weather. Out of these respondents, 1.4% do not have formal education, 11.3% have only primary education, 74.5% have secondary education and 11.3% of them have tertiary education. For example; respondent 31 from the Etekwuru community said *"It comes like sudden rainfall, sunshine, dark cloud and keep changing now and then"* Respondent 19 from the Mmahu community said; *"The weather in this community is very confusing and this started not quite long because in the olden days, we could tell what will happen with our weather at every season but now it is not so due to how the weather keeps changing forms like falling rains when it is not supposed".*

In total, 23 (9.6%) described climate change as something that is normal and naturally occurs often. The respondents who gave this description include 40% of those who have no formal education, 29.2% of those with only primary education, and 0.7% of those with secondary education. Respondent 41 from the Opuoma community said; "*what we are seeing today with our weather has been the same for a long and we are used to it because it is something natural and occurs normally, we cannot attribute it to any other thing*".

In total, 41 (17.1%) of the respondents said climate change means an irregular pattern of rainfall. Out of this number, 7.3% have no formal education, 19.5% of them have only primary education, 53.6% of them have secondary education and 19.5% have tertiary education. For example, respondent 64 from the Mmahu community said; "*rains do not come as usual, and we are worried because sometimes it comes in strange months, falls scantly, and in another month it falls so heavily that everywhere gets flooded*".

The remaining 34 (14.2%) of the participants indicated that climate change means an increase in temperature. Also, 20.6% of this group have no formal education, 29.4% of these people have only primary education, 38.2% have secondary education and 11.8% have tertiary education. Respondent 93 from the Etekwuru community said: *"Weather in this community is characterized by hot temperature that increases towards the end of one year and the beginning of another, making us so uncomfortable to sleep at night*" Further, this result implies that education enhanced their knowledge of what climate

change entails. Looking at their responses, those with better education described climate change as to mean change in weather, irregular rainfall, and increase in temperature while more poorly educated participants said it is a normal/natural happenings. Table 5.3 suggests that rural households in these localities are fairly aware of climate change. However, Table 5.3 shows that their perspectives on climate change diverge. Even though a significant number of respondents are aware of what climate change is, many are still unaware of how the local climate is changing. For example, out of the total number of respondents who said climate change is a 'change in weather', 77.5% have heard about climate change. Also, 82.3% of those who said climate change is an 'increase in temperature' have heard about it. By contrast, 73.9% of those who said it is a 'normal occurrence' have not heard of climate change.

Table 5.3: Climate change description by respondents (n=240)

What do you think climate change means?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
It is a change in weather conditions	60	49	33	142	59.1
It is a normal natural occurrence	10	7	6	23	9.6
It is an irregular rainfall pattern	14	15	12	41	17.1
It is an increase in temperature	16	9	9	34	14.2

5.2.15 Observed changes in the climate of the communities

Table 5.4 reveals that 214 (89.2%) of the household heads reported that changes have happened in the weather and climate of their communities. Respondent 55 from Etekwuru said, *"Our weather is no longer what it used to be as rains hardly come for farmers to start planting early in the year rather what we see are hot soils and air.*" In total, 147 (68.7%) of these participants who have observed changes in their community's weather and climate have also heard the term "Climate Change" while 67 (31.3%) of them have not heard about it. Meanwhile, only 16 (6.7%) of the participants claimed they had not seen any changes in the weather and climate of their communities. These people have a lower awareness of climate change because the majority (68.7%) had earlier reported they had not heard about climate change. However, 10 (4.1%) of the respondents are not sure if there have been any changes in the weather and climate. Also, 70% of these 10 participants have lived for less than 10 years in the study area and cannot tell if there is any form of change in weather and climate unlike 204 (95.3%) respondents who have lived for more than 10 years and also those who have lived their whole lifetime there. This result shows that

observation of changes in weather and climate is a function of experience over time. Further, 62.6% of those who have observed changes in weather and climate are the same people who said "it is a shift in weather", only 7.5% said "it is a normal/natural occurrence" and 17.7% of them called it "irregular rainfall pattern" while 12.1% described climate change as an "increase in temperature".

Table 5.4: Observed changes in weather/climate (n=240)

Have you noticed any changes in weather/climate in this community?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
I have observed changes in weather/climate	89	73	52	214	89.2
I have not seen any changes	8	5	3	16	6.7
I am not sure if there is a change	3	2	5	5	4.1

5.2.16 Description of weather/climate events in the communities

The heads of households were questioned about the weather and climate events that occurred in their communities. The majority of household heads 116 (48.3%) reported that floods were the most severe weather/climate events they encountered in their communities (Table 5.5). 75.0% of these people had earlier described climate change to mean change in weather, and 95.6% of them have lived in these communities for more than 10 years. Further, 61 (25.4%) said that high temperatures had been the biggest weather/climate event they had ever experienced. Of this proportion, 88.5% have lived in this study area for more than 10 years. Meanwhile, 33 (13.8%) said that excessive rainfall that results in various degrees of damage has been the worst weather/climate event in their areas. This was reported by 90.9% of those who have lived in these communities for more than a decade and also those who described climate change to mean "irregular rainfall pattern." Furthermore, 17 (7.1%) said the most common climate event they had seen was an annual delay in the start of the rainy season. This was reported by 35.5% of those who described climate change to mean "normal/natural occurrence of weather". The most common weather/climate event reported by 5.4% of the respondents was cloud cover, pollution, and dryness. This report is coming from 84.6% of people who have lived less than 10 years in these communities. The result therefore shows that the ability of respondents to properly describe the weather/climate events affecting these communities is dependent on the number of years they have lived there.

Table 5.5: Description of weather/climate events (n=240)

Can you describe a big weather/climate extreme event that has taken place here?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
Flood comes almost every year	31	46	39	116	48.3
High temperatures make everywhere hot	36	16	9	61	25.4
Excessive rainfall that causes damages	19	8	6	33	13.8
Delayed annual rainfall onset	8	6	3	17	7.1
Other events like cloud cover, pollution, dryness	6	4	3	13	5.4

5.2.17 Experiences with weather/climate extreme events

According to the findings in Table 5.6, household heads had varied experiences with extreme weather/climatic events. In total, 15.8% of the household heads claimed they feel discomfort from high temperatures and out of this number, 52.6% of them are the same people who described the biggest weather/climate events they had experienced to be “rising temperatures” and 31.6% of these people are farmers. Also, 67 (27.9%) of the household heads said extreme weather/climate events destroyed their crops.

The majority of these people (59.7%) described the biggest weather/climate events in their communities to be "flooding" and 19.4% of them described the event to be "excessive rainfall" which can destroy crops. In total, 86.6% of farmers said this, 2.9% of hunters, 4.5% of fishermen/women, and 5.9% of those who do other economic activities. Further, 39 (16.3%) claimed extreme events destroyed their farmlands of which the majority (59.3%) had described the biggest weather/climate event they had experienced to be "flooding", and 56.4% of them are farmers who depend on these farmlands for survival.

Death of humans and livestock were reported by the respondents and out of the 13 (5.4%) people who said flooding is the biggest weather/climate event, 69.2% of this category while 30.8% reported high temperature to be the biggest weather/climate event they had experienced. Farmers form 38.5% of this category of participants while 30.4% are those who do fishing as their main economic activity.

Respondent 10 from the Etekwuru community said; "*during the last flooding event in this community, a man was chasing a reptile that came with flood into his house and mistakenly butchered his son who died instantly"*. Respondent 29 from the Mmahu community said; "*during the last flood, I lost all my goats and chickens to the flood water because I could not save them while my family members were almost drowning in the water".* These respondents also claimed that weather/climate events destroyed their buildings. These participants are 31 (12.9%) of the total number of household heads in this study, and out of this number, 69.2% described their biggest weather/climate event to be flooding, 11.3% high temperature, and 19.5% excessive rainfall.

Further, 22 (9.2%) reported that they usually get infected and sick during weather/climate events. Among these people are 40.9% of the same respondents who experienced flooding while 36.4% experienced high temperatures, and 81.8% of these people who got sick and infected are farmers. People in these rural communities have experienced disruption of businesses and income reduction during weather/climate events. This was reported by 30 (12.5%) of the total respondents, 80% of whom are farmers.

Table 5.6: Experiences with weather/climate extreme events

Tell me about these events and your experiences	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
I feel discomfort from the high temperatures	23	8	7	38	15.8
These events destroy our crops	34	23	10	67	27.9
They destroy our farmlands	11	14	14	39	16.3
These events cause death to humans and livestock	5	5	3	13	5.4
They destroy our buildings	6	12	13	31	12.9
They cause sicknesses and diseases in people	9	8	5	22	9.2
These events disrupt our businesses and reduce our incomes	12	10	8	30	12.5

5.2.18 Frequency of weather/climate events

The majority (97.5%) of respondents said that weather/climate events happen in their communities every year (Table 5.7) and out of this number, 53.7% had experienced flooding, 28.5% high temperature, 15.4% excessive rainfall, 7.9% delayed rainfall, and only 0.8% experienced other weather/climate events that they described as cloud cover, pollution, and dryness. Furthermore, only 13.5% of these people who claimed weather/climate events occur every year had lived in these communities for less than 10 years, 31.8% of them had lived in the communities for more than 10 years while 64.0% had lived in these communities their whole lives. However, only 1.7% of the household reported that weather/climate events occur monthly while 0.8% said it happens every week.

Table 5.7: Frequency of weather/climate events (n=240)

How often do you experience these weather/climate events?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
We usually experience them every year	94	80	60	234	97.5
These things happen almost every month	3	1	0	4	1.7
They occur weekly	2	0	0	2	0.8

5.2.19 Sources of weather/climate information

To raise awareness of climate change in rural populations, weather and climate information is essential. Household heads were asked to list their sources for weather and climate information (Table 5.8). Of those respondents, 130 (54.2%) said they get their weather and climate information from radio and television. Out of these 130 participants, 71.5% are those with secondary education, 13.8% of those with primary education, 12.3% have tertiary education and only 2.3% have no formal education. Further, 68.4% of the participants whose sources of weather/climate information are radio and television, are between the age of 40-69 years while only 23.8% are young people of 18-39 years old.

Also, 18.3% rely on the internet and social media for their information. This group is among the 88.7% of the younger members of the communities (18-39 years old) who are more familiar with this technology. For example, respondent 77 from the Mmahu community said; *"I do not stay a day without browsing through the internet and this makes me restless whenever my phone battery is low, so I must*

make a good effort to charge it because it is where I get most of the information of what is happening around the world and within my environment." These people are mostly participants who have secondary and tertiary education (86.4%).

In total, 27.5% of household heads rely on information from their neighbours, friends, and families as well as their own experiences throughout the years. This is the source of weather/climate information for 85% of people with no formal education and only 4.5% of people with tertiary education. The majority of these household heads whose sources of information are friends, relatives, neighbours, and personal experiences are between the age of 40-59. Gender also influences sources of weather/climate information as this result suggests that more males (59.2%) use radio and television, 54.5% also use the internet and social media while more females (75.8%) rely on information from friends, neighbours, and personal experiences.

Table 5.8: Sources of weather/climate information (n=240)

How do you get information on weather/climate?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
I get my information through radio and television	50	42	38	130	54.2
This information is obtained from the internet and social media	21	8	15	44	18.3
I get this information through my neighbours, friends, and personal experiences	29	30	7	66	27.5

5.2.20 Frequency of weather/climate information received by household heads

Household heads frequently receive information at various times. Table 5.9 shows that 71 (29.6%) of the respondents get their information on weather/climate every day and of this number, 42.2% are those who use radio and television, 21.1% use the internet and social media as their sources of information while 36.6% get their information from friends, neighbours, and experiences over time. Further, 85.9% of these participants attended secondary and tertiary schools. Further, 14 (5.8%) claimed they get information on weather/climate every week while 4 (1.7%) get their information monthly.

In total, 46.2% of the respondents obtain their weather and climatic information annually. Out of this proportion, 76.6% use radio and television, 10.8% use the internet and social media to elicit information on weather/climate, while 12.6% depend on information from friends, neighbours, and their own experiences. This is because various government agencies like Nimet, often publish their annual predictions, which are then broadcast on radio, and television, posted on the internet and social media platforms, printed in newspapers, and published in magazines. However, 40 (16.7%) of the respondents say that they obtain their information only when the event is about to happen and 50% of these people are those whose sources of weather/climate information are friends, neighbours, and personal experiences. Also, 65% of these people who get information on weather/climate events only when it is about to occur, have no formal education or only attended primary education while none of them have tertiary education.

Table 5.9: Frequency of weather/climate information (n=240)

How often do you get information on weather/climate?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
I get this information every day	25	33	13	71	29.6
I get this information every week	14	0	0	14	5.8
I get my information every month	4	0	0	4	1.7
I get this information annually	35	40	36	111	46.2
The information is spread to us when it is about to happen	22	7	11	40	16.7

5.2.21 Perceptions of weather/climate events by household heads

Household heads revealed their perception of weather/climate events in their communities (Table 5.10). In total, 92 (38.3%) said that anytime there is a weather/climate extreme event, they view it as a time of unknown conditions, suffering, and hardship. Further, 71.7% of participants who reported this, have only secondary education while 16.3% have tertiary education, and 80.5% of all the respondents have lived above a decade in these communities. In another category of respondents, 52 (21.7%) perceive weather/climate extreme events as periods of food shortage and hunger reported by 50% of participants with secondary education and 19.2% with tertiary education. Most of these participants (85.5%) have

also lived more than 10 years in these communities. Further, 29 (12.1%) said weather/climate extreme events are times of God's punishment to the people. Also, 24.1% and 51.7% of people who reported this were those without formal education and those with only primary education, respectively. Only 37.9% of these participants have lived in these communities all their lifetime. In total, 31 (12.9%) of the respondents perceive weather/climate extreme events to mean signs that the world is ending. The majority of these people (74.2%) have secondary education while none have tertiary education and all of them have lived in the communities for more than 10 years. Also, 19 (7.9%) of the household heads said weather/climate extreme events are normal and natural occurrences that happen often. The majority of these people (76.3%) have either primary or secondary education and 21% of them do not have formal education. Meanwhile, only 15.8% have lived in these communities for less than 10 years.

Table 5.10: Perceptions of weather/climate events (n=240)

What comes to your mind when weather/climate events occur?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
It is a time of unknown conditions, suffering, and hardship in the community	34	32	26	92	38.3
This is the period of food shortage and hunger	20	20	12	52	21.7
It is a time of punishment from God	12	10	7	29	12.1
These are signs of the end of the world	16	8	7	31	12.9
They are normal and natural occurrences	8	6	5	19	7.9
Other	10	4	3	17	7.1

5.2.22 Weather/climate events' impacts on people and the environment

People in the selected communities claimed that diverse weather/climate extreme events had impacted them. In total, 39 (16.3%) of the respondents reported that during weather/climate extreme events, they feel restless, discomfort, and lose sleep due to unfavorable weather/climatic conditions. The most affected group (38.5%) of persons in this category are those who do other economic activities like government jobs, and trading. Also, 53.8% of the most affected group are male participants and 46.1%

are between the ages of 18-39 years. Further, 20.4% of the respondents said that during this time they lost the majority of their farmlands and other sources of income. In total, 83.7% of farmers reported this, and 55.1% of these people are female respondents. Also, 73.4% of these people are between 40-69 years old. In another group of participants, 44 (18.3%) reported that weather/climate-related disasters hurt their communities' access to food by destroying their fruit trees and crops. Among these people are 86.4% of farmers who said that most of their crops are destroyed by climate events like floods. In total, 59.1% of them are female household heads and most of them are between 18-49 years old. Furthermore, another 44 (18.3%) claimed that weather/climate extreme events bring about an increase in the prices of foods making them less affordable for the average income earners in the communities. The majority (56.8%) of these people are into farming as their source of income while 22.7% do other economic activities like government jobs and trading. Also, 63.6% of these people are male household heads with most of them (52.3%) within the 30-49 years age bracket. Further, 27 (11.3%) said that these events cause more cases of typhoid and malaria to occur in their communities reported by 62.9% of farmers and 63.0% are female household heads. Also, 70.3% of these people are between 49-69 years old. Additionally, 30 (12.5%) of the respondents stated that during this time, they became homeless due to floods that had taken over their homes. In total, 73.3% of these people are also farmers while 26.7% do fishing as their source of income. Also, 60.0% are female respondents and the majority (66.7%) are between 50-59 years old. Finally, 2.9% of the respondents mentioned other effects like biodiversity loss and construction damage as the impacts of weather/climate events in these communities.

Table 5.11: Impacts of weather/climate events on people and the environment (n=240)

What impacts do they have on the people of this community and the environment?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
It makes one feel restless, sleepless, and discomfort during the day and nights	22	10	7	39	16.3
Most of our farmlands and other means of livelihood are lost during this period	19	17	13	49	20.4
These events destroy crops and fruit trees	17	19	8	44	18.3
Prices of foods rise during this time	20	14	10	44	18.3
There are increases in the cases of malaria and typhoid in our community	11	8	8	27	11.3

People are rendered homeless during this period	8	10	12	30	12.5
Others like biodiversity loss, and construction damage.	3	2	2	7	2.9

5.2.23 Sources of help during weather/climate extreme events

Rural households seek assistance from a variety of sources during weather/climate events (Table 5.12). Only 24.6% claimed they receive help from the government, 83.0% of them have good relationships with other community members while 93.2% of them have blood relationships or family ties.

Another 24 (10%) reported that help comes from oil companies and NGOs. Among these people, 66.7% are people with good community relationships while 87.5% have family ties. Further, 32 (13.3%) depend on God for help because they do not have trust in the government or anyone to assist them. Also, 62.5% of these people are those who do not have good community relationships and 75% do not have family ties as well. The majority (64 or 26.7%) of the respondents claimed that neighbours, friends, relatives, and church members help them during weather/climate events. All of these people have good community relationships while 90.6% have family ties (family relationships). However, 61 (25.4%) do not get any help irrespective of their community relationships or family ties.

Additionally, the respondents reported the types of support they received during this period. Based on this, 57 (23.7%) claimed they received food items such as rice, garri (processed cassava), yam, and cooking oils. Further, 35.1% claim that this form of support comes from the government, 21.0% said they get them from oil companies and NGOs, while 43.8% claimed that these food items are given to them by friends, relatives, neighbours, and church members.

In total, 46 (14.6%) who lose their homes during weather/climate events like floods claimed that relief materials like mattresses, blankets, mosquito nets, and alternative accommodations are provided for them. Also, 28 (60.9%) of these people claimed that these types of help come from the government, 5 (10.9%) said they get them from oil companies and NGOs while 13 (28.3%) obtain them from friends, relatives, neighbours, and church members than from government and other formal sources.

Another form of help reported is food and cash donations by 35 (14.6%) of the respondents. Out of this number, 30.4% said the government renders such help, 18.2% credited this form of support to oil companies and NGOs while 51.4% of the household heads get this type of support from friends, relatives, neighbours, and church members. 21 (8.8%) only get words of encouragement and moral support. This was reported by 51.1% of those who depend on God for support and 28.1% are those who get help from friends, relatives, neighbours, and church members. However, 81 (33.3%) said they do not receive help during weather/climate events from any of the government, NGOs, oil companies, and others. This group of persons includes 24.7% of those who depend on God for assistance and 74.1% are those who previously said they do not get any help. This result suggests that rural households get more help from friends, relatives, neighbours, and church members.

Table 5.12: Sources of help during weather/climate extreme events (n=240)

If you are to ask for help during extreme weather/climate events, who renders this help?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
We receive help from the government	26	15	18	59	24.6
We do receive little help from oil companies and NGOs	8	7	9	24	10.0
We depend on God for assistance	10	12	10	32	13.3
We do receive support from relatives, neighbours, friends, and church members	29	20	15	64	26.7
We do not get any help	27	26	8	61	25.4
What type of support do you receive?					
We do receive food items	24	19	14	57	23.7
Relief materials and accommodations are given to us	16	20	10	46	19.2
Cash and fund donations are given to us	18	9	8	35	14.6
We receive words of encouragement and moral support from friends and relatives	8	7	6	21	8.8
No support is rendered to us during this time	34	25	22	81	33.7

5.2.24 Relief from support rendered

Support during extreme weather and climate events is intended to aid community members in adjusting to and recovering from the effects of climate change. In Table 5.12, respondents disclosed their sources of help and the types of help they receive during weather/climate events. Therefore, Table 5.13 evaluates how the support from the government, NGOs, local stakeholders, and neighbours has helped rural people to recoup after weather/climate events.

From the results in Table 5.13, 124 (51.7%) of the respondents asserted that neighbours were very supportive and helpful during climate extreme events like floods. Further, 70.6% of these people are those who claimed that the support they got gave them relief from the effects of weather/climate events. Also, 39 (16.2%) reported that although neighbours render help it is usually minimal. Further, 21.2% of them are among the category of persons who said support from these sources helped them to recover from the effects of weather/climate events. However, 77 (32.1%) do not get help from neighbours and are among the 155 respondents that claimed that the support they get does not help them to recover.

Further, household heads recounted how supportive the government, local leaders, and NGOs were during and after weather/climate events. On this point, 71 (29.6%) claimed that government, NGOs, and local leaders support them in different capacities. Only 23.7% of those who claimed they got help from the government agreed to this. However, the majority 169 (70.4%) of the household heads claimed they have not received any assistance from any of the government, NGOs, or their local leaders. Household heads were asked to name the types of support they receive before, during, and after weather/climate extreme events. In total, 60 (25.0%) said they usually receive food items like rice, garri, yam, and cooking oils. This was reported by 28.3% of those who get help from the government, 16.7% of the participants that get help from oil companies and NGOs, and 55% of those who get help from friends, neighbours, relatives, and church members. In the second category, 55 (22.9%) of respondents said that flood relief materials such as mattresses, blankets, and mosquito nets are sent to them, especially during weather/climate events. Also, 50.9% of these people get help from the government, 10.9% get help from oil companies and NGOs, and 38.2% are those who get help from friends, neighbours, relatives, and church members.

Further, 20 (8.3%) of the household heads claimed they received financial assistance in the form of cash and fund donations during this time. Among this group are 9 (45.0%) who get help from the government, 8 (40.0%) from oil companies and NGOs, and 3 (15.0%) from friends, relatives, neighbours, and church members. However, 105 (43.8%) claimed that nothing is given to help them cope with the impacts of weather/climate events. Further, 30.5% of these people are those who depend on God for assistance, 6.7% of those who rely on friends, relatives, neighbours, and church members, 58.1% are those who reported no help from anywhere and only 4.8% are those who claimed government help.

Finally, respondents evaluated this support to be either helpful or not in bringing relief from the negative impacts of weather/climate events. Only 85 (35.4%) reported that the support received helped them to recover. In total, 16.5% were those whose source of help is government, 12.9% of those who get help from oil companies and NGOs, and the majority (70.6%) were those whose sources of help are friends, relatives, neighbours, and church members. Among these 85 respondents, 32 (37.6%) get help in the form of food items, 23 (27%) get theirs in the form of flood relief materials such as foams, pillows, blankets, and mosquito nets, 18 (21.1%) get help in form of cash and fund donations, and 12 (14.1%) get only words of encouragement and moral support.

However, 155 (64.6%) claimed that support rendered to them did not give them relief to cope with weather/climate events in their communities. Further, 45 (29.0%) get help from the government, 13 (8.4%) get help from oil companies and NGOs, 32 (20.6%) depend on God for assistance, only 4 (2.6%) are those who get help from friends, and relatives, neighbours and church members while 61 (39.3%) are the same participants who maintained that no help is given to them. In addition, 25.2% of those who got food items as help said it did not help them to recover, 14.8% are those who got flood relief materials, only 1.9% are people that received cash and fund donations, 5.8% are those who get words of encouragement and moral support from relatives, friends, and neighbours, and the majority of them (52.2%) are those who do not receive any form of help. The majority of the household heads do not receive help from government and local stakeholders and most of those who got help from them claimed the support did not help them to recover after weather/climate events.

Table 5.13: Relief from supports rendered (n=240)

	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
How supportive were neighbours during this time?					
Neighbours were very supportive and helpful	45	41	38	124	51.7
They rendered little support	15	13	11	39	16.2
There was no support from neighbours	40	26	11	77	32.1
Have you ever received any support from the government, your local leaders, NGOs, or any other concerned groups during or after weather/climate events in this community?					
Yes, they have been supported in different capacities	33	18	20	71	29.6
No, they have not rendered any assistance	67	62	40	169	70.4
What type of support do you and your community get before, during, and after climate events?					
We usually receive food items	26	15	19	60	25.0
Flood relief materials are sent to us	23	19	13	55	22.9
We receive financial assistance	8	6	6	20	8.3
Nothing is given to help us cope	43	40	22	105	43.8
Did the support help you recover?					
Yes, it helped	32	29	24	85	35.4
No, it did not help	68	51	36	155	64.6

5.2.25 Alternative accommodation during extreme weather/climate events

Results from household heads on access to alternative dwellings separate from their typical residences are shown in Table 5.14. In total, 123 (51.3%) said that because of the positive relationships they have, as shown in Table 5.1, friends and family members can accommodate them whenever there is a need to relocate from their homes, especially during floods. Further, 91.9% of these people have good relationships with other community members, and 87.0% of those who have family ties. However, 117 (48.7%) of the respondents said they have no other place to live besides their homes when

weather/climate events like floods occur, reported by 75% of those with no good community relationship and 43.2% of those participants who share a good relationship with other community members. Also, 47.5% of those with family ties do not have an alternative place to stay while 53.5% of those who have no family ties do not have any other place to live outside their homes.

Table 5.14: Alternative place to live during extreme weather/climate events (n=240)

Do you have any alternative place to live if your home gets affected by weather/climate events?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
My friends and relatives can accommodate me if such a thing happens	56	35	32	123	51.3
I do not have any other place to live outside this home	44	45	28	117	48.7

5.2.26 Membership of social groups/organizations

Social group affiliation improves a community's capacity to adapt to climate change. Household heads were therefore asked to identify the social groups to which they belong. Their responses are shown in Table 5.15, with 92 (38.3%) indicating that they belong to groups of people within the same age bracket. The majority (53.3%) of the members of age-grade associations are females. The data analysis shows that 84.8% of the members of age-grade groups are farmers, 5.4% are hunters, 6.5% do fishing, and 3.3% do other economic activities such as government jobs and trading. In total, 36 (15.0%) belong to one social club or the other which comprises 27 (75.0%) farmers, 5.5% of hunters, 8.3% of fishermen/women, 11.1% of people who do other jobs and 55.6% of them are male respondents. Also, 57 (23.8%) of the participants indicated that they are members of church organizations like church committees, ushers, and workers. Out of this number of persons, 70.2% do farming as their source of income, 12.3% are into hunting, 7.0% are into fishing activities, and 10.5% do other economic activities. Female respondents formed 57.9% of these members of church organizations. Nevertheless, 55 (22.9%) do not participate in any social groups or organizations. The majority (65.5%) of these household heads undertake fishing and other economic activities, and 54.5% of them are male respondents. When extreme climate events occur in their communities, the more sociable community members are more likely to receive assistance from the social groups to which they belong, whereas those who do not associate with people are more likely to suffer from the effects of climate change due to the lack of collective efforts in

adaptation. For example, respondent 38 from Opuoma said "*Whenever there is a flood in our community, my group members usually contribute money and other items like food, clothing materials for the most affected amongst us, and I have been a beneficiary of this gesture for more than two times since I joined them".*

Further, 199 (82.9%) of those who have good relationships with other community members belong to age-grade groups, social clubs, or church organizations. Similarly, all of those who do not have good (positive) relationships with other community members are not members of any social group/organization. For example, respondent 72 from the Etekwuru community said; "*I do not fancy membership to any social group because I do not like their activities as a Christian and secondly, I do not think they will be of help to me at any time, so to avoid unnecessary troubles, I have chosen to stay on my own".*

Table 5.15: Membership of social group/organization (n=240)

What organization or groups do you belong to in this community?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
I belong to an age-grade	35	30	27	92	38.3
I belong to a social club in this community	13	13	10	36	15.0
I am a member of a church organization	26	20	11	57	23.8
I do not belong to any social group	26	17	12	55	22.9

5.2.27 Community assistance during needs

People must be willing to help one another during times of crisis, such as weather/climate extreme events, for community adaptation to be effective. In light of this, 59.2% of the household heads in Table 5.16 stated that the community is highly supportive during times of need. This claim was made by all community members with good relationships, 79.3% of age-grade members, 69.4% of social club members, and 77.0% of members of church organizations. However, 98 (40.8%) of the respondents said that community members are unhelpful in times of need, and do not belong to any social group/organization.

Table 5.16: Community assistance during needs (n=240)

Do you think people in your community will assist you when you need help?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
People of this community are very helpful	64	36	42	142	59.2
People of this community do not help	36	44	18	98	40.8

5.2.28 Recovery from weather/climate extreme events through help from neighbours and other community members

As shown in previous results, family, friends, and neighbours are crucial for coping with and recovering from weather/climate disasters. According to Table 5.17, 56.2% of respondents agree that other community members help them recover from the effects of climate change impacts. Among this group, 11.1% get help from the government, 11.8% from oil companies and NGOs, 44.4% get help from friends, relatives, neighbours, and church members while 32.6% of those who claimed they do not receive any help however, believed that assistance from community members will help them recover. This result implies that the majority of those who get help from the government disagreed that community members would be of help during climate disasters. This notion is held by 43.8% of participants who said that they preferred support from the government and appropriate authorities during weather/climate extreme events, rather than assistance from their neighbours and other community members. For example, Respondent 12 from the Mmahu community said "*Everyone is suffering the same thing in this community and I do not think people have enough to give out during climate disaster and even when they help, it is usually minimal therefore, it will not make us recover from the damaging effects of climate disasters".*

Table 5.17: Recovery through help from other community members (n=240)

Do you think help from other community members will make you recover?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
Their assistance will make me recover	62	35	38	135	56.2
Their assistance will not make me recover	38	45	22	105	43.8

5.2.29 Involving community members in the formulation of climate change adaptation policies

Heads of rural households in these communities criticized the government for failing to consider their needs while making policies that affect them. They were questioned about whether participating in the formulation of climate change adaptation policies would make them less vulnerable and more resilient to natural disasters. The majority (86.2%) of respondents said that being involved in the formulation of policies that affect them will help them better cope with extreme weather/climate events (Table 5.18). Respondent 77 from the Etekwuru community affirmed thus; *"If the government is willing to help us during weather/climate extreme events, they should always call our people to a meeting so we could tell them the areas we need help and not coming up with things cooked up in the government house which will not assist us in any way"*. In total, 96.3% of people with tertiary educational qualifications and 93.8% of those with secondary education reported this. On the contrary, 33 (13.8%) do not think their involvement in policy formulation will ameliorate the pains they bear during weather/climate extreme events. Further, 55% of participants with no formal education agreed to this claim including 36.4% of those with primary education, and only 3% of participants with tertiary education.

Table 5.18: Involvement of community members in the formulation of climate change adaptation policies (n=240)

Do you think getting community members involved in formulating adaptation policies will make it easier for people to cope with weather/climate events?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
Involving us in making policies that concern us will help us to cope	87	70	50	207	86.2
I do not think our involvement in making policies will make us cope easily	13	10	10	33	13.8

5.2.30 Coping with weather/climate events through help from social groups

Table 5.18 demonstrates that, except for a few individuals, 77.1% of the household heads interviewed are members of various social groups. However, 59.2% of rural household heads feel that support will come from the groups/organizations they belong to, compared to 40.8% of them who do not believe that social groups will assist them during weather/climate events (Table 5.19). Those who think help from

social groups/organizations will enhance their climate change coping capacity include 40.8% of the members of age grade groups, 16.9% who belong to social clubs, 33.8% of members of church organizations, and only 8.4% of people who do not belong to any social group/organization. Meanwhile, out of the number of participants who disagreed that help from social groups/organizations will help them cope during weather/climate events, 34.6% belong to age-grade groups, 12.2% are members of social clubs, 9.2% belong to church organizations while 43.9% do not belong to any social group/organization. Further, respondents were asked to indicate the types of support they get from social groups/organizations. On this ground, 19.6% of them claimed they usually get financial assistance during weather/climate events which comprises 20.6% of members of the age-grade group, 46.8% of the participants belonging to social clubs, 10.5% of participants belonging to church organizations. This result implies that 20.6% of those who belong to age-grade groups receive help in the form of financial assistance (cash and fund donations), 46.8% of the members of social clubs, and 10.5% of those who belong to church organizations. In total, 22.5% of the respondents further revealed that they only get moral support and words of encouragement from their group members during weather/climate events. This category of participants includes 42.4% of members of the age-grade group, 13.9% of social club members, and 17.5% of church organization members. Another set of participants (19.6%) reported that social groups/organizations they belong to give out food items to help their affected members during climate disasters. This category of respondents consists of 30.4% of age-grade members, 19.4% of social club members, and the majority (71.9%) are members of church organizations. However, 27.5% of the respondents who reported they do not receive any help from social groups/organizations are 9.1% members of age-grade groups, 3.0% of social club members, and 83.0% of those who are not members of any social group/organization.

Table 5.19: Coping with weather/climate events through help from social groups/organizations (n=240)

With many social organizations in this community, do you think they will help you cope with extreme weather events?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	(%)
I think they will help	67	34	41	142	59.2
I do not think they are helpful	33	46	19	98	40.8
What type of help do you get from them?					

I usually receive financial assistance from them	20	15	12	47	19.6
I do receive moral support from our members	27	13	14	54	22.5
I get food donations from them	13	7	6	26	10.8
I get accommodations from them	15	17	15	47	19.6
I do not get any help from them	25	28	13	66	27.5

5.2.31 Challenges in coping with weather/climate events

The household heads who participated in the study described several obstacles preventing them from adapting to climate change, as shown in Table 5.20. Out of 38 (15.8%) of the respondents who claimed that lack of electricity is their biggest challenge in coping with effects of weather/climate events, 12.5% of them are farmers, 16.7% are hunters, 18.2% are fishermen/women, and 31% do other economic activities. Also, 45% of the respondents who reported that poverty is their biggest challenge in coping with weather/climate events are 52.5% of farmers, 38.9% of those who do hunting, 42.4% of those who engage in fishing, and only 10.3% of those who do other economic activities. Another group of respondents (12.5%) said their biggest challenge to climate change adaptation is the lack of basic infrastructure like good roads, markets, schools, and healthcare facilities. Among this group are 11.9% of farmers, 11.1% of hunters, 15.1% of those who do fishing, and 13.8% of those who engage in other economic activities. Food shortage is another challenge reported by 16.7% of the respondents. 16.9% of farmers said food insecurity is a big problem to them during weather/climate events, 22.2% of hunters reported the same, while 21.2% are people who do fishing as their source of livelihood, and 6.9% of them do other economic activities. The last group of participants (10%) claimed that insecurity of lives and property is their biggest challenge during weather/climate events. For example, respondent 68 from the Opuoma community said "*During this time, many of us relocate to safer places leaving our homes to burglars who break in freely and steal things we were not able to evacuate*". Participant 51 from the Mmahu community said "*Due to the activities of cultists in this community, we hardly come out early or late in the night to do our usual economic activities for the fear of being shot dead, we do not feel safe anymore".* More males (52.6%) pointed to lack of electricity as their major concern, 55.5% of female respondents indicated that poverty is their biggest challenge, 60% of those who said their biggest challenge is lack of basic infrastructure are male respondents, 55% of those who reported food shortage are also male respondents while 62.5% of those who said insecurity of lives and property is their biggest challenge to coping with weather/climate events are female respondents. The biggest challenge to coping

with weather/climate events for 45.2% of household heads that have lived in these communities for less than 10 years is lack of electricity. On the contrary, the greatest challenge to coping with weather/climate events for 53.2% of those who have lived their entire life in rural communities is poverty, whereas 10.8% of them indicated that lack of electricity is their biggest challenge, 7.9% reported lack of infrastructure, 14.4% reported food shortage while 13.7% of these participants claimed that insecurity of lives and property is their greatest challenge.

Table 5.20: Challenges in coping with weather/climate events (n=240)

What are your challenges in coping with weather/climate events?	Etekwuru Community	Mmahu Community	Opuoma Community	Total	Percentage (%)
Our community does not have electricity	20	12	6	38	15.8
We are very poor in this community	41	35	32	108	45.0
This community lacks basic infrastructure	16	10	4	30	12.5
Food shortage is a challenge here	11	13	16	40	16.7
Insecurity of lives and property is a big problem in this place	12	10	2	24	10.0

5.3 Focus Group Discussions (FGDs)

This section deals with data obtained through FGDs. There were three FGDs in this study consisting of one FGD for each of the three communities. The FGDs each had six (6) participants selected carefully from the communities for each of the discussion sessions. The participants comprised both male and female farmers between the age bracket of 39-60 years. The qualitative data from the FGDs were subject to thematic analysis where they were transcribed, translated, coded, and categorized into themes (Caulfield, 2019). The thematic analysis for the FGD responses gave rise to the following themes: Rural farmers' collaborations and engagements; Rural farmers' climate change awareness; Major weather/climate events affecting farmers and the supports they receive; and Farmers' weather/climate events coping strategies and challenges. The FGDs support and enhance the information obtained from both the questionnaires and the interviews. The themes identified from the data helped to validate the information given by rural household heads and the local stakeholders (traditional leaders and town union members) obtained from questionnaires and interviews respectively.

5.3.1 Rural farmers' collaborations and engagements

The FGDs involved 18 farmers, six from each of the three selected communities. They were asked open-ended questions on how they collaborate and engage with each other, the major weather/climate events they experience, the impacts of the events, their coping/adaptation measures, support received, and challenges to adaptation. According to the 18 respondents, farmers collaborate in various ways which help them survive hardship occasioned by weather/climate events. For instance, participant 3 from the Etekwuru community said: "*Many farmers interact and make discussions while farming activities are ongoing because these farms are located close to each other."* Also, some farmlands are situated at boundaries between one community and another, allowing the farmers to have inter-community linkages. Some farmers who are better aware of climate change create climate change awareness while on the farm and share ideas on how to cope with anticipated weather/climate events. For example, a town union member (during the interview) also mentioned that farmers spend time discussing and through that process, they teach themselves and spread information on weather/climate. They normally do that, especially during farming seasons where they sit and discuss right inside the farm while resting from the day's work. From the response of Participant 6 (from the Mmahu community), farmers discuss ways to make their crops survive harsh weather conditions and the type of crops to cultivate in the next planting year. For example, participant 4 from the Etekwuru community said that during these discussions, farmers learn about new seeds, tubers, and cassava stems that mature early before floods come. They also share these seeds, cassava stems, farming tools, and other implements. Participant 2 from the Opuoma community said that farmers could borrow farm tools from each other without paying rent and the gesture is returned when the other farmer needs it.

In total, 16 (88.9%) participants out of the 18 said they cooperate to buy seedlings, tubers, and cassava stems which are shared accordingly to reduce the cost of purchase per farmer. According to Participant 5 from the Mmahu community, farmers pool their resources to buy farming implements, seeds, and feeds which will not only reduce the amount they spend but will help them get the right tools for farming and foster cooperation. Also, the participants said farmers render free labor to each other which helps them to cultivate large farmlands in a shorter time. For example, a household head said there is usually an agreement that any amount of days a farmer puts in for another farmer will be the same amount of days he/she will get in return.

Further, 15 (83.3%) participants out of the 18 said that farmers in rural communities also engage themselves during market days. They also reported that in the study area, there are four market days and each community has a particular day for their market to function at full capacity. During this time, farmers have the opportunity to interact with other farmers, customers, seed sellers and stem sellers, livestock and feed sellers, sellers of farm tools, and others. The market creates a good opportunity for sharing information, ideas, and innovations that may help farmers cope with weather/climate events. For example, participant 6 from the Etekwuru community said: "*We usually learn new ideas from the people selling seeds and stems who make us understand the different maturing periods of these seeds and stems. We also learn when best to plant them and on which soil is the best for their growth.*" However, 6 participants reported that new ideas and information on sustainable farming systems are meant to be taught by extension workers from government agencies but they do not have the opportunity to interact with them due to their poor attitudes and inaccessibility. However, this is contrary to the claim of the local government chairman who reported that extension workers from the Agricultural Development Programme (ADP) teach farmers occasionally. Meanwhile, participant 6 from the Mmahu community said: "*Extension workers do not give us adequate time to learn because they are always in a hurry to leave during the few times we met them*." Because extension workers hardly visit and interact well with the farmers in these communities, there is no new training, therefore farmers rely only on the farming methods known to them to survive the impacts of weather/climate events. This implies that farmers and extension workers have poor relationships because they do not interact sufficiently. Also, respondent 5 from the Etekwuru community said: "*As young people who do not know much about previous farming methods used by our grandparents, we try to initiate our ways of farming.*" Since extension workers hardly spend time training rural farmers in these communities, the implication of using trial-by-error methods by these young farmers may exacerbate their vulnerability to climate change impacts.

In total, 10 (55.6%) of the respondents reported that farmers have days they meet and discuss the ways to survive harsh weather conditions. Participant 5 from the Opuoma community said that these meetings provide opportunities to know their members who are sick or victims of any disaster to render support. Sundays are ideal days for such meetings because people do not farm on Sundays. Also, participant 1 from the Opuoma community said that farmers deliberately visit others whom they think are doing better to learn what works for them to apply such methods to their farms. For example, a town union member (during the interview) reported that farmers copy each other during farming seasons.

5.3.2 Rural farmers' climate change awareness

All of the 18 participants were asked questions on their knowledge of climate change to understand their level of climate change awareness. A total of 14 (77.8%) farmers are aware of changes in their weather but do not know if it happens as a result of climate change. For example, participant 3 from the Mmahu community stated: *"At least we know it has to do with the behavior of our weather. I have heard about this thing on radio and television but do not understand fully how it connects to what we are suffering. It sounds strange to my ears and I would like to know more about it."* Participant 2 from the Etekwuru community said: "*My son in high school mentioned it to me but I took it for granted because we believe that everything happening in our world is orchestrated by God. It is very important to let more people know about it because it affects everyone in this community*." One of the challenges to climate change adaptation in these rural communities is the level of religiosity of the rural community people which is the reason they believe that everything happening is the making of God. For example, rural household heads mentioned that when disaster occurs, they begin to pray to God for help. In the same manner, the farmers said that prayers are made in churches for God to intervene during disasters because the government and other concerned authorities barely assist.

Further, 16 (88.9%) of the participants said that educating rural farmers with knowledge of climate change is necessary to create better awareness that will improve their preparedness and adaptation to the impacts of weather/climate events that may occur in the future. On this point, participant 6 from the Opuoma community said: "*It will benefit everyone if farmers and the entire community are made aware of this problem so that our sufferings will reduce. I believe the more the knowledge, the more people will understand the ways to adapt to the situation"*.

5.3.3 Major weather/climate events affecting farmers and the support they receive

In the FGDs farmers were asked to report the major weather/climate events that mostly affected them and the forms of support they received. As was discussed during the interviews, farmers during the FGDs reported the major weather/climate events they experienced. In total, 15 (83.3%) farmers said that floods are the biggest weather/climate event affecting their farming activities. For example, participant 2 from Etekwuru said: *"Although we are affected by excessive rainfall, rising temperatures, windstorms, and delayed onset of rainfall, the major one is flooding because of the magnitude of destruction it causes.*"

According to the farmers, the most affected portions of the farms by floods are cultivated lands, farmsteads, and livestock buildings. Also, residential houses are damaged during high floods which can render farmers homeless, out of business, and helpless because adequate support is not rendered by the government.

Also, 12 (66.7%) of the respondents reported that during floods, support comes from the government, oil companies, and other individuals from the communities. For example, participant 3 from the Mmahu community said: "*Government sends support in the form of relief materials like mattresses, blankets, and mosquito nets, however individuals in the community assist more because that of government, oil companies, and NGOs do not reach most of us."* Also, participant 4 from the Etekwuru community claimed this does not come at the time it is mostly needed. For instance, participant 2 from the Opuoma community said that the majority of what they bring is flood relief materials (Figures 5.15, 5.16) like mattresses, blankets, and mosquito nets. These are given to a few persons because there is not enough for everyone. However, participant 1 from the Mmahu community claimed that farmers get more support from other community members in the form of food items such as garri, rice, cooking oils, tomatoes, and noodles. These forms of support were also identified by household heads, traditional leaders, town union members, and the local government chairman during the interviews (Tables 5.12 and 5.26).

In total, 10 of the farmers said that stakeholders in the communities help them to solicit support from the government but the outcome is always disappointing because the government either neglects their plea or sends a few relief items that barely help farmers to survive climate disasters like floods.

5.3.4 Farmers' weather/climate events coping strategies and challenges

The FGD participants were asked to highlight the measures used by farmers to cope with weather/climate events and the challenges they face in adapting to these conditions. The farmers in these rural communities employ different methods and responses to survive the impacts of weather/climate events. For example, 12 participants (66.7%) said they do early planting and early harvesting of crops. Participant 6 from the Opuoma community said: "*Once rain drops, we begin to cultivate our crops to enable us to harvest them earlier before floods arrive that year*." Farmers target early rains and immediately begin cultivation of crops and harvest as early as August/September. According to these farmers, labourers are hired to enable them to complete planting.

Further, 11 of the farmers (61.1%) claimed they try to avoid flood-prone areas by cultivating on marginal lands to stay safe from floods. This measure affects their annual crop production and reduces the food supply in the communities. For instance, participant 3 from the Mmahu community complained that food has become scarce and the available food items are expensive for an average community member as a result of farmland abandonment, and adverse weather/climatic conditions.

In total, 8 of the respondents (44.4%) said they build alternative shelters for their livestock once they get a flood alert. This report suggests that weather/climate information helps farmers to prepare for anticipated disasters. However, participant 3 from the Mmahu community said that those who have alternative shelters for their livestock find it difficult to access feed leading to the deaths of animals because flooded roads affect the free movement of livestock to feed.

More so, 16 farmers (88.9%) said they purchase early maturing seeds and stems of cassava (for example, trukem which gives high yields in a short time) to plant at the onset of rains. For example, participant 5 from the Mmahu community said: "*We buy trukem stems from people that have them and plant around March/April for them to mature on or before September*." This particular variety of cassava is a native cassava stem known for its early maturity and high-yield qualities. However, it is more expensive to purchase than other cassava stems but because of the advantages it has, farmers prefer them as a measure to adapt to weather/climate events.

In total, 10 respondents (55.6%) said that excessive rains bring about pests that attack their crops, therefore they use nylon bags placed on standing sticks to scare them off since they do not sleep on the farms (Figure 5.1). On this point, participant 5 from the Mmahu community said that the birds see them as standing images which makes them leave the farmlands.



Figure 5.2: Nylon bags (in white colours) placed on trees to scare birds from attacking young crops in Egbema

Animal pests like birds usually attack crops, especially during periods of heavy rainfall in the study area. Therefore, farmers devise a means of using white nylon bags placed carefully on standing sticks (Figure 5.2) to make the birds feel the false presence of human beings on the farm to scare them away and save the young crops.

Further, 13 of the farmers (72.2%) reported trying several farming methods like crop rotation, shifting cultivations, slash and burn, and mixed cropping (Figures 5.3, 5.4) to see what works best amidst changing climatic conditions. However, at some point, they feel discouraged because yields do not increase after such efforts. For example, participant 2 from Opuoma said some of them make mounds and ridges (to enable their crops to stand firm, absorb nutrients, and protect crops from soil erosion) which they are not used to doing and most times, heat from the soil kills their crops. Further on this point, participant 6 from Opuoma stated: "*I usually make mounds and mix them with organic manure to enable the crops to grow faster. I do this for yams and cassava because my maize matures within 3 months. I*

used to raise the sides of my farms with soil to avoid the water destroying my crops before harvesting them and also leave some trees to stop fast-flowing water from damaging my crops."



Figure 5.3: Mixed cropping (cassava and maize) practiced by rural farmers in Egbema

Figure 5.3 shows farmland cultivated with cassava (the shorter crops) and maize (the taller crops). In other to maximize the little land available for farming and adapt to climate change, farmers in the study area practice mixed cropping.

Figure 5.4 shows the most common farming method in the study area. Farmers believe that slash and burn farming system will help their crops grow faster as the burnt vegetation adds nutrients to the soil. The farmers believe that when the crops grow faster, they are likely to mature earlier for harvest before September when floods are expected.



Figure 5.4: Slash and burn farming method practiced by rural farmers in Egbema

Also, 10 participants (55.6%) further stated that farmers construct canoes to enable themselves to move out of their flooded homes and also to transport harvested crops out of the flooded farmlands (Figures 5.5, 5.6). Canoes are the cheapest and most efficient means of transportation in these communities during weather/climate events such as floods.



Figure 5.5: A farmer with an emergency canoe going to his flooded building

Canoes and boats are the main transportation means during flood disasters in Egbema since roads are covered by water (Figure 5.5).



Figure 5.6: Farmers harvesting cassava with their emergency canoes

Figure 5.6 shows farmers and free labourers harvesting their crops prematurely due to floods. During this period, canoes aid in transporting both the farmers and their harvested crops out of the farmlands.

Further, all the farmers claimed that farmers in the study area encounter several challenges while trying to adapt to these weather/climate events. For example, 15 (83.3%) of the farmers said there is a lack of credit facilities. On this point, participant 3 from the Mmahu community said: "*We had a workshop with ADP some time ago. We were taught how to cultivate rice and grow it on our land but unfortunately, we could not venture into that because it is capital intensive and no support from any quarters."* It was an initiative from the federal government which was done in every local government area across the country. However, the farmer reported that the training did not help him because he did not go into rice farming. There are no credit facilities, incentives, and funds to help farmers even when training is given to improve farming activities. Further, participant 4 from the Etekwuru community complained that farmers who

wish to set up large-scale farms are discouraged due to a lack of credit facilities, incentives, and loans from financial institutions.

All the farmers reported that poverty is their greatest challenge to climate change adaptation. For example, participant 6 from the Opuoma community said: "*Lack of funds discourage farmers from buying appropriate farm tools, early maturing seeds, tubers, and stems*." Further, participant 5 from the Mmahu community said there are no funds to buy insecticides, herbicides, pesticides, or fertilizers that enhance farming activities which farmers see as a big challenge. He also stated that when farmers are sick, they cannot afford good medical treatment. Due to these challenges, participant 2 from the Opuoma community said many farmers are leaving the venture for alternative businesses since the income they get from farming is not equivalent to the efforts invested.

Further, 12 (66.7%) of the farmers said that the absence of good healthcare facilities has resulted in deaths that should have been avoided. Participant 1 from the Etekewuru community said: "*In this community, there is no single hospital, and when people are sick, they are either taken out to other communities where there is a hospital or taken to the state capital for treatment."* Participant 6 from the Etekwuru community said that some sick people die even before getting to the hospital due to the distance and the nature of the roads.

The majority 16 (88.9%) of the farmers reported a lack of electricity supply as one of the major challenges they have. For example, participant 2 from the Opuoma community said: "*Our perishable goods cannot be stored for a longer time because there is no power to use the refrigerators*." Also, 14 (77.8%) participants reported that their communities lack basic social amenities that support living in rural areas. For example, participant 2 from the Mmahu community said: *"We do not have good markets, when it rains, everyone will start scampering for safety and in this case, we could return home with our goods without making sales*." Participant 4 from the Opuoma community said that dilapidated market structures that expose farmers to rainstorms while trying to sell their products are a big challenge to farmers. Basic social amenities like pipe-borne water (for safe drinking water) are absent in these rural communities. Most of them depend on individuals who have boreholes for their drinking water, while others drink from wells, and water from the streams. This makes rural households vulnerable to communicable diseases as a result of consuming unsafe water.

5.4: Interviews

This section presents the results of analyses from qualitative data obtained through interviews. There were a total of 21 interviews involving the Director Generals of NEMA and NESREA, traditional leaders, and town union members. These qualitative data were subject to thematic analysis where they were transcribed, coded, and categorized into themes (Caulfield, 2019). The themes captured all the key points of the interviews about the objectives of this study. The thematic analysis for responses that focused on community relationships and stakeholders' engagements gave rise to the following themes: Relationships between local stakeholders and other community members; Interactions between local stakeholders, government officials NGOs, and government agencies; and Collaborations amongst government agencies, and local stakeholders.

5.4.1 Community relationships and stakeholders' engagements

Community relationships and stakeholders' engagements dealt with how rural people related with each other in rural communities and their interactions with internal and external stakeholders. There were a total of 21 participants comprising traditional leaders, town union members, officials of government agencies (NEMA and NESREA), and the local government chairman of Ohaji/Egbema who responded to open-ended questions focusing on the relationships and interactions between these people and community members. Thematic analysis of these responses produced the following themes: Relationships between local stakeholders and other community members; interactions between local stakeholders, government officials, and government agencies; and Collaborations amongst government agencies, and local stakeholders (Table 5.21). Table 5.21 shows responses from the participants regarding community relationships and stakeholders' engagements. The numbers in the table indicates the number participants who commented on community relationships, interactions, and engagements.

Table 5.21: Community relationships, interactions, and engagements

Themes	NEMA (1)	NESREA (1)	Traditional leaders (3)	Town Union members (15)	Local Government Chairman (1)	Total (21)
Relationships and collaborations between local stakeholders and other community members	0	0	3	13	1	17
Interactions between local stakeholders, government officials, NGOs, and government agencies	1	1	3	5	1	11
Collaborations among government agencies, and local stakeholders	1	1	1	4	1	8

5.4.1.1 ***Relationships and collaborations between local stakeholders and other community members***

This theme explored the relationships and linkages that exist between community stakeholders (traditional rulers and town union members) with other community members, the roles of local stakeholders in the communities, information sharing modes, climate change awareness, platforms for interactions, and relationships amongst the local stakeholders. For example, three participants who are traditional leaders of the three selected communities claimed that links exist between local leaders and rural people due to the cordial relationships people enjoy in the communities. On this point, participant 3 (a traditional leader) further stated that community members and local stakeholders share information, ideas, and innovations on farming systems most suitable to their climatic conditions.

In response to the questions on the roles of town union members in the communities, 9 (42.9%) participants indicated they are critical to bringing peace, unity, and orderliness in every rural community of Egbema. For example, a total of 12 (57.1%) participants reported there are many collective efforts and voluntary individual efforts made by the members of the town union in gathering people of their community together to bring about oneness and good relationships. For example, participant 2 (a traditional leader) from the Mmahu community said: "*Gathering community members together through organizing of social-cultural events, meetings, general assemblies, and town hall meetings, information sharing is made easier."* Bringing people together in rural communities can strengthen ties and bonds

people share and could be an effective way of creating awareness of weather/climate events and providing support for climate change adaptation.

In total, 16 participants (76.2%) claimed that good relationships amongst community members help to make information sharing easier. For example, a town union member 4 from the Mmahu community reported how neighbours share information with others around them. Further, two of the three traditional leaders revealed that during cultural festivals such as new yam festivals, masquerade festivals, and other cultural celebrations that bring community members together, the traditional leaders seize the opportunity to share information and ideas including that of climate change. For example, the traditional leader of the Etekwuru community said: "*We interact like one big family in this community. People of this community love themselves that is why we do things together without having issues. We have several occasions that bring us together like our festivals every year and town hall meetings. We have social clubs/groups that we belong to and also, many of us belong to age groups where we meet and interact with each other."* Other community members see these platforms as the best avenues to reach out to their local stakeholders. This implies that other community members could have access to the traditional leaders during meetings involving age-grade groups because they are members of the same group. During festive periods, people who live away from the communities return to enjoy cultural dances, masquerades, inter-community football matches, social club meetings, and other traditional celebrations. For example, town union member 5 from the Etekwuru community (a town union member) said that local stakeholders always set football matches for villages within the community at festive periods which attracts community members who live in other places. Many of these people return with ideas, innovations, and information on weather/climate that may be beneficial in helping rural households take pragmatic actions against anticipated climate disasters. For example, town union member 5 from the Etekwuru community stated how some persons from the urban areas came back to share bulletins and magazines containing annual weather predictions that helped many in the community. These festivals are avenues for people to meet and share information that creates awareness amongst rural households. Other community members especially from the Mmahu community claimed that masquerade carnivals/festivals are organized every year and people from far and near attend.

The majority of the town union respondents reported that the secretary of the town union is charged with the responsibility of sending out invitations for meetings which is mostly done through town criers and

sometimes through social media, or letters of invitations sent to executives of local stakeholders such as the youth bodies, council of elders and chiefs. For example, town union member 4 from the Etekwuru community said: "*Messages are delivered during the evening and early morning hours to be sure everyone is at home to get whatever information that is passed across.”* According to 10 participants (47.6%), people return from various activities in the evening hours which is the best time to convey useful information to everyone in the community and when the sound of the gong is heard, people keep calm to digest the message from the town crier because whenever the gong sounds, there is a crucial message from local authorities. This suggests that using a town crier (verbal communication) is a more effective mode of spreading information in rural communities of which the study area is one.

More so, 11 (52.4%) participants belonging to the town union indicated that communities have several platforms on which they share information. For example, town union member 3 from the Mmahu community said: "*In our community, we usually have town hall meetings, general assemblies, expanded exco meetings where everyone is allowed to participate and make contributions to the development of the community.”* With the permission of the traditional leaders, town union members call for general meetings where information on serious issues such as weather/climate information is shared. For example, town union member 1 from the Mmahu community revealed there was such a meeting before the 2012 flood that devastated many communities. Further, 6 (28.6%) participants claimed that emergency meetings are scheduled especially when the community stakeholders receive important information such as weather/climate prediction/forecast. Town union member 5 from the Etekwuru community said: "*Community leaders must call people together and let the information out to the public to avoid damages during such anticipated disaster*." Through this information sharing and awareness creation, rural households tend to prepare for the weather/climate events to come. However, this cannot be achieved without good relationships among community members.

Further, 17 (81%) participants claimed that local stakeholders enjoy cordial relationships amongst themselves. According to them, these relationships have brought significant developments like the building of flood houses to accommodate flood victims in the communities. The traditional leader of the Mmahu community said: "*Everything we have achieved in this community is owed to the relentless efforts of our stakeholders who I refer to as the bedrocks of my leadership*." Other community members hail the efforts made by their local stakeholders in bringing a few developments while citing how the government

neglects them. Local stakeholders like town union members help to attract developments from the government, oil companies, NGOs, and individuals. This is possible because of the healthy relationships and interactions that exist among local leaders in these communities. Further, the traditional leader of the Mmahu community stated that local stakeholders and the traditional leaders are always making efforts to see to the development of the community by discussing such vital issues during town hall meetings. Other community members are allowed into these town hall meetings to ask questions and make suggestions and contributions.

A total of 15 (71.4%) participants claimed that collaborations between these stakeholders are critical in finding solutions to problems affecting any community of which climate risk is one. For example, the traditional leader of the Opuoma community stated: "*We live together, do things together, and are always looking out for others. Every complaint in the community is unanimously dealt with to satisfy the complainant and the community at large as long as the right process is followed."* People of these rural communities believe in collective efforts and collaborations in solving societal problems affecting them. On this point, town union member 4 from the Mmahu community revealed that community members come together to de-silt their water drainage and expand their roads through physical and financial contributions without waiting for the government. This is why expanded exco meetings are scheduled by the stakeholders to give room for deliberations amongst them and other community members. According to the traditional leader of the Opuoma community, they run inclusive leadership where everyone is important and their contributions to the growth of the community are not neglected. These claims suggest that healthy collaboration exists between town union members, community traditional leaders, and other community members and if this link is missing at any given time, there will be a social crisis that will directly affect the well-being of vulnerable community members who may not access help or support during weather/climate events. This implies that nothing positive happens in the communities if there is a disjointed link between the local stakeholders. The traditional leader of the Mmahu community stated that the last security challenge suffered by the community was a result of deteriorated relationships and links between local stakeholders.

Further, town union member 5 from the Mmahu community said: *"In 2012 when the flood was more catastrophic, we informed major stakeholders in the community who came together to discuss and analyze the situation, giving us the mandate to write to government agencies for assistance."* This also

implies that town union members and traditional leaders always have a common ground to interact for the benefit of other community members. When there is a crisis or an impending one, they take proactive measures by finding solutions within and outside the community. For example, town union member 4 from the Etekwuru community reported how they go to NEMA to lay complaints of climate-related disasters in their community.

5.4.1.2 *Interactions between local stakeholders, government officials, and government agencies*

To bring about development and growth to communities in rural areas, there is a need for interactions and positive relationships between local stakeholders, government, NGOs, and government agencies. In this context, government agencies here are NEMA and NESREA. Only the Director Generals of these agencies were involved in the interviews. In total, 21 participants (involving two DGs, one Local government chairman of Ohaji/Egbema, and 18 other local stakeholders) responded to different open-ended questions concerning the interactions of stakeholders, NGOs, government, and government agencies.

Of the 18 local stakeholders interviewed, 17 (94.4%) complained that governments at the state and federal levels are usually difficult to interact with due to bureaucracies and unnecessary protocols. For example, the traditional leader of the Mmahu community said: *"The Government of Nigeria does not help matters when it concerns rural communities. The government does not give an ear to our complaints and when we demand to meet with them, we are left disappointed because they keep failing to honor appointments until one gets tired. After all, they do not recognize us as important stakeholders."* This implies that the government does not run inclusive governance where local stakeholders can contribute meaningfully to national, state, and local debates. For example, the traditional leader of the Mmahu community complained that decisions affecting rural people are made by the government without involving local leaders which has become a norm for several years. The effect of this exclusiveness may be one of the reasons rural people feel marginalized and vulnerable during climate-related disasters because help may likely not come early. On this point, town union member 3 from the Opuoma community said that the last time there was a fire incident that claimed lots of lives in Egbema, it took the state government time to intervene but before then, many casualties were recorded. However, the local government chairman said: "*The council chairman conveys meetings of stakeholders where issues are discussed and information from federal and state government is shared amongst the stakeholders*

who are invited by letters, memos, and communiqués. Although the local government chairman invites local stakeholders to town hall meetings, the local stakeholders prefer having contact and direct interactions with the government outside their local council. They are not satisfied with the link between them and the government at the state and federal levels. Of the traditional leaders and the town union members who were interviewed, 17 (94.4%) said that they no longer trust the government and do not believe the government may be of substantial help to them in times of climate disaster because the government makes promises and fail to fulfill them, hence their reliance on local stakeholders' collaborations and community collective efforts to solve their problems. Community members do not feel the government has their interest, so they resort to helping themselves through communal efforts by making contributions and compulsory levies that assist the leadership of the communities.

The local government chairman further stated that there have been meetings conducted at the local government headquarters in the Mmahu community where weather/climate events like flooding were discussed. In that meeting was the chairman of the council, secretary of the council, traditional leaders, town union members, representatives of oil companies, and officials of government agencies from NEMA, Ministry of Agriculture and Environment as reported by the local government chairman. According to the chairman, the outcomes of these meetings were pledges of support to the communities affected by floods from oil companies, and government agencies. On this point, household heads, including farmers also pointed out that there was support received from government agencies, however, this support was very little to help the large number of climate-related disaster victims. Also, in those stakeholders' meetings, annual weather/climate predictions/forecasts and warnings were shared and discussed to create more awareness. This information trickled down to other community members through the attendees of the town hall meetings.

Town union member 2 from Opuoma stated that the inaccessibility of government at the federal level which controls the agencies concerned with the management of environmental hazards and disasters is a hurdle to the management of climate-related disasters like floods. This is contrary to the report from the local government chairman who said local stakeholders have access to government at all levels against the 94.4% of the interviewees who had earlier revealed how difficult it is to have direct contact with government at state and federal levels.

Only one participant who is the traditional leader of the Mmahu community claimed that he works with NGOs and they have helped the community at some point. Meanwhile, three participants who are town union members claimed that NGOs had come for inspections and discussions with affected communities during the flood of 2012 but the outcome was not positive because, after assessments, they left the community without bringing solutions to the problem. According to the respondent, the NGOs came, took inventories of damaged properties, assessed the destruction caused by the disaster, and promised to return for assistance but were not seen after such assurances. Figure 5.6 shows how the local stakeholders interact with government officials, and government agencies concerned with weather/climate events.

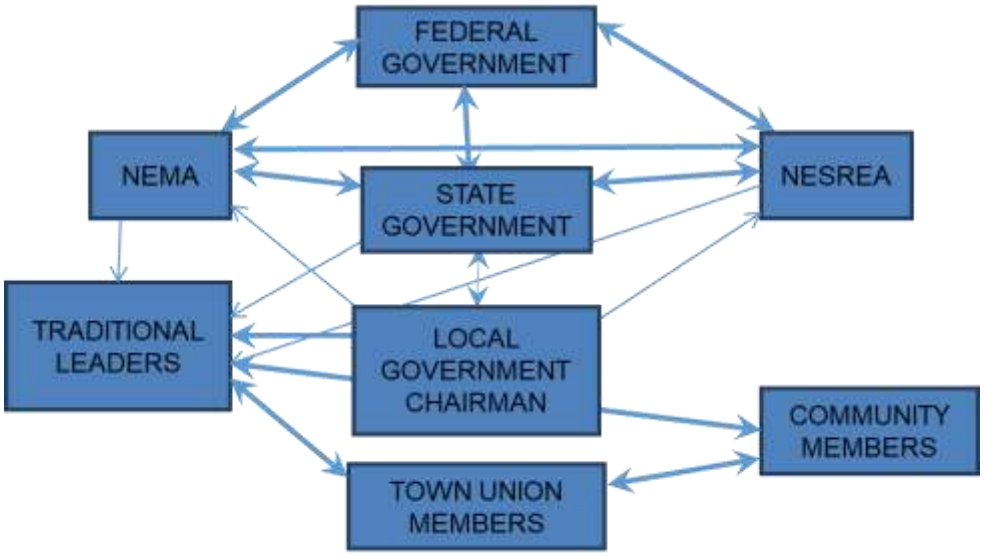


Figure 5.7: Stakeholders' interactions. The double-head arrow shows where two stakeholders interact with each other while single arrow shows one-way interaction. Similarly, strong links are shown by thicker arrows while the thin arrows show weak links.

Figure 5.7 depicts the links that exist between government at all levels, NEMA, NESREA, traditional leaders, town union members, and other community members. From the diagram, federal, and state governments have strong links with NEMA, and NESREA whereas local government has weak links with the agencies. Further, NESREA and NEMA share strong ties but have weak connections with local stakeholders. The local stakeholders have strong links amongst them and with other community

members. Also, the diagram shows that the government and its agencies have very weak or no direct link with rural community members.

5.4.1.3 *Collaborations amongst government agencies, and local stakeholders*

The NEMA and NESREA were the two agencies the researcher visited for interviews. The two Director Generals (DGs) of the agencies alongside the other 19 participants (traditional leaders, and town union members) were asked open-ended questions on their collaborations with other government agencies and local stakeholders that help them achieve their goals and satisfy the purpose for which the government established the agencies. Their responses indicated that links exist between them and sister agencies in the country. For example, the DG of NESREA reported that NESREA works in collaboration with agencies like NEMA, NIMET, NGOs, researchers, and other concerned bodies. The agency forms stakeholders' forums with these entities where they deliberate, discuss, brainstorm, and share ideas on how to deal with the issues of climate events and other environmental problems. For example, the DG of NEMA revealed that NEMA, NIMET, and NHISA officials meet in the capital city of Nigeria (Abuja) every year for interactions. Similarly, the DG of NESREA further stated that this stakeholders' forum provides the avenue to discuss ideas to mitigate the effects of climate change by curbing anthropogenic activities that are harmful to the environment such as the reduction in emission of greenhouse gases by regulating industrial pollution. This claim of discussing climate change adaptation was also pointed out by the DG of NEMA. The agency also forms National Regulatory Dialogue (NRD), and the National Council on Environment (NCE). NRD is a yearly forum that brings together environmental regulators and stakeholders from different sectors such as the public sector, academia, and the international community. The 11th NRD was on 3rd August 2021 while the 12th NRD was held on 25th of August, 2022. Similarly, the NCE is a body comprising all environmental stakeholders in Nigeria who meet occasionally to appraise the environment and give solutions to environmental issues. Occasionally, NESREA brings the NRDs, NCE, and other stakeholders such as NGOs, traditional leaders, academia, etc together to brainstorm on how to conserve ecosystems. Contrarily, the local stakeholders reported they hardly have access to these agencies. According to the DG, NESREA coordinates different stakeholder meetings to come up with ideas on how to protect the environment and reduce natural disasters in Nigeria. These activities may not be effectively done without involving related agencies and necessary stakeholders.

The DG of NEMA revealed that NEMA collaborates with other agencies like NIMET, and NIHSA. He further stated: "*On one hand, NIMET provides annual weather/climate predictions, and on the other hand, NIHSA comes up with annual flood outlook, while NEMA creates awareness on disasters using this information provided to carry out disaster risk reduction exercises."* NEMA depends on the interactions with NIMET and NIHSA to bring about climate change awareness in Nigeria. This information helps NEMA to identify flood-probable areas and give warning alerts to people most likely to be vulnerable to the disaster. However, community members did not attest to NEMA giving warning alerts regularly. The NEMA DG further said: *"Through a series of meetings, and workshops, NEMA interacts with sister agencies. To a very large extent, after these meetings, and predictions, the agencies will come together to analyze these predictions. This helps the agency to be alert and think ahead of time before another disaster occurs."* After brainstorming and sharing ideas during annual meetings, there is always a need to analyze previous predictions and actions taken to evaluate their effectiveness. No one attested to this claim during the interviews except the DG of NEMA. However, according to the NEMA DG, this is done to avoid disaster occurring from previous predictions. This claim may not be true due to the report of frequent climate-related disasters experienced in these communities by rural household heads.

Only 2 (11.1%) participants reported to have had contact with a government agency such as NEMA. For example, town union member 4 from the Etekwuru community who is also a town union member said: "*Whenever there is a flood in the community, town union members converge for a meeting where we agree to write to NEMA for emergency response*." This suggests that the link between government agencies and local stakeholders is a weak one (Figure 5.8). However, NEMA response is usually slow and most times come late when those affected by flood disasters must have given up hope.

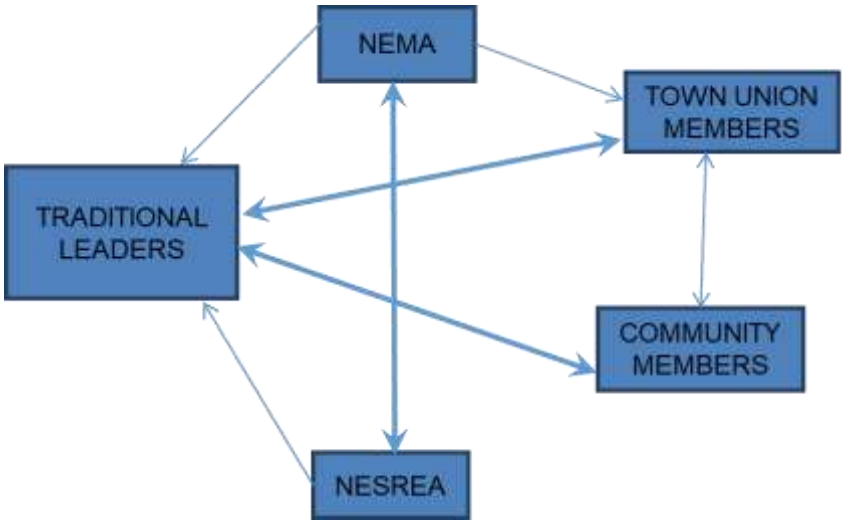


Figure 5.8: Weak link between government agencies and local stakeholders. The thick double-head arrow shows strong links while the thin one-head arrow shows weak links.

Figure 5.8 shows that NEMA and NESREA have weak links with local stakeholders. It further indicates that community members share good relationships with their local stakeholders while losing touch with government agencies that should help during weather/climate events.

The DG of NEMA reported that besides other agencies they collaborate with, local community leaders are also important stakeholders in the management of disasters in Nigeria. He also claimed that NEMA had engaged local leaders in town hall meetings where issues on disaster reduction and management are discussed. Further, the DG of NEMA said: *It is very important to involve these local people in the activities of managing disasters in their communities to get better results because they are even the major stakeholders who know the pain of the people*." This implies that neglecting local stakeholders will not lead to effective disaster management. According to the DG of NEMA, the agency uses what is called its community strategy for disaster management to include local stakeholders in disaster management processes. The DG further explained that this strategy is technical support from the local government emergency management committees and that of the state emergency management agency with NEMA at the federal level coordinating them. The local government emergency management committee is an arm of NEMA in the local government area that handles minor emergencies (minor disasters) while the State emergency management agency coordinates that of the entire state. For example, the DG of NEMA stated: "*When dealing with locals, or the communities, for them to get involved in what you are doing,*

you engage them and make them see that activity as their own to get a useful and meaningful response. Unlike going to a community to do a project and not knowing if it is what they will appreciate or like, it is better to carry them along, make them see the project as theirs by making them part and parcel of the activities and they will advise you on what they think is beneficial to the community." For disaster risk reduction and disaster management to be effective in rural communities, it is necessary to engage local stakeholders since they are the representatives of rural households in their various communities. Involving them in these activities may yield better results because they know their specific needs and have firsthand information on the needs and vulnerabilities of other community members. These claims of involving locals in disaster management are not true because the local stakeholders reported that government officials are difficult to access. Although government institutions and agencies like NEMA and NESREA have strong links amongst them that cannot be said about the links between these government agencies and the local stakeholders. More so, the local stakeholders and the government agencies have weak connections. These links do not exist at all between rural households (community members) and government agencies (Figure 5.8). This is because the common citizens in the country find it difficult to access the government and its agencies. However, these rural community members rely upon their stakeholders for information from the government because of the strong links they share in the communities (Figure 5.8). Local stakeholders have stronger links with the local government chairman than federal and state government agencies.

5.4.2 Major weather/climate events in rural communities of Egbema

The 18 interview participants comprising traditional leaders and town union members were asked to understand the major weather/climate events experienced in their communities, the effects of the extreme weather/climate events, how the people respond to them, the challenges they face, and the support they receive. Thematic analysis of their responses gave rise to the following themes: sources of weather/climate information and communication mode, impacts of weather/climate events in rural communities, coping strategies of rural community members, support during weather/climate events, challenges to weather/climate event adaptations in rural communities, and climate change adaptation decision making. There is a range of weather/climate events affecting rural communities in Nigeria but the emphasis here was on the major ones with higher risks referred to as 'disasters'. The traditional leader of the Etekwuru community said: *"The major ones are floods and high temperatures. The flood affects mostly our farm areas due to the nature of our land, while the high temperature affects everyone."* From

the responses of the participants of these interviews, 16 of the respondents (76.2%) indicated that flooding is the major weather/climate event experienced by people of these rural communities (Table 5.22). For example, town union member 5 from the Etekwuru community said: *"Every year flood covers our farmlands because oil companies have blocked waterways causing overflow of rivers and sadly, these oil companies hardly assist us."* This suggests that floods occur frequently in these communities, mostly every year starting from the month of September. Floods in recent times have affected most of the communities within this study area.

Out of the 15 town union members interviewed, 11 (52.4%) claimed they were overwhelmed by flood disasters because everyone has been affected directly or indirectly since most of them are farmers. On this point, the traditional leader of the Mmahu community said: *"We mostly experience flooding every year from the month of September. However, major floods are more catastrophic and it comes almost every 3 years.*" Although floods occur every year the major (high) floods occur between 1-3 years. These flood events are referred to informally as catastrophic because of the level of damage people suffer such as farmland destruction, building collapse, destruction of livestock houses, and others.

In total, 13 town union members complained about the effects and frequency of flood disasters while 2 participants from Etekwuru were concerned about high temperatures as a climatic hazard. For example, town union member 3 from the Etekwuru community said: "*We live on the higher side of the community and mostly suffer high temperatures due to gas flaring, and oil company activities around us*." This is because the Etekwuru community has two land areas, one is on a higher terrain while the other part is where their farmlands are located on a lower terrain. Therefore, the people on the lower land experience more of flooding than those on the higher ground who complain of mainly rising temperatures.

Further, 10 participants reported that excessive rainfall causes significant damage in the communities. For example, town union member 2 from the Etekwuru community stated that once it rains heavily, many structures are destroyed by the fast-flowing runoff. He further claimed that some community members lose their house roofs as a result of excessive rainfall that comes with winds and thunder.

Table 5.22 Major weather/climate events reported in the rural communities of Egbema

Weather/climate events	Traditional rulers	Town union members	Total

	(n = 3)	(n = 15)	
Flooding	3	13	16
High temperatures	0	2	2
Excessive rainfall	2	8	10

5.4.2.1 *Sources of weather/climate information and communication*

Three traditional leaders were interviewed to understand how they get weather/climate information and how the information is shared with other community members. The traditional leaders claimed they have several sources of getting information on weather/climate such as radios, televisions, magazines, town hall/stakeholders' meetings, and bulletins from the Nigerian Meteorological Agency (NiMET). The information on weather/climate is shared through several means to forestall damages and casualties during these climate crises. For example, the Etekwuru traditional leader said: *"When it has to do with rainfall which is the major climatic element here, we do not hesitate to inform other community members by sending out town criers to inform them. The town crier will deliver the message mostly in the morning or evening hours when people are still at home or have returned from work."* The effective means of sharing this important information is a factor in helping rural households prepare for anticipated weather/climate events to reduce vulnerability. In this instance, information may be more effectively shared using town criers, during meetings, and general assemblies. Some of them use text messages and social media, however, it is not effective to spread information in rural areas using social media because many are poor and do not have access to cell phones. Further, the traditional leader of the Opuoma community said: *"Information on weather/climate is very vital because we depend on agriculture and this will affect the farmers, therefore I make sure our people are aware of the annual predictions of weather/climate to avoid recording serious damages and losses. I usually tell people around me and the chiefs who come to the palace for other matters. The village heads too are told and they go home to disseminate the information."* Traditional leaders also use village chiefs to convey weather/climate information to community members. The information on weather/climate is not hoarded by these traditional leaders, hence the employment of effective means to create awareness by spreading the message to other community members to reduce the impact of climate disasters in the communities.

In total, 15 participants (71.4%) claimed that radio and television provide them with information on weather/climate. For example, town union member 3 from the Opuoma community said: "*No day passes without listening to the radio or watching a television to know what is happening around us. This is my*

daily routine because useful information like that of weather/climate is broadcasted." Most of the elderly persons in the rural communities use radios while few who can access electricity use their televisions to get information. Further, the traditional leader of the Mmahu community revealed that he does not miss early morning news and throughout the day he reads newspapers, and magazines.

Further, 13 (61.9%) of the respondents claimed that information on weather/climate is obtained during town hall/stakeholders' meetings where people who are more informed share the news they have got. For example, participant 3 from the Mmahu community recounted how an executive member of the town union gave them the predictions of flood occurrence in 2012. According to the participant, the information helped him to adjust his activities and prepare before the flood arrived.

5.4.2.2 *Impacts of weather/climate events in rural communities*

In total, 18 participants comprising of 3 traditional leaders and 15 town union members were asked about the effects of weather/climate events on the rural people of Egbema communities. Their responses show that weather/climate events have great impacts on the people and their environment (Table 5.23). Their claims were in line with the reports given by other community members who expressed their conditions/experiences during and after weather/climate events in their communities.

All the participants recounted their experiences with major weather/climate events in their communities which is mainly flooding. Here, 17 (94.4%) respondents reported that during and after weather/climate events, there are unusual food shortages due to damage to farmlands and crops and also due to early/premature harvesting of crops consequently leading to high prices of food items. For example, town union member 5 from the Opuoma community said: "*During high floods, only the rich people can afford good meals because they have the financial power to buy from other places.*" On this point, town union member 4 from the Opuoma community reported that roads and markets get flooded, hindering the supply of food to the local people and the few marketers who supply under the harsh conditions sell at high prices. Food insecurity was reported by the majority 17 (94.4%) of the participants in this study who noted that during times of climate disasters like flooding, only a few community members can afford good meals while many suffer malnutrition due to food shortage. For example, town union member 3 from the Etekwuru community reported the case of his neighbor who lost two children to malnutrition. There is usually food scarcity due to the destruction of farmlands, death of livestock, and decline in food

production caused by flood events in these communities. During informal interactions with residents, they disclosed that the October 2022 flood event destroyed many farms and made garri (processed cassava) expensive for an average rural household.

All the participants reported that floods destroy their crops and farmlands. For example, the traditional leader of the Mmahu community said: "*When floods take people unaware, farmlands and crops in them are covered by water making it difficult for people to harvest them*." Some people abandon their farms because of floods, leaving the crops to be destroyed. For example, the traditional leader of the Opuoma community said that during the October 2012 flood event, many farmers could not harvest their crops because the flood water came quicker than usual and the volume of water was so much that many farmlands were left with crops in them. Farmers also claimed that due to bad roads, they were unable to quickly harvest all their crops before the flood took over.

Table 5.23: Impacts of weather/climate events in the study area

Impacts	Traditional Leaders (n = 3)	Town union members (n = 15)	Total (n = 18)
Food shortage	3	14	17
Destruction of crops and farmlands	3	15	18
Homelessness	2	13	15
Increased mosquito bites, contaminated water, and reptile intrusion	3	9	12
Hampered economic activities	3	15	18

Further, 15 (83.3%) participants reported that floods bring about homelessness. They claimed that many rural community members are displaced during floods and have no alternative homes which may increase their vulnerability during this period (Figures 5.9 and 5.10). Community members reported earlier that weather/climate events like floods have displaced several persons in their communities temporarily or permanently. Town union member from the Mmahu community said: *"Flood victims scamper for safety, taking refuge in places like schools, churches, open fields, and people's compounds*." During floods in these rural communities, houses are taken over by water (Figure 5.9) forcing rural households out of their homes. Victims of floods become temporary refugees (Figure 5.10) in other places (as Internally Displaced Persons (IDPs)) because their homes have been destroyed by flood and some (permanent refugees) may not return to the community after the flood has receded. For example, town union member

3 from the Opuoma community reported that during the last catastrophic flood event of October 2012, many community members were forced to find refuge in school and church premises, and community members whose houses were destroyed not get back home after the flood event.



Figure 5.9: Flooded homes in Egbema caused by the October 2022 flood event



Figure 5.10: Flood displaced community members in Egbema, October 2022

In total, 12 (66.7%) participants reported the presence of reptiles and an increase in the number of mosquitoes during floods. Town union member 5 from the Mmahu community reported that: *"During this time, many community members fall sick due to mosquito bites, contaminated water and some die when bitten by dangerous reptiles like snakes.*" They claimed mosquitoes become larger in number and result in higher cases of malaria that eventually kill some persons because there are no hospitals. During flood periods, mosquitoes breed freely requiring rural households to take extra measures to protect themselves. Also, reptiles such as snakes and crocodiles are either washed by flood water or looking for safe places to invade homes in these communities inflicting people with bites that cause death. Some fall sick due to the consumption of contaminated water during floods. Community members complained that during floods, death rates increase due to contaminations of the environment resulting in cholera and typhoid diseases, reptile bites, malaria, and other sicknesses.

All the participants claimed that roads are covered by water during floods (Figure 5.11) impeding movement of goods and services within and outside the communities. For example, the traditional leader of the Opuoma community said: "*When floods come, people are forced to stay stagnant because the roads have been taken over by water and most times the level of water is so high that people do not risk*

crossing the water except they have canoes or can afford to pay for other people's services." This suggests that economic activities are greatly affected during the flood period. For example, an indirect impact is that marketplaces may be flooded when the roads are impassable, places of work may close temporarily forcing, people out of work, and people's shops may also be covered by water making them lose income. Direct impacts is that farms will be flooded leading to loss of income and shortage of food for farmers and other community members, sicknesses/diseases, destruction of homes, death of human and livestock. The implication is that people's sources of livelihood are greatly impacted during weather/climate events such as flooding.



Figure 5.11: Flooded road in Egbema, October, 2022

5.4.2.3 *Adaptation strategies for rural households*

In total, 18 respondents including traditional leaders and town union members were asked to identify the coping strategies adopted by rural households during weather/climate events in their communities (Table 5.24). On this point, 13 (72.2%) of the respondents claimed that community members use different adaptation measures such as early planting and early harvesting to avoid damage to crops in their farmlands. Community members also reported that they plant early enough to enable them to harvest

earlier before floods arrive. The traditional leader of the Opuoma community said: "*We plant whenever the first raindrops and harvest our crops before September when floods usually come*." To avoid damage to crops, farmers plan to cultivate their crops immediately after they notice the first onset of rains. For example, town union member 5 from Mmahu said: "*The major food we produce in this community is cassava, so we usually buy early maturing stems of cassava called 'trukem' and it takes less than six months to be ready for harvest.*" Using early maturing plants helps farmers to harvest their crops before any flood disaster. If these crops are planted early in the year, they may be ready for harvest before September when flood is expected to occur. This is to give their crops time to mature before they are harvested. In this way, they survive the flood when it finally comes. However, these crops may be harvested prematurely when the floods come earlier than expected (Figure 5.12).



Figure 5.12: Farmers harvesting premature cassava during the October 2022 flooding in Egbema

In total, 12 (66.7%) of the respondents reported that people leave their farmsteads and residences once there are signs of flood to avoid serious damage to lives and property. For example, town union member from the Mmahu community said: "*Many of us migrate from our community to other places whenever*

this flood comes because people may get drowned trying to stay back." Many of the community members who have been displaced by floods claimed that family members and friends in neighbouring communities accommodate them during flood periods. Every time a flood occurs, rural households are forced out of their homes for safety. People are accustomed to leaving their homes and farmsteads whenever floods come. For example, during the October 2022 flood event, thousands of community members in the study area were displaced leading to migrations to safe places like other people's homes. These migrations are usually done when the flood alert is received or when the level of the water is still very low (Figure 5.13). This method may be more effective because people share good relationships with other community members and even with people from neighbouring communities who are willing to accommodate them till the flood water recedes.



Figure 5.13: Community members relocating from their flooded home in October 2022

In total, seven respondents claimed they use prayers for God to intervene in their plights. For example, the traditional leader of Etekwuru said: "*God is our helper during flooding because we do have special prayer sessions for flood in our worship centers*." Some rural households feel helpless and resort to prayers during weather/climate events. For example, town union member 5 from the Etekwuru

community who claimed to be a clergy member reported that special prayer sessions are made against disasters in the community and special offerings and contributions are made for those affected by climate disasters. Due to their strong religious beliefs, these people rely on God to help them cope because they do not trust there will be assistance from the government.

Table 5.24 Responses on coping strategies to flood disasters

Coping strategies	Traditional Leaders (n = 3)	Town union members (n= 15)	Total
Early planting and harvesting	3	10	13
Use of early maturing plants	2	8	10
Migration	3	9	12
Prayers	1	6	7

5.4.2.4 *Challenges to climate change adaptation in rural communities*

In total, 18 respondents comprising traditional leaders and town union members were asked open-ended questions to highlight the challenges faced by their communities in adapting to climate change (Table 5.25). All of the interviewees (18) identified that poverty is the biggest challenge they face. They claimed that poverty makes people more vulnerable to climate change because they cannot afford basic life needs. Town union member 3 from the Etekwuru community said: *"When there is any disaster in this community, people go through serious hardships because they have no money."* When people are poor, they are most likely to be vulnerable to climate-related disasters like flooding. This is because money is needed to afford basic life necessities to survive harsh weather/climatic conditions. Community members reported that high poverty levels have made many of them lose their loved ones because they cannot access good healthcare services especially during and after climate disasters. For example, town union member 2 from the Opuoma community narrated how his cousin's brother died because there was no good hospital to treat him.

Table 5.25: Challenges to climate change adaptation in rural communities

Challenges to adaptation	Traditional leaders	Town union members	Total
Poverty	3	15	18
Lack of basic infrastructure	2	12	14
Political marginalization	3	9	12
Limited alternative jobs	3	8	11

Out of the 18 respondents, 14 (77.8%) reported that the community lacks basic infrastructure like good roads, hospitals, electricity, pipe-borne water, and good schools. Town union member 1 from the Opuoma community said: *"There is no or little government presence in terms of basic and social amenities in the community".* These infrastructural deficits make rural people vulnerable to climate disasters in these communities and inhibit their ability to cope during these events. For example, bad road networks make it more difficult for farmers to transport their harvested agricultural produce to the market, away from flood areas, and move to the nearest town for economic reasons. Also, the lack of good healthcare facilities such as hospitals promotes high mortality during weather/climate events like floods because sick people have nowhere to go for treatment and those bitten by reptiles like snakes may die as a result of inadequate treatment. A lack of electricity means perishable agricultural products cannot be preserved for a longer time. People who can afford electric generators and petrol have more access to electricity while people who may not afford electric generators (farmers) have lesser access to power and are more vulnerable during extreme events like heat waves.

In total, 11 (61.1%) of the respondents reported that most people in these communities rely on farming because they do not have access to other jobs. The traditional leader of the Etekwuru community said: "*There are no alternative jobs for our people outside agriculture and when there is a problem like flood disaster, most of our people suffer while some take to crimes to survive.*" Lack of alternative jobs may increase the vulnerability of rural households to weather/climate events especially when their farms have been taken over by floods. The availability of other jobs can provide alternative livelihoods to rural households whenever their farmlands have been destroyed by flood events.

Further, 12 (66.7%) of the respondents reported that political marginalization is a big challenge to them because the government neglects them and does not consider them fit to occupy positions in the government. For example, town union member 4 from the Opuoma community reported: "*Despite the exploration of natural resources from our communities, and how the government earns huge revenues from these natural endowments, our people are treated badly that we do not see our sons and daughters appointed into government positions."* These communities have huge oil deposits that have been drilled by companies for years yet they are poor and lack infrastructural and human capital development. Because these people are predominantly farmers, the lack of basic social amenities exposes them to

climate risks and limits their resilience by hampering their efforts to adapt. The traditional leader of the Etekwuru community noted that if their people are incorporated into the government, they will certainly bring developments to the community. However, the people feel the government does not need them in governance despite their contributions to the revenues of the state and the country at large.

5.4.2.5 *Suggestions by interviewees for reducing social vulnerability*

The traditional leaders were interviewed to understand what they think would reduce the social vulnerability of rural households to climate-related disasters in their communities. In the views of the three traditional leaders, social vulnerability to climate change can be reduced by fixing many inadequate social amenities and exposing people to the impacts of weather/climate events. According to the traditional leader of the Etekwuru community: "*The most important factor here is poverty alleviation to enable rural households to afford basic life necessities*." Pulling people out of poverty will make them live better lives thereby reducing their vulnerability to weather/climate events. For example, when people have money during a flood, they can afford food for their families until the flood recedes. Community members claim that poverty alleviation will help them become more resilient to climate-related disasters like floods because they will be able to have access to good medical services, food, and other basic life needs.

Two out of the three traditional leaders thought that people would adapt better to climate change if good healthcare facilities were provided in every community. For example, the traditional leader of the Opuoma community said: "*Most of the deaths recorded here are because we do not have good hospitals to treat our sick ones. People prescribe drugs on their own, while some others use herbal medications to cure themselves but if hospitals and clinics are built, these things will reduce or stop totally*."

The three traditional leaders also advocated for job creation, especially for youths, and assistance for elderly people who are too weak to work. On this point, the traditional leader of the Etekwuru community said: "*The government needs to create jobs for the youths to curb social vices and other crimes. They should assist our farmers to produce more foods from the farms.*" When there are no jobs, the youths commit crimes, causing nuisance and victimizing innocent rural households. Therefore creating well-paid jobs will keep the youths engaged meaningfully. Also, town union member 4 from the Mmahu community claimed that skills acquisition and empowerment programs organized periodically can help to curb crimes and reduce over-dependency on agriculture. This may be true because many of the youths

in the study area are jobless except for farming. Assistance to farmers will help to produce more foods to address the issues of food insecurity, especially after weather/climate events like flooding.

Further, two out of the three traditional leaders suggested that roads leading to various locations within their communities should be fixed to enable them to have free movement. On this point, the traditional leader of the Opuoma community said: "*There are places we cannot drive our cars but only trek because the roads are so bad. Secondly, motorists have hiked transport fares around our communities because the roads are not good. I believe fixing these roads will reduce the hours spent traveling from one place to another and also reduce the amount people pay to motorists for a short distance.*" Good rural road networks are necessary to help farmers transport their goods from the farms to the market. Fixing the roads and creating more roads around these rural communities will give the community people access to places in a shorter time.

5.4.2.6 *Support during weather/climate events*

Nineteen respondents comprising the local government chairman of Ohaji/Egbema, traditional leaders, and town union members of the three selected communities were asked open-ended questions on the sources and types of support given to rural households during and after weather/climate events in the study area.

From the responses of the 19 participants, rural households in these communities need support to cope and recover from the impact of weather/climate events and this support comes from different sources and in different forms (Table 5.26). For example, 8 (42.1%) respondents claimed to give words of encouragement to victims of weather/climate events. Town union member 4 from the Etekwuru community said: "*Some of our members assist by visiting flood-affected areas, and the victims, to make necessary reports that are forwarded to governments, oil companies, and NGOs for support*." Town union members give the people words of encouragement to help them stay strong while assuring them of government support. They claimed to advise people living along flood-prone areas and waterways to always vacate those places till after the flood disaster to avoid recording casualties.

Table 5.26 Support received during weather/climate events

Support	Local Government Chairman (n = 1)	Traditional leaders (n = 3)	Town union members (n = 15)	Total
Free farm labour	0	3	11	14
Free accommodation	0	2	12	14
Flood relief materials	1	3	8	12
Words of encouragement	0	0	8	8

Further, 12 (63.2%) participants claimed that support comes in the form of cash, food, clothing, and relief materials donated by other community members, government, and relevant agencies to the affected persons in the communities. These participants also reported that support from the government and oil companies is usually little and does not get to all the flood victims. For example, town union member 3 from the Etekwuru community said: *"I have contacted the environmental agencies who through the government brought relief materials for those affected by floods and we shared them accordingly but not everyone got the help."* Local stakeholders write to NEMA for aid whenever floods occur in their community. More so, the local government council chairman also said: *"These supports do come from oil companies, government and individuals. Most of the support comes in the form of relief materials such as foams, pillows, clothes, blankets, and food items such as rice, tomatoes, oil, etc. Sometimes little cash support is rendered to the vulnerable people during this period. These items are shared among communities affected by the disaster through their leaders. The leaders are mandated to distribute them amongst the affected households/individuals."* Sadly, these supports are not enough for the affected persons in the community due to the quantities supplied (Figures 5.14, 5.15, and 5.16).



Figure 5.14: Food donations from government to flood victims in Egbema, 2022 showing community members who were displaced by the 2022 flood receiving some food items such as noodles and biscuits from government officials. These people are of different families who found refuge in the community primary school building.



Figure 5.15: Flood relief materials from government officials during the 2022 flood disaster, like blankets, mosquito nets, foams, and pillows distributed flood in the Egbema community communities.

With hundreds to thousands of people being displaced and affected by floods, these items may not be enough to help them cope during this period. Therefore, support from other sources such as friends, families, neighbours, and church members is sought. For example, flood victims receive assistance from other community members in the form of food items, accommodations, etc.



Figure 5.16: Food items from the government to a flood victim in Egbema, comprises three sachets of noodles, one bucket of garri, a few cups of rice, and a slice of yam.

During observations of the recent October 2022 flood disaster in Egbema, it was discovered that the government brought food items to assist the victims and from these food items, a victim received a few sachets of noodles, little quantity of garri, a slice of yam, and few cups of rice distributed by some local stakeholders (Figure 5.16). These food items may not be enough to feed households with more than seven members for just two days.

Further, 14 (73.7%) respondents claimed that victims of floods get help from other community members. For example, the traditional leader of Etekwuru said: "*Due to the good relationship people share in the communities, victims of flood get community help in the form of free labour to harvest crops from flood-prone farmlands."* Good relationships have helped farmers to get free labour from their neighbours and other community members (Table 5.26). This helps the farmers to harvest their crops faster before the floods take them over. The farmers validated this claim when they also reported that other community members render free labour to harvest their crops once the flood is approaching.

In total, 14 (73.7%) respondents also reported that other community members give accommodation to people who are displaced by floods. The traditional leader of the Opuoma community said: "*Our people*

are accommodating, so anyone whose house has been submerged in water can take refuge in another person's home till the flood is over." Those who do not have alternative homes to relocate to during floods can find accommodation from other community members for free until they can return home. This has been how many flood victims find alternative accommodation. Community members also claimed that flood victims are allowed to sleep in people's compounds for free. This has been a common way to assist people whose homes get flooded.

5.4.2.7 *Climate change adaptation decision-making*

Climate change adaptation decision-making is a critical aspect of the adaptation process that requires attention due to the ineffectiveness of many conventional adaptation measures used in the past. The three traditional leaders in the selected communities were asked questions on how the government includes them in climate decision-making processes.

The traditional leaders argued they are meant to contribute to decision-making processes as it concerns their communities. The traditional leader of the Etekwuru community said: *"The government cannot make those decisions without letting us know otherwise it will not be effective. I have never been invited to make such formulations or policies on climate change."* They further argued that adaptation measures may be failing in rural areas because they are not consulted or involved in the process, and the government does not consider them before making these decisions. The traditional leader of the Opuoma community also said: "*Most times, the decisions are made already and only conveyed to us through briefing or memos from the government.*" Involving traditional leaders in climate change decision-making may result in formulating better adaptation policies that will more effectively address the impacts of weather/climate events in rural communities. However, making adaptation decisions outside the local stakeholders may result in formulating ineffective adaptation measures.

5.4.3 Ecosystem management and environmental education

NESREA is the government agency responsible for ecosystem management and conservation in Nigeria. Due to the damage caused by anthropogenic activities, NESREA has the responsibility of maintaining ecosystems, protecting biodiversity, and reducing environmental degradation and pollution. The DG of the agency was the participant who responded to open-ended questions asked by the researcher. The DG of NESREA claimed that the agency does environmental education to create awareness for

environmental disasters such as floods. The DG of NESREA said: *"In carrying out the ecosystem management and interrelated conservations in rural communities, the agency uses what is called 'green corps'. These are volunteers used to monitor environmental situations in rural communities with their offices in the capital of every state in Nigeria*." These Green Corps are used as vanguards, especially in the rural areas where there is no presence of NESREA. These people report or give feedback to NESREA, and the agency responds more swiftly to environmental problems in rural areas when the report comes from the Green Corps. According to the DG, NESREA's role in the conservation and management of the ecosystem is to encourage sustainability in the use of natural resources and the agency has regulations for monitoring the abuse/misuse of these natural resources such as forest, soils, and wildlife. The DG of NESREA said: *"NESREA is a signatory to Multilateral Environmental Agreements (MEAs) through Designated National Authority responsible for receiving and reporting information (DNA). The agency analyses each of the agreements and conventions, domesticating them to the locals. One example is the Montreal Protocol which is on DOS (ozone layer-depleting substances). NESREA formulate regulations to work in tandem with the agreements and conventions, bringing them down to the local environment."*

These laws on the environment are broken down for local implementation in both rural and urban areas of the country. The DG of NESREA said that the agency has sanctions and penalties for violations of ecosystem laws and regulations by individuals, companies, industries, or corporate bodies. For the enforcement of these laws and regulations, NESREA uses its enforcement officers to do so. The DG of NESREA said: "*The agency issues conservation permits to companies and industries that engage in activities capable of endangering the environment. Before this permit is issued, the agency must be satisfied that such company has put appropriate measures in place to curtail the emission of greenhouse gases and the release of injurious substances into the environment."* These sanctions or punishments could either be in the form of fines or jail terms to environmental law violators and those who operate their companies and industries without permits.

The DG of NESREA also said the agency does environmental education using what is called 'the carrot and stick approach'. For the carrot approach, the DG said it involves making people know the environmental consequences of their actions, and the time given to the people to amend their actions, while the stick approach involves meting out sanctions/punishments when the defaulter fails to make amends after the timeline given to do so elapses. More so, the agency does not go to houses for

environmental education and awareness rather it uses children who are taught in their schools as vanguards to relate to their parents and other family members when they get back home. Also, the DG claimed they use the services of graduates who are on one-year youth service in Nigeria as vanguards because most of them are posted to rural communities. These youth vanguards he said help NESREA to teach environmental education, create awareness, and monitor environmental situations in the communities of their primary assignments and make reports to the agency. Further, the DG of NESREA said: "*NESREA organizes town hall meetings in rural communities where traditional leaders and other local stakeholders are sensitized.*" The DG claimed that the agency sends some of its trained officials to rural areas to teach them how to conserve the environment. The town hall meetings where these teachings take place are attended by local stakeholders from different rural communities. The DG of NESREA further stated that this is an avenue to send warnings to individuals, companies, corporate bodies, and industries in rural communities of the impending dangers of pollution, floods, and the implications of gas flaring by oil companies. However, none of the local stakeholders reported ever meeting with NESREA officials in the study area. According to the DG of NESREA, the agency uses jingles on radios to alert people of impending climate risks in rural areas and other parts of the country.

Further, the DG of NESREA claimed the agency inspects the environment of rural communities especially when a written report is forwarded to the agency. According to the respondent, if it is a complaint from a community, the agency will form a team of officers who are sent to ascertain the nature of the complaint and to determine the appropriate authority to handle it. The officers usually have the opportunity to find out if what is written on the complaint letter is the same as what is observed on the ground, should that be the case, the complainant and the entire community will be invited for an open conference. In this open conference, community members are allowed to contribute to the discussion to enable the officers to understand what they want NESREA to do for them. However, in the study area, the rural householders could not attest to NESREA's presence and efforts in this regard and none reported ever going to NESREA for complaints. The local stakeholders reported that some of these agencies (like NESREA) cannot easily be reached and they barely come to their communities for any function. Further, the DG of NESREA said: "*During the opening conference, the team did advise and give steps to curtail the situation and satisfy the complainants."* After the open conference, the responses of the rural communities will be considered while NESREA officers will advise them appropriately and give a timeline for when the officers will return to be sure they adhered to the environmental advice given. In

this way, NESREA also monitors environmental activities in rural communities. All these processes are more on paper than practical because the local stakeholders never identified NESREA's presence in their communities.

The DG of NESREA further stated: "*While there are environmental laws and regulations by NESREA, the agency is yet to promulgate climate change adaptation laws in Nigeria. However, there are plans to do so but the agency is taking its time to come up with appropriate laws. However, NESREA trains its staff on how to combat climate change in the country*." The DG of NESREA said that NESREA faces some challenges in implementing environmental regulations and climate-related policies. According to this participant, one of the major barriers is the neglect of the environment by the government at all levels. The DG of NESREA said: "*Government officials do not take environmental issues seriously because they think it does not matter much*." Because the environment does not matter to the government, the agency is not well funded to function at its maximum capacity which is a very big challenge to NESREA. The DG said: "*Neglect of the environment by leaders, lack of adequate funding, legislative bottle-necks where national parliamentarians who do not support particular environmental laws due to selfish reasons cause setbacks in enacting such laws are some of the institutional barriers to implementation of climate change policies*." In the country's parliament, when laws are not for the benefit of some legislators, they deliberately delay the process or kill the bill to enact such laws.

5.4.4 Disaster risk management

According to the DG of NEMA, the agency was established by Act 12 of 1999 (national emergency management agency establishment act, 1999) as amended by Act 50 of 1999 to manage disasters in Nigeria. NEMA has three tiers of government namely; federal, state, and local government. The DG of NEMA was the respondent to the open-ended questions on disaster risk reductions and management in rural communities. The DG of NEMA revealed the agency's operations trickle down from the federal level where NEMA is situated, to the State Emergency Management Agency (SEMA), and finally down to the Local Government Emergency Committee (LGEC). The LGEC includes personnel in the local council area trained to manage disasters within their jurisdiction. For example, the NEMA DG said "*NEMA at the federal level advises states to establish state emergency management agency through the state legislations backed by law, and the formation of the local government emergency management committee*." The Director General claimed that there are three levels of disasters namely; catastrophic,

major, and minor handled by the different tiers of NEMA. For instance, if the disaster is catastrophic, it is a national disaster and would be handled by NEMA at the federal level, but when it is categorized as major, it is handled by the state emergency management agency while the minor disaster is handled by the local government emergency management committee. The local government emergency committee handles the implementation of disaster policies at the local level.

This participant said that when disasters occur in rural communities, there are actions that communities are asked to take which are monitored by the local government emergency committee which helps the community to be involved in the activities of disaster risk reduction. Further, the DG said: "*The local government emergency committee handles the implementation of disaster policies at the local levels and besides, if disaster occurs in a community, which is located in a particular local government, there are community activities that are monitored by the local government emergency management committee that helps such community to own some of the activities towards disaster risk reduction because it is not about when it happens you begin to think of management but try to reduce the risk associated with the disaster and thereby giving an enabling environment for activities to thrive like the farming activities, industrialization and some other aspects of the economy. That is why this paradigm shift in disaster management is a key and it has been trickled down to the communities for them to curtail some of these activities. This is an important aspect of risk reduction and disaster management.*" However, rural households in these communities never attested to such a claim by NEMA. For example, during the interviews town union members reported how difficult it takes to communicate and interact with government agencies like NEMA. The DG further claimed that communities are taught to take disaster risk reduction actions rather than waiting for management. Therefore, there is a paradigm shift from management to risk reduction where actions are taken to reduce disaster risks to the minimum. However, rural households and farmers in these communities lack the requisite knowledge of disaster risk reduction which shows that NEMA's claims are more theoretical than practical.

Regarding climate change and policies formulated by NEMA, the DG reported that the agency has the National Disaster Framework (NDF) which helps to address different forms of disasters in Nigeria. On this point, the DG of NEMA said: "*The National Disaster Framework cut across all aspects of disasters in Nigeria which the climate disaster is included and it is done in collaboration with other stakeholders in managing climatic conditions in Nigeria*." The DG of NEMA further stated that the government of

Nigeria is a signatory to international agreements such as the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCC), and the Sendai frameworks. He also said: "*NEMA further formulates policies about these international agreements to bring them down to the local communities for disaster risk reduction."* The Nigerian government comes up with communiqué on what is needed to be done, so NEMA keys into those policies and brings them down to the local levels to ensure that disaster risks and impacts are reduced to the minimum.

5.4.4.1 *Disaster risk management strategies in rural communities*

NEMA involves communities in the management of disasters where they adopt some outlined disaster risk management strategies to ensure active participation, preparations, and implementation of the activities taught to them. The DG of NEMA said: "*The agency creates awareness, making the rural people a vital part of the activities, and encouraging communities to adopt early warning systems especially for farmers to help them maintain their products. NEMA conducts ad-hoc training for communities on the responses to disasters and also advises them to reach out to other individuals who were not present for the training."*

More so, the NEMA DG claimed that the staff of the agency are trained and retrained constantly to make sure they are abreast with current realities. An example was the training given to selected NEMA staff by the agency outside the country in 2012. The DG further stated that NEMA in anticipation of climate-related disasters stockpiles its warehouses, making sure that important items for emergency responses are available. This claim was evident during the coronavirus pandemic where several warehouses were stocked with food items and relief materials like foams, pillows, and blankets. However, these are done in the urban areas and there are no such emergency schemes reported in the rural communities.

5.4.4.2 *Challenges to disaster risk management*

The DG of NEMA stated that the agency faces several challenges in discharging its duties effectively. Some of these challenges were highlighted in this interview. Firstly, the DG of NEMA stated that cultural and religious beliefs of rural communities pose serious challenges to disaster risk management because many of the rural households do not believe that disasters are results of climate change, and many of them object to relocation during floods claiming they cannot leave their ancestral homes. The reason is that the people have strong religious backgrounds comprising Christians and traditionalists. These people

are difficult to encourage to adopt climate change adaptation measures. On this point, the DG said: *It is quite obvious that, in that 2012 flood event, some of the community members believed that climate change is an act of God and therefore refused to listen to what NEMA had to say. It is difficult to convince these people on what to do to reduce damages during climate disasters."* This may not be true because community members emphasized how ready they are to learn new ways of dealing with disasters such as floods (Section 5.2.3).

More so, the DG of NEMA reported that disaster risk management efforts by the agency suffer from bureaucratic bottlenecks by government officials that affect response time. For example, during the 2022 flood, victims of the flood waited for weeks before getting little relief materials from the government agency. The NEMA DG said: "*The legislators of the country do not take climate change seriously, hence there are setbacks in passing bills concerning adaptation policies and disaster risk reductions."* Blocking these policies has resulted in to increase in disaster victims across the country.

5.5 Triangulation of Results

This section combines the results from the questionnaire survey, interviews, and FGDs. The main points from the results relating to social vulnerability and climate change adaptation were identified in this section. The results obtained were subject to thematic analysis and the following integrated themes were identified: social vulnerability of rural communities; climate change awareness and perception of rural community members; major weather/climate events and their impacts on people and the environment; roles of community relationships in building climate change adaptive capacity; adaptation to climate change in rural communities; and disaster risk reduction and management. This section helps to validate the data obtained for this study.

5.5.1 Social vulnerability of rural community households

From the questionnaire data, the socio-economic and demographic characteristics of respondents in the rural communities studied show that the majority of the household heads (80%) are between 18-59 years old while 20% are 60 years and above (Table 5.1). Further, the males (mainly between 18-39 years of age) are more educated than the females who are mainly within the older age brackets. In addition, the younger household heads have higher educational qualifications than the older household heads which may affect their climate change adaptation behavior because it is expected that persons with higher

educational backgrounds are likely to have better climate change knowledge which can also reduce their exposure and vulnerability to impacts of weather/climate events. However, the older household heads are expected to have more experience in climate as well as farming methods in their respective communities than the younger ones regardless of educational level.

Household size was a reflection of the age and education of household heads (Section 5.2.4). Data obtained from the questionnaires show that 72.9% of the total households have at least five members and above (Table 5.1). Having more household members entails committing more resources to their well-being by the household heads which may likely not be available, leading to his/her vulnerability during climate disasters like floods. Also, more household members may promote higher resilience against climate change through collective actions. This implies that households with a higher number of members need better sources of livelihood to survive especially during weather/climate events. However, farmers argued during the FGDs that more household members provide more labour for farming activities to mitigate against higher vulnerability to extreme weather/climate events (Section 5.3.3). In addition, 87.9% of the household heads are engaged in primary economic activities with the majority (66.7%) being farmers (Section 5.2.5). More so, 50.5% of the household heads earn less than 50,000 naira per month, implying that about half of the people in these communities are living below the national poverty line (Section 5.2.6). In the interviews, the claim of community people living below the poverty line was supported by the responses by traditional leaders, and town union members who identified poverty as the greatest challenge they have against climate change adaptation (Table 5.25). Poverty in this context encompasses not only a lack of funds but also a lack of access to clean water and nutritious food, lack of access to basic healthcare, inequality or social injustice, lack of education, lack of access to jobs, and poor basic infrastructure like water, electricity, and housing. This implies that social vulnerability to climate change in rural communities may be greatly amplified by poverty. This is also evident in the means of transportation indicated by the household heads. For example, data from the questionnaires show that 56.3% of the rural household heads use bicycles and foot for movement and of this number, the majority are farmers (Table 5.1). This suggests that farmers and other community members will likely find it difficult to transport themselves to schools, hospitals and farmers may also find it difficult to transport their products from the farms to the markets and could be more difficult during climate disasters like floods because they would need faster and better means of transport.

However, during the FGDs, farmers revealed how they constructed emergency canoes to help them transport their harvested farm products away from flooded farmlands (Figures 5.4 and 5.5).

Further, data from the questionnaires show that access to healthcare facilities like hospitals is low because only 34.6% can afford to go to hospitals for treatment when they are sick while others self-medicate, or visit traditional herbalists (Table 5.1). This implies that the absence of good healthcare facilities like standard hospitals and clinics may likely raise the vulnerability of rural community members to climate-related disasters. For example, during floods, people get sick easily due to contamination of the environment (land and water) without access to good healthcare which may increase the mortality rate in the affected communities. During the interviews, 77.8% of the local stakeholders named the lack of basic infrastructure like a healthcare system as one of their challenges to climate change adaptation which can also increase their vulnerability to weather/climate events (Table 5.25). In addition, 12.9% of the households have persons with disabilities, and may likely be more exposed and vulnerable to climate change impacts due to the poverty level of the household heads and the lack of good healthcare facilities (Table 5.1). More so, these disabled persons have higher needs, and may not be able to work, therefore depending on other household members for survival.

5.5.2 Climate change awareness and perception of rural community members

It is expected that since 87.1% of the household heads have lived for more than 10 years in these communities, they will have better knowledge and experience of weather/climate events that have occurred. Further, data from the questionnaires show that the majority (89.1%) of the 164 people who have heard about climate change are between the ages of 18-49 years (Table 5.2). Similarly, all the local stakeholders claimed they had heard about climate change before the interview date. The data from the questionnaire further illustrates that those who attended higher schools have more awareness of climate change than those with less education (Sections 5.2.3 and 5.2.13).

Of the total household heads, 97.5% said they experience extreme weather/climate events every year (Table 5.7). This result is supported by the response of the Mmahu traditional leader who reported during the interview that floods occur every year starting from the month of September. However, farmers including household heads reported to have heard about climate change on radios, televisions, and from their children in high schools, friends, and neighbors but could not understand fully what it meant (Table

5.8). In the same vein, during the interviews, the traditional leaders and town union members claimed they get information on weather/climate from radios, televisions, magazines, newspapers, and town hall meetings. Data from the questionnaires further show that the information on weather/climate is mainly gained annually by 46.2% of the people in these communities (Table 5.9). Data from the interviews show that the local stakeholders help to share information on weather/climate with other community members through community meetings/gatherings, or by using town criers. Meanwhile, data obtained from the FGDs indicate that farmers share weather/climate information during farming activities and/or when they gather or visit each other (Section 5.3.1). Similarly, data from the interview shows that government agencies like NEMA share weather/climate information through the release of annual rainfall predictions from NIMET, and annual flood outlook from NIHSA using stakeholders' town hall meetings, radio programs, and jingles (Section 5.4.4). This information is predictions of annual rainfalls, temperatures, and floods which most times occur as forecast and have been important in helping community members prepare to adapt to extreme weather/climate events. All these are ways of raising the consciousness of rural community people to weather/climate events to reduce impacts and make preparations for anticipated climate risks.

Data from the questionnaires show that the majority (59.1%) of the rural household heads described climate change as a 'change in weather conditions' (Table 5.3). In the same manner, their perception of climate change varied thus; floods that come almost every year, high temperatures, excessive rainfall, delayed annual rainfall onset, and other events like cloud cover, pollution, and dryness (Table 5.5). Of the total household heads who participated in the survey, 89.2% observed these changes in their communities (Table 5.4). However, data from the questionnaires show that 48.3% of the household heads think climate change refers to just flood events. The data from the interviews show that 76.2% of the local stakeholders also emphasized flood events as the major weather/climate events affecting their communities (Table 5.22). Also, data from the FGDs shows that 83.3% said flood is the biggest weather/climate event they experience. However, two town union members from the Etekwuru community identified high temperature as one of the major weather/climate events experienced.

In terms of perception, data from the questionnaire shows that 38.3% of the rural household heads see weather/climate events as times of unknown conditions, suffering, and hardship (Table 5.10) likewise the traditional leaders, town union members, and farmers who had the same views in the interviews and

FGDs. This is because they have different levels of vulnerability, religious belief, educational qualification.

5.5.3 Major weather/climate events and their impacts on people and the environment

The major weather/climate events reported by household heads, farmers' groups, traditional leaders, and town union members in the study area are floods. However, household heads reported their experiences with weather/climate events generally to include discomfort as a result of high temperatures, destruction of crops and farmlands, deaths of humans and livestock, destruction of buildings, sicknesses, and diseases, and disruption of economic activities (Table 5.6). However, the data from the questionnaire shows that 27.9% (the highest number) of participants indicated that the weather/climate events experienced in their communities mostly destroy their crops because the majority of the households are farmers. Data from the interviews show that 94.4% of the participants claimed that food shortage becomes pronounced due to the destruction of crops and farmland. The responses of the rural households imply that weather/climate events experienced in these communities impact human health, the environment (ecosystem), and economic activities (sources of livelihood). For the impacts on people, household heads reported that weather/climate events impact negatively on their health, and render people homeless. While responding to questions on the impacts of weather/climate events, traditional leaders, town union members, and farmers reported during interviews that floods increase cases of sicknesses and diseases (Table 5.23). Further, household heads said weather/climate events impact negatively on the environment by causing loss of biodiversity and destruction of construction works like roads and bridges (Table 5.11). Economically, household heads reported that weather/climate events destroy their means of livelihood which are majorly primary economic activities such as farming, fishing, and hunting (Table 5.11). These claims are supported by the report given by traditional leaders, town union members, and groups of farmers during interviews and FGDs. The most affected persons are the farmers who are women. This implies that women are among the most vulnerable groups during climate disasters.

5.5.4 Roles of community relationships in building climate change adaptive capacity and social resilience

Data from the questionnaire shows that 85% of the household heads share family ties while 82.9% have good relationships with other community members which is the basis for cooperation and collective

actions amongst community members (Table 5.2.8). This is corroborated by the responses of traditional leaders and town union members who noted that family ties and good relationships allow people to get help from other community members during weather/climate events (Section 5.4.1.1). Data from the interview shows that 76.2% of the participants argued that good relationships among community members aid in creating awareness of climate risks. Further, 51.3% of the household heads said they could get free temporary accommodation from other community members during weather/climate events (Table 5.14). Also, data from the interviews indicate that 57.1% of the local stakeholders claimed they interact and relate well with each other and this good relationship fosters collective actions in their respective communities (Section 5.4.1.1).

Community collaboration is a vital social capital people in this study area use to build up climate change adaptive capacity. For example, data from the questionnaire shows that 59.2% of the household heads affirmed that community members are helpful and ready to assist in terms of need, especially during climate disasters like floods (Table 5.16). Out of the 240 participants, 56.2% believe that assistance from other community members will help them recover after climate-related disasters (Table 5.17). Also, town union members reported how they render help to others in their communities whenever there is a disaster. However, most of the rural household heads do not trust the government therefore they rely on God and other community members for help during weather/climate events. The traditional leaders and the town union members made similar remarks that suggest there is a weak link between them and the government (Section 5.4.1.2). For example, data from the interviews show that 94.4% of the participants claimed that government at federal and state governments cannot be easily accessed.

5.5.5 Adaptation to climate change in rural communities

Membership of social groups/organizations which is important for social capital helps rural community members to survive the effects of weather/climate events. Household heads reported that those who belong to social groups (for example, clubs, and church organizations) receive help from their members when they fall victim to flood disasters whereas those who do not belong to any association hardly get help during the same period (Table 5.15). Farmers also claimed to assist their members during weather/climate events in their communities. For example, data from the questionnaires show that 59.2% of the household heads believe that the social groups they belong to will help them cope with the effects of climate change (Tab 5.19). This may be in the form of financial assistance, moral support, food

donations, accommodation, and others. However, data from the interview indicate that 94.4% of the participants do not trust that the government could offer them enough help during weather/climate events. Household heads, farmers' groups, and the interviewed local stakeholders claimed that support from the government is usually little and only a few people benefit from it. Therefore most flood victims prefer help from family members, friends, church members, and neighbours.

Traditional leaders and town union members reported adopting several measures to adapt to climate change. These measures include early planting and harvesting, use of early maturing crops, and prayers. These coping strategies were also mentioned by farmers during the FGDs (Section 5.3.4).

To formulate better and effective climate change adaptation policies, data from the questionnaires indicate that 86.2% of the household heads believe that formulating effective climate change adaptation policies for rural communities can only be achieved by getting the rural people involved in the process. During the interviews with local stakeholders, the traditional leaders and town union members also pointed out that their involvement in the formulation of climate change adaptation policies is paramount. However, the local stakeholders especially traditional leaders reported that the government does not consider them important when making decisions that affect their people (Section 5.4.2.7).

5.5.6 Disaster risk reduction and management

According to the responses of DG of NEMA and NESREA, local stakeholders are incorporated into ecosystem conservation and management, disaster risk reduction, and management, although, when interviewed, 94.4% of the local stakeholders complained of limited access to these government agencies. The NEMA DG claimed that the disaster risk reduction strategy is a paradigm shift from conventional disaster management where rural community members are informed about and trained on actions to take before and during disasters rather than when disasters are left to occur and managed by the agency. Further, the agency claimed that information on floods and other disasters is made available to the local people to raise their awareness level and help them to prepare by applying the knowledge of disaster risk responses they have been taught. NESREA and NEMA claimed to use different approaches such as environmental education, and community strategies to achieve this purpose (Sections 5.4.3 and 5.4.4). The collaborations between NEMA, NESREA, NHISA, and NIMET make disaster risk reduction possible in Nigeria. Therefore, the combination of community-based adaptation and disaster risk reduction strategies will help to reduce the impacts of weather/climate events on rural households.

There are challenges to disaster risk reduction and disaster management identified by these agencies. These challenges include environmental negligence by the government, legislative and bureaucratic bottlenecks, lack of funding, cultural and religious beliefs, and attitudes of rural community members.

5.6 Chapter summary

Data from questionnaires, FGDs, and interviews show that factors of social vulnerability such as age, gender, education, household size, income, sources of livelihood, access to healthcare, mode of transport, alternative housing, including elements of societal vulnerabilities like lack of basic infrastructures, poor healthcare system, lack of alternative jobs, and lack of farmers incentives influences rural community members' resilience to climate-related disasters. Although large number of rural residents claimed to be aware of climate change through their observations and experiences over time, they lacked sufficient climate change adaptation knowledge outside their traditional methods of early planting, harvesting, migration and relocation from flooded areas. This is as a result of poor or weak relationships between community stakeholders and government agencies responsible for climate change actions and the exclusion of local stakeholders from climate change adaptation decision-making processes. However, rural residents may adapt to climate change impacts by utilizing their social capital in form of social networks, relationships of trust and reciprocity, and through collective efforts and collaborations between stakeholders and community members, rural households can create social resilience against extreme weather/climate events. This chapter gives way to chapter five (discussion of the results).

CHAPTER SIX: ANALYSIS AND DISCUSSION

6.1 Introduction

This chapter analyses and discusses the meaning and relevance of the empirical findings presented in Chapter Five. This study aims to understand how rural people use their social capital/networks to improve their climate change resilience and adaptive capacity. This chapter evaluates the factors that characterize rural households as socially vulnerable, their climate change awareness and perception, and also explored the possibility of integrating disaster risk reduction strategies into community-based climate change adaption measures. This chapter's discussion is also augmented by the literature addressing the research aims and objectives as outlined in Chapter One.

6.2 Factors of social vulnerability predisposing rural communities to climate change impacts

Social vulnerability is the propensity of individuals, groups, or communities to be affected by natural and anthropogenic disasters (Martins and Gasalla, 2020). The disparities in gender, age, wealth, education, disability, health, class, and other sociocultural factors define different levels of vulnerability amongst individuals and groups to climate-related disasters (Mwinkom *et al.*, 2021). Social vulnerability in the context of this study is influenced by the socio-economic and demographic characteristics of household heads in the study area that affect their climate change adaptive capacities and resilience. The factors of social vulnerability which include gender, age, education, household size, income, sources of livelihood, means of transportation, access to healthcare, and disability of household members were all considered in this study to evaluate the social vulnerability that exposes rural residents and communities to climate change impacts.

The vulnerability factors are important tools in disaster risk management because they provide objective data on social vulnerability in the population to inform on disaster risk reduction activities. Information on younger household heads, older household heads, and the presence of healthcare facilities, for example, may be of particular interest to disaster risk managers because they represent populations that may be more vulnerable to health impacts. For example, education indicators help to understand the level of literacy by displaying the percentage of household heads or by other people in individual households. Poverty indicators may indicate where welfare response and financial assistance are likely to be most beneficial and should be prioritized during response and recovery. When considering emergency housing

during a hazard event, alternative housing indicators may be relevant. Access to a personal motor vehicle or use of public transport may be beneficial in assessing possible evacuation strategies during extreme weather/climate events. These factors play important roles in determining the social vulnerability of rural communities to climate change at household levels (Mwinkom *et al.*, 2021). Although the result shows that all these factors are important, income and sources of livelihood were pronounced by the respondents to be the most challenging socio-economic factors causing vulnerability in rural communities. Under this section, these factors of vulnerability are discussed individually and summarized in the last part of the section.

6.2.1 Gender as a factor of social vulnerability

The gender of the household heads influenced access to and the spread of climate information and, consequently, attitudes towards adaptation to climate change in rural communities (Kibue *et al*., 2015). Table 5.1 shows that 51.2% of the rural household heads are female. These women may play key roles in climate change adaptation (e.g. Forino *et al.*, 2015). This is partly because the majority of the female household heads are farmers who consider social relationships as invaluable which create opportunity for sharing information (Section 5.3.1). Female household heads and farmers exchange knowledge about climate change, and how to mitigate the effects through information-sharing platforms like farmers' seasonal meetings/gatherings. Many rural communities in Egbema practice polygamy, where a man has more than one wife and may have many children, and where the male head dies, his wives become separate household heads within the same environment while sharing one family name. This kind of family structure increases the number of widows/female household heads thereby increasing the vulnerability of such households to climate change impacts in the communities on one hand, and providing extended family support on the other. In contrast to the findings of this study, Flato *et al*. (2017) reported that due to lower beginning wages and, to a lesser extent, other household factors that contribute to economic disadvantages, single male-headed families are more vulnerable. However, they agreed that households run by widows, single women, and women with a non-resident husband (such as "left-behind" migrant households) are particularly at risk during extreme weather/climate events given that such women may lack the power to deal with stressors. This shows that the gender of rural household heads and farmers influences social norms and economic power, which in turn influences rural households' and farmers' behavioral adaptations to climate change. Additionally, gender inequality affects how people adapt to climate change since it affects the level of impacts on both genders depending

on their level of socio-economic vulnerability (World Bank, 2021). This is due to the possibility that female rural residents may be systematically disadvantaged in terms of access to resources, and opportunities, with greater exposure to risks, and sensitivity to risks, making them more susceptible to the effects of extreme weather/climate events (Eric and Thomas, 2007). Female household heads are therefore more vulnerable to climate change than male household heads (Forino *et al.,* 2015). Similarly, a study in Gwer local government area of Benue State in Nigeria also conclude that male household heads have better adaptation capacity because they have more social networks, and access to capacity-building programs and credit facilities, whereas female heads of households are more exposed and sensitive to extreme weather/climate events (Onah *et al*., 2023). Access to the knowledge and tools necessary to effectively prepare for, respond to, and cope with a disaster, including early warning and secure housing units, is particularly difficult for women. Given that women have lower levels of education in rural areas, older female household heads may adjust to climate change over time via experience, but younger female households that lack experience and education will be less able to withstand the effects of climate change and be more sensitive to them. Due to the impacts of climate-related disasters, women in rural areas have higher mortality rates than men during disasters (Eric and Thomas, 2007; Fatouros and Capetola, 2021). This can be attributed to poorer socio-economic levels of women in rural areas, protracted psychological stress, poverty, mobility challenges, lack of education, unemployment, hunger, and limited access to healthcare (Fatouros and Capetola, 2021). This does not, however, imply that women are always the most adversely affected by climate change since males may also experience high fatality rates as a result of being overrepresented in disaster rescue operations.

6.2.2 Age as a factor of social vulnerability in rural communities

The age of the household head is a factor in farming experience, previous climatic event knowledge, and current rural adaptation practices (Siagian *et al.,* 2014, Forino *et al.,* 2015). It increases the agricultural experience and has a favorable impact on views, awareness of climate change, attitudes, and preparations for climate change adaptation (Kibue *et al.,* 2015). For example, in the rural communities studied, participants in the age of 49 years and above (older household heads) do not have better education status than participants below 49 years of age, which defines why younger household heads may have modern climate change adaptation knowledge. Similarly, the social vulnerability of older adults (especially 60 years and above) to climate change may be exacerbated by complex medical needs impacting their physical, sensory, and cognitive abilities to care for themselves and respond to climate disasters. These

elderly people may rely on caregivers and a robust healthcare system, which is difficult to come by in the study area. They may also rely on family and social networks in their localities. However, because they have seen previous and present climatic occurrences over an extended period, these older adults may be more conscious of climate change (e.g. Maddison, 2006). This indicates that older household heads, regardless of their level of education, low mobility, and frailty are more likely to be aware of climatic trends, and the actions they may take to adapt to the consequences of climate change. On the contrary, the communities are dominated by younger farming populations who may lack adequate practical experience to know how to withstand climatic stress in the future. This implies that experience enlightens household heads and farmers about climate change and feasible adaptation strategies because a household head with climate change experience is more likely to be willing to adapt to climate change. However, the youthful population composition of the communities is important for agricultural activities because of the energy and vigor among young people. Therefore, it is expected that communities with a young farmers should have more agricultural productivity because younger people may be more mobile, healthy, and educated. However, this potential is not maximized in the rural communities of Egbema to bring about food sustenance due to a lack of enthusiasm for farming by younger people (Section 5.3.4). Further, the young population indicates high social vulnerability because younger people are less experienced with previous extreme weather/climate events and applied adaptation strategies than older people as reported by Forino *et al*. (2015). On the contrary, Ozor *et al.* (2012) argued that older people are more experienced and are likely to make better climate change adaptation decisions than younger adults. Although experience with previous extreme events helped more rural households to adapt to the impacts of climate change, education played a vital role in improving their climate change awareness (Section 5.2.13). This implies that in rural communities, being educated is not enough for climate change adaptation because the younger people have a higher educational background while the older people are more experienced. A blend of old and young adults within households may be a better mix in climate change adaptation since farming activities require both experience and vigor to carry out efficiently because age may negatively affect changing planting time and farming methods (Mwinkom *et al.*, 2021). This mix of old and young adults in farming will encourage a seamless transition and transfer of climate change adaptation knowledge (for example, from parent(s) and grandparent(s) to their children and grandchildren). However, these young adults feel reluctant and are not fully committed to farming activities (Section 5.3.4). Therefore entrusting farming in the hands of younger adults who lack interest in the venture may increase the risk of future food insecurity in rural communities.

6.2.3 Education as a factor of social vulnerability

The household head's level of education can raise awareness of climate change within the household which may foster more favourable attitudes and actions that influence resilience against climate change impacts (Kibue *et al*., 2015). The higher the level of education, the more likely it is that household heads and farmers will be able to receive, process, and comprehend climate change information (Mwinkom *et al.,* 2021) because the availability and understanding of reliable climatic information is a prerequisite for reducing vulnerability. Household heads get an understanding of climate change, the root causes of its occurrence, and how to handle its effects via education and effective communication. As a result, education enhances the attitudes and perceptions of heads of households concerning climate change. It also enhances comprehension of the potential results of adaptation which may impact the household head's behavioural intention towards climate change adaptation. However, the result of the analysis shows that 71.7% of the community members have at least a secondary education qualification suggesting that the majority of rural household heads in these communities are not illiterate (Table 5.1). Illiterate people are most likely to have the least skills to be employed in non-climate sensitive job sectors, depend on those occupations that are climate-sensitive for their livelihood, have reduced access to information, and may not be able to identify risks that can increase their vulnerability (Ozor *et al*., 2010; Kibue *et al*., 2015; Mwinkom *et al.,* 2021) and 28.3% of the households belong to this category. However, social vulnerability as a result of educational level is not high in the study area because anyone who has at least a secondary educational qualification in Nigeria can read and write, is regarded as fairly well educated, and may likely know about climate change (Sections 5.2.13, 5.2.14). For example, from a relatively short-term perspective, improving general education among women and marginalized groups may reduce individual and communal vulnerability. Similarly, on a longer time frame, general education may indirectly contribute to adaptive capacity by promoting economic growth, health, democratic governance, and cooperative resource management (Mwinkom *et al.,* 2021). However, depending only on education to adapt to climate change may not yield the desired adaptation results because of the low access to education in rural communities of the study area, and the lack of proper climate change education in the school curriculum (Amanchukwu *et al*., 2015). Climate change knowledge through education does not necessarily translate to proper adaptation actions but can help to lower vulnerability by improving basic climate change knowledge and perception, risk assessment, and enhancing traditional adaptation knowledge transferred from parent to offspring (older adults to younger ones). This suggests

that combining education with other factors such as experience from previous weather/climate events (from older adults), climate change workshops, and training attendance will give rise to better climate change adaptation behaviour or actions amongst farmers. More so, the highly educated rural residents tend to be more resilient to climate change impacts since they may earn higher income (section 5.2.6), have smaller size of households (section 5.2.5), and may have better access to healthcare (Section 5.2.12). Similarly, high literacy levels may reduce social vulnerability since it avails rural residents the opportunity to access a wide range of information on climate change hence more educated rural households have better climate change risk perception than illiterate ones (Section 5.2.21), implying that education plays a vital role in climate change risk awareness. More so, where younger household members have more knowledge and education than the household heads, such households may be more resilient.

6.2.4 Household size contribution to social vulnerability

Household size is referred to as the number of individuals living together and sharing responsibilities in a household, which is a factor of social vulnerability considered in this study to have affected climate change adaptation amongst households in rural communities (Table 5.1). More so, it is expected that household size should influence total household income per month and means of livelihood of the household head because larger household size requires that household as a whole must earn a higher income from better-paying jobs to sustain the family and provide social resilience, especially during difficult times like extreme weather/climate events (Ozor *et al.,* 2012; Mwinkom *et al*., 2021). It is equally expected that larger households (multi-generational families) should have greater income but that is not necessarily the case in the study area (Section 5.2.6). Households living on low incomes may be further pushed to higher levels of vulnerability during climate disasters due to the size of their households (Mba *et al.,* 2021). Despite the poor economic circumstances of rural households in the study area, the average household size recorded was seven and the highest household size had 25 members. This implies that household heads must earn a corresponding income from other sources of livelihood outside farming to help their families survive hardships during climate-related disasters. This should bring about diversification of sources of livelihood which means earning from different streams but this is not the case with rural residents of the study area (Section 5.2.6). However, having other earners in the household who could support the household head may help to increase social resilience to climate-related disasters. Further, the more educated household heads have fewer household members while the less

educated ones have more household members (section 5.2.4). Data analysis on household size shows that 80% of the study participants with 2-4 household members have at least a secondary educational background (Section 5.2.4). Given that the less educated households earn lower incomes, having large household sizes may exacerbate their social vulnerability. This situation encourages social vulnerability because these families may not be able to cope with the negative impacts of weather/climate events due to a lack of financial strength to afford the basic needs of life such as access to the healthcare system and to improve their living conditions and maintain their resilience.

On one hand, large household size may increase vulnerability by posing challenges during climate disasters, and on the other hand, it is beneficial by increasing the social resilience of farmers who claim they derive farm labour from their households especially when practicing early planting and harvesting of crops as a climate change adaptation measure. Large households usually have larger farmlands due to the communal system of land tenure practiced in the study area suggesting that such families may produce more food to feed their families. In contrast, larger household sizes may affect food security as a result of a reduction in food availability in rural communities. Also, larger households consume nearly all food produced by the family which is one of the causes of food shortage in the communities. This is because rural households in the studied communities are smallholder farmers who mainly produce to feed their families and have little or nothing to sell to others. When a family is large, especially a multi-generational household (Section 5.2.4), there is a tendency to have more economically inactive persons who depend on others which increases the overall vulnerability of the household. The average number of persons per household varies in Egbema communities and the childbirth rate is usually high as a result of teenage pregnancies and early marriages which increases the population with more vulnerable persons. Since the less educated household heads have more household members (Section 5.2.4), there is a likelihood of having more persons without formal education in such households because of the lack of resources or financial commitments required to send them to schools or that their labour is required within the house or farm.

6.2.5 The role sources of livelihood play in rural households' social vulnerability

The major economic activities in the rural communities of Egbema are farming, fishing, and hunting which are undertaken by 87.9% of the participants (Table 5.1). However, 66.7% of the community members are farmers implying that farming is the highest employer of labour in the communities. The

older population formed only 18.8% of farmers which suggests that farming activities are now in the hands of younger adults. Despite the advantage of having more youthful farmers, the experiences of the older adults could be missed during weather/climate extreme events especially when climate change coping strategies are not transferred from older people to the younger ones (Section 5.3.1). This was the case with a few young farmers in the Etekwuru and Mmahu communities of the study area where the young farmers claimed to be using their initiatives to farm instead of the traditional system known to have been transferred from one generation to another (Section 5.3.1). This may be the case for people who lost their parents/grandparents at a young age and had no opportunity to learn traditional farming skills from them. Further, only the most educated rural populace has other economic activities such as civil service jobs because they migrate to the cities. The reality is that these better-educated people are among the fewest in the communities and their absence in farming may not affect food production and availability if the existing farmers are adequately trained and equipped.

The study shows there are more female household head farmers than males suggesting that rural communities of Egbema may be vulnerable to climate change impacts because women dominate the agricultural sector of the economy. When climate disasters such as floods occur, the majority of the rural population is out of business for a while due to a lack of alternative employment consequently impacting food availability and their general living standards or conditions. For example, during the series of previous flood events (especially in 2012 and 2022), it took several months for fishing settlements to return to their base for business (Martins and Gasalla, 2020). Similarly, all farmlands within the coastal areas were flooded, displacing farmers from their farmsteads. This shows how vulnerable the coastal farmers and the fishing settlements are to climate change impacts in the study area (Section 5.4.2.2). Therefore, the means of livelihood for household heads in rural communities influence their social vulnerability to climate change (Cutter *et al.*, 2003; Mabuku *et al.*, 2018; Martins and Gasalla, 2020). This is because the rural people mainly engage in primary economic activities that increase vulnerability and do not diversify their sources of livelihood. Climate-sensitive occupations like farming, fishing, and hunting mostly rely on weather patterns for operation, and changing climatic conditions will hinder output, affecting the survival of the households involved by exposing them to climate change risks.

6.2.6 How income of rural households affect their level of vulnerability to climate change

The economic status of rural residents in the study area reveals that households' wealth, access to healthcare, and mode of transportation vary (Section 5.2.6). The disparities in levels of vulnerability among rural areas are explained by these characteristics because income earned determines households' level of poverty (Mba *et al.,* 2021) and potential to adapt to climate change. The income of rural household heads was a factor derived from their sources of livelihood (economic activities), and influenced by gender, education, and age. In terms of economic activities, rural household heads who engaged in primary economic activities (farming, fishing, and hunting) are more vulnerable to climate change impacts since they earn less income per month (mostly less than 10,000 naira to 30,000 naira) compared to those who do other jobs like rendering services, government jobs, trading (business), and crafts (Table 5.1). The study shows that 4.2% of the participants live in extreme poverty (people living below one dollar per day) and another 35% earn less than 30,000 naira month, suggesting that vulnerability may be exacerbated because the household heads live below the poverty line and may find it difficult to survive climate-related disasters due to lack of fund to afford foods and other necessities of life. More so, 60% of the poorest people in the rural communities belong to the 40-59 year age group who are mainly women and also who form the bulk of the farming population. The younger population of 18-39 years old has a higher monthly income (52.9% earn 100,000 naira and above) than the older groups and has higher social resilience, probably because this age range has the highest number of tertiary education graduates who do other economic activities outside of primary economic activities sensitive to climatic conditions. The income of household heads varied according to household sizes in the sense that larger families who may earn higher total income because of higher demands for basic needs fall below the poverty line, thereby increasing social vulnerability to climate change impacts (Section 5.2.6).

The findings of this study further suggest that income earned by household heads affects their adaptive capacity given that households with lower incomes may struggle to access things like good healthcare facilities and food during extreme weather/climate events. Also, the low income earned by most of the household heads in the community shows a high level of poverty when compared to the national minimum wage which is a factor of social vulnerability to climate change (Cutter *et al.,* 2003; Otto *et al*., 2017; Mabuku *et al.,* 2018; Ekanem and Umoh, 2021). Therefore, rural residents in the study area are vulnerable to climate change impacts since they do not engage in secondary economic activities to

help diversify their sources of livelihood which can serve as social protection for their households by lowering their vulnerability to climate-related disasters.

6.2.7 Means of transport as a factor of social vulnerability

Transport within and outside the community is a necessity considered in determining the social vulnerability of rural communities to climate change impacts given the role mobility plays during climate-related disasters (Adnan and Kreibich, 2016; Bayrak *et al.*, 2023). Also, having a reliable and efficient means of transport is necessary for improved economic activities and social-wellbeing which may help to reduce the social as well as economic vulnerability of rural households and communities to climate change (Ekanem and Umoh, 2021). It was discovered that rural households make use of vehicles, motorbikes, bicycles, foot, and others like taxis, and canoes for transport (Table 5.1), and the majority (65.8%) of the households that use bicycles and feet do so due to their low-income status resulting from their sources of livelihood (mainly primary economic activities). Only the affluent populace and those who live a little above the poverty line (30.8%) can afford personal vehicles and motorbikes for movement. The participants who use canoes and taxis for transportation (3.4%) do it for emergencies and transport across water especially during floods.

Having a suitable and adequate means of transport can enhance social resilience to climate change impacts since the movement of humans, livestock, and other goods may be faster when using vehicles and motorbikes than the use of bicycles and foot (Adnan and Kreibich, 2016). Also, means of transport may impact access to education and healthcare. Going to medical appointments or school is not only impeded by poor road networks but also by how rural residents make such movements. However, transport modes are inefficient in rural communities of the study area due to poor road infrastructure implying that most rural people may be exposed to hazards because of their poor and slow response systems of transport especially when there is an urgent need for households to relocate from flood-affected areas. These rural communities may become isolated for response teams and health workers when climate disasters occur.

The farmers are the most at a disadvantage and vulnerable during weather/climate events since their crops and animals are affected by floods, and they earn a low income and move mostly on foot and bicycles. Therefore, evacuation and migration/relocation from flood-prone areas may also be slow,

leading to more victims of climate events and loss of goods and services. Differences in the mode of transport may contribute to the varying levels of social vulnerability of rural people to the impacts of extreme weather/climate events in the study area. For example, most rural household heads who have personal vehicles quickly adjusted by relocating their family members and property during the last flood event of October 2022 while many households who have only bicycles struggle to cope (Figure 5.12).

6.2.8 Disability in households

In the context of this study, disability in the household is a measure of social vulnerability to climate change impacts because disabled persons require special care which translates to a burden for poor rural households who earn as low as 10,000 naira per month (Akpe and Solomon, 2017; King and Gregg, 2021). In the rural communities of Egbema, 12.9% of the households have at least one disabled person who must be taken care of which is above the national average of 7% for household members above 5 years and 9% for household members older than 60 years according to the World Health Organization report for Nigeria (2018). The burden created by disability in such households may increase coping demands and vulnerability when weather/climate events occur because most disabled persons depend on other household members for survival (Omolo and Mafongoya, 2019). For example, 64.5% of the households with disabled persons live below the poverty line (earning less than 30,000 naira per month, which is the minimum pay for every worker in Nigeria). Therefore to cope with the current economic situation of Nigeria in the post-COVID-19 era, the effects of extreme weather/climate events, and climate-related disasters, these households must source external help to enhance their social well-being and resilience because households with disabled members will most likely be more vulnerable to climate-related disasters (Forino *et al.*, 2015; Omolo and Mafongoya, 2019; Mason *et al.*, 2021). This may be a result of the high dependency of disabled persons on other members of the household for food, clothing, shelter, healthcare and transport. Also, given that disabilities were found in some of the households, extra efforts to improve social resilience must be taken by the affected households because the presence of disabled persons may likely exacerbate the vulnerability of the household to climate change since disabled persons are more likely to be poor, less educated, require more care and needs, and may also have less access to resources than persons without disabilities (WHO, 2013). Also, these disabilities may be more within the older adults than the younger ones.

6.2.9 Access to healthcare by rural households

Access to healthcare is a crucial factor in social vulnerability due to its importance in improving the resilience of rural communities to climate change impacts (Cutter *et al.,* 2003; Mavhura *et al*., 2017; Gibb, 2018). Rural community members reported low access to healthcare partly due to poverty, and the near absence of healthcare facilities within their immediate localities (Table 5.1). For example, 66.7% of the farmers claimed that poor access to healthcare increased the number of casualties recorded during climate-related disasters because of poor emergency response and most rural people are poor and cannot afford to go to hospitals which are mostly outside of the communities. However, it was discovered that rural household heads patronize different healthcare providers such as hospitals, clinics, chemists, and herbalists whenever they are sick and only 34.6% of the household heads who earn above 50,000 naira monthly have access to hospitals (Table 5.1). However, the study observed that most rural communities within the study area are vulnerable to climate change impacts due to inadequate healthcare facilities like hospitals. The implication is a high mortality rate recorded during climate-related disasters like floods reported by farmers and local stakeholders who claimed they lost one or two family members to sicknesses and diseases in previous flood events (Section 5.2.12). This was a result of self-medication with drugs procured from the numerous chemist outlets in the study area. Interestingly, male household heads (54.2%) have better access to hospitals than their female counterparts (45.8%) who tend to patronize patent medicine dealers (chemists) suggesting that poor access to healthcare exacerbates vulnerability amongst rural women. The result of this study also suggests that women (63.1%) are likely to rely on traditional knowledge for the treatment of sicknesses and diseases (Section 5.2.12). Further, only a fraction (about 34.6%) of people who got bitten by reptiles and those who got malaria, typhoid, and cholera during floods are treated in hospitals while about 51.7% self-medicate by purchasing drugs from patent medicine dealers or visiting a traditional healer (herbalist). Access to healthcare may be a function of income, age, and education because people who earn more in tend to have more access to hospitals and good clinics and are likely to be more resilient, whereas those with lower income use chemists and herbalists to treat their sicknesses and may be more vulnerable and less resilient (Section 5.2.12). Similarly, educated household heads who know the implications of self-medication will likely make efforts to access good healthcare.

The study found that the majority (66.3%) of people who have access to hospitals in the study area are younger household heads between 18 and 49 years old with 50.6% of them earning at least 40,000-80,000

naira monthly whereas 51.2% of those who get medicines from chemist shops are above 49 years old with 57.1% of these households earning 10,000-30,000 monthly. Therefore, the result of this study indicates that rural community members in the study area are vulnerable to climate change due to low access to healthcare which may be attributed to poverty and the absence of healthcare facilities. Large households with more aged or young members will be more vulnerable to climate change due to low access to healthcare because of the financial pressure on the low income of the household head. Meanwhile, the absence of healthcare workers for emergency response and treatment of sick rural residents exacerbates their vulnerability to the impacts of weather/climate extreme events. This is because government presence in the form of infrastructure like hospitals is nearly absent in the study area as observed by the researcher and also reported by the participants of the study, thus making the rural community members vulnerable to climate-related disasters. Therefore to access good healthcare, rural residents may travel long distances to the nearest towns through poor road networks under high transportation costs and when it comes to travel time and lost productivity, this may be a very burdensome situation. The implication is that sick persons may die on the way due to the time taken to reach healthcare facilities. Additionally, access to healthcare is hampered by a lack of reliable means of transport. Public transport is sometimes an option for patients in urban regions; however, similar services are frequently absent in rural areas. Elderly people with chronic diseases who frequently attend outpatient healthcare facilities are more prevalent in rural areas. Without accessible public or private transportation, this becomes difficult. Also, the cost of healthcare in the cities is not subsidized for rural residents who earn little from their primary economic activities hence encouraging them to self-medicate or forego adequate treatment.

6.2.10 Alternative housing for vulnerable rural households

Having alternative accommodation or a place to stay during weather/climate events like floods, is another measure of the adaptive capacity of rural communities against extreme weather/climate events. The result of the study indicates that 51.3% of the participants have alternative homes or places for shelter due to the positive relationships they share with other community members (Table 5.14). However, a significant number (48.7%) of the rural people would be vulnerable when extreme weather/climate events occur which requires relocation to safer places since they do not have alternative places to live during disasters like floods (Section 5.2.25). During extreme weather/climate events, other community members may share their accommodation or houses with family members, friends, or even social organization members

who are affected by the disaster temporarily. Rural community members render this form of help due to shared relationships of trust and family ties that exist between them. Accessing free accommodation or alternative housing during extreme weather/climate events may increase the social resilience of socially vulnerable people who are most likely to be affected by the climate crisis.

6.2.11 Social vulnerability model

The social vulnerability factors were not considered in isolation to determine how each factor and its indicators link up in contributing to the vulnerability of rural communities to the effects of climate change in the study area (Figures 6.1, 6.2). The social vulnerability model (Figure 6.1) for the study area shows that ten identified social vulnerability factors play vital roles in either increasing vulnerability while reducing resilience or reducing vulnerability while increasing resilience to climate change impacts. Further, the model shows the relationships of these social vulnerability factors, where one influences another.

The arrows in the model (Figure 6.1) indicate the interconnectedness of the social vulnerability factors like income and sources of livelihood. The model shows that a rural community dominated by women and young adults as heads of households may be less resistant to climatic stressors as a result of inherent social and societal vulnerabilities (Figures 6.1, 6.2). It further shows that other elements of social vulnerability are linked to the income of household heads.

Despite the low-income rural residents earn in the study area, they have large households (many household members) and among them may be persons with disabilities who require special care and needs. Having large households and physically challenged persons demands that such households remain within high Generalized Resistance Resources (GRRs) to withstand the negative impacts of climate disasters (Idan *et al.*, 2016). However, due to low incomes, these households may fall within Generalized Resistance Deficits (GRDs) and become less resilient and vulnerable to extreme weather/climate events.

Given that rural households mainly rely on climate-sensitive occupations for survival, they require adequate transport networks/modes to access markets. Since the majority of rural residents use bicycles and feet in the study area, they are likely to be less able to transport goods and may be more vulnerable to the impacts of extreme weather/climate events as a result of slow response, emergency, and evacuation

efforts. The model (Figure 6.1) further shows that since rural residents have inadequate transport networks/modes, they are likely to have poor access to healthcare and education. Poor access to healthcare implies that rural residents may record high mortality during disasters. Meanwhile, a community dominated by women with less education implies that more people will be vulnerable to climate change since they may earn a lower income, lack access to crucial weather/climate information, climate risk awareness and preparedness strategies, and effective adaptation behaviours.

Although income can influence the building of alternative housing units, however, the major factors that influence it in the study area are the availability of social capital and social networks. Relationship of trusts that lead to social capital can lead to situations where alternative accommodation is provided to people who are affected by climate-related disasters like floods.

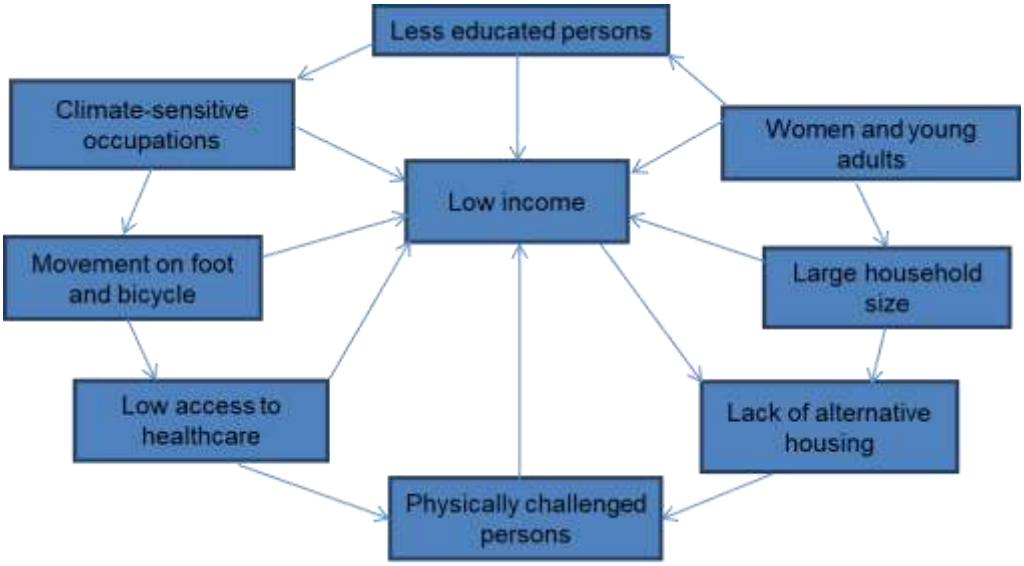


Figure 6.1: Proposed social vulnerability model for the study area

In the context of this study, social vulnerability differs from societal vulnerability, however, they have relationships. Social vulnerability refers to the susceptibility of individuals and social groups to the negative impacts of climate disasters whereas societal vulnerability deals with the inadequacies of communities, government structures, infrastructure, agencies, governance frameworks, and policies that lower the resilience of individuals and social organizations against climate disasters. Therefore the degree to which rural residents are sensitive and exposed to impacts of climatic stressors is partly a function of

their characteristics such as sex, age, income, household size, and sources of livelihood, and also a function of inherent societal vulnerabilities in their localities (Figure 6.2).

Societal vulnerability can also be seen as a function of the relationships between rural communities, infrastructure, and resource flows that can affect the capacity of rural residents to withstand climate stressors. The poor provision of networked services (telecom services), network failures, and shortages or uncertainties in resource provisions for any locality may increase the vulnerability of individuals within that locality. This is evident in the inequalities in resource distribution and allocations that can be attributed to poor governance frameworks and the political and socioeconomic marginalization of rural communities. For instance, the lack of a good water scheme for the provision of safe drinking water leads rural residents to consume contaminated water from streams, rivers, and wells that compromise their health as well as poor quality of schools, roads, and poor electricity supply.

Societal vulnerability can interact with the factors of social vulnerability to improve or weaken the capacity of rural residents to adapt to climate change impacts. These interactions indicate the interconnectivity between the factors of social vulnerability and the elements of societal vulnerability in influencing the adaptation responses amongst rural residents of the study area. The elements of societal vulnerability such as access to quality education, healthcare system, housing, and transport systems affect individual characteristics of individual rural residents disproportionately during weather/climate extreme events (Figure 6.1).

A community dominated by young, poor (low-income) female household heads, will likely face a greater climate-related crisis (IPCC, 2022). This community may be less resilient to climatic stressors because they rely on climate-dependent occupations as sources of livelihood since there are no or fewer alternative employment provided by the government or able to be developed by individuals due to lack of training. Poor implementations of government policies, and decisions resulting in weak infrastructure like inadequate healthcare systems, poor road networks/transport modes, sanitation, and electricity supply increase the vulnerability of rural residents. For example, due to poor governance frameworks, poverty reduction programs aimed at lifting low-income (poor) households from extreme poverty may be coveted by greedy government officials and politicians to enrich themselves. Since the majority of rural households earn low incomes and at the same time have large family sizes, more people are likely

to fall into poverty and become vulnerable to climate disasters. Similarly, large households with disabled persons may suffer more harm during climate disasters due to low access to healthcare facilities and the absence of facilities to aid movements such as ramps, grab bars, or handrails for wheelchair users and the aged. Poor healthcare systems may hamper the treatment or lead to mistreatment of sicknesses and diseases caused by exposure to impacts of climate disasters like floods thereby increasing mortality rates amongst rural households.

More educated rural residents are expected to earn higher incomes through better-paying jobs. However, the societal vulnerability created by the weak implementation of government policies, programs, and frameworks for rural developments negatively influences the livelihoods of rural residents irrespective of their educational background.

Societal vulnerabilities in rural communities also present themselves as challenges/barriers to climate adaptation. Factors of societal vulnerabilities such as land use and cultural practices can affect rural residents' capacity to cope and recover from climate change impacts. This implies that the general way of life (culture and tradition) also influences climate change adaptation actions/responses of rural residents. For instance, land tenure systems may hamper the acquisition of lands for farming where land is split up between family members, while the inability of the government to provide rural farmers with credit facilities, incentives, and access to loans may reduce farmers' production capacities thereby weakening their adaptation capacity and resilience against climate change. In the study area, lands are allocated based on age and gender, implying that women and young adults will likely not get land allocations for farming since the priority is on older male farmers.

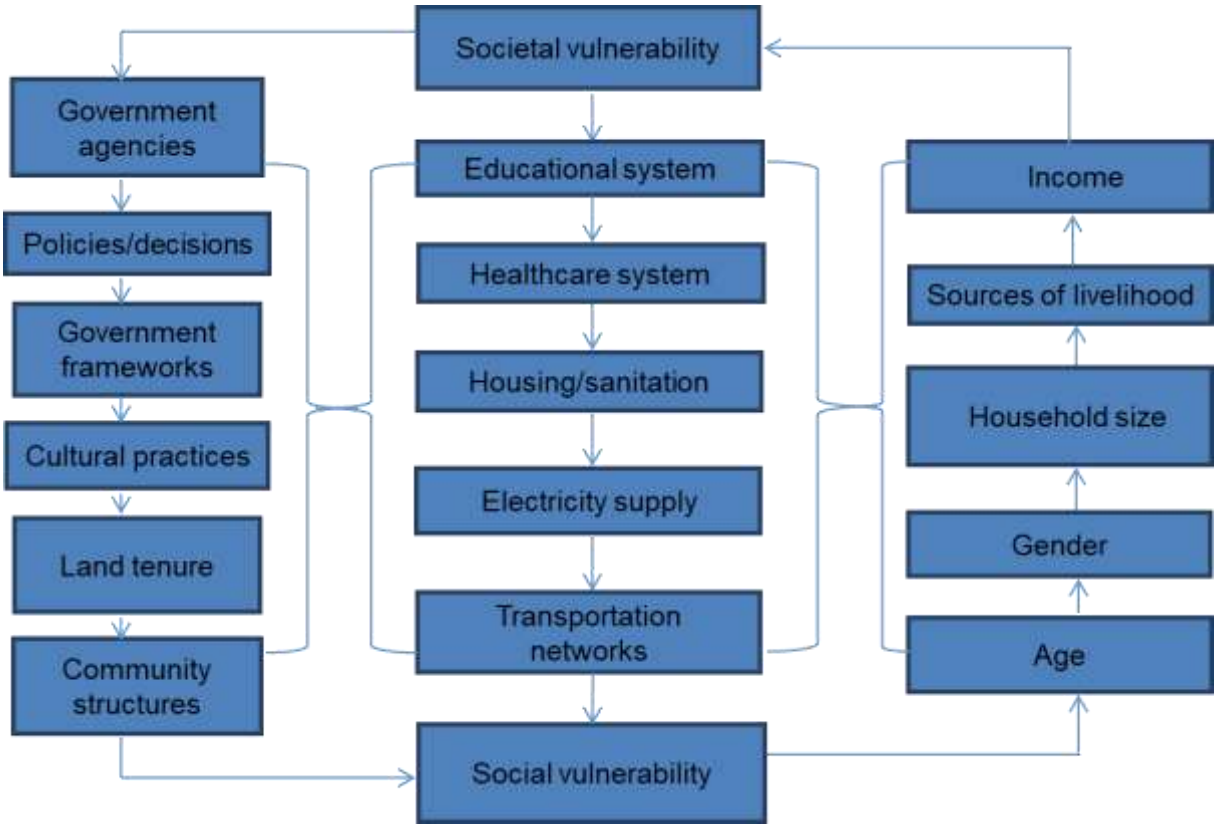


Figure 6.2: Interactions of societal vulnerability with individual characteristics of rural residents. The arrows indicate the connection between the factors that contribute to societal and social vulnerability.

6.3 Awareness, Perception, and Preparation for Future Climate Risks

The length of residence in the communities provided respondents with adequate knowledge borne out of their experiences in the climatic conditions of the study area over time (Table 5.2). The response from 87.1% (Table 5.1) of the research participants who claimed to have spent more than 10 years in the study area forms a strong basis for awareness of weather and climate patterns. This is because respondents who have resided in the study area for more than 10 years or a lifetime would have witnessed a series of previous extreme weather/climate events, observed changes in climatic conditions of the study area, and could tell their experiences during those periods and the most effective coping strategies practiced. Also, due to the long time people spend together in a community, rural households can form strong ties and relationships over a long time that enhance climate change information sharing, rendering free farm labour and other assistance during weather/climate events. This is important since social resilience to climate change may be improved through social bonds and networks that support collective actions

before, during, and after climate disasters. Only a small fraction of the participants (12.9%) have lived in these communities for less than 10 years. These were the household heads who came for temporary work and those that have recently relocated from other places. It is therefore deduced that they may not have substantial experience to give an accurate account of climate events in the past years (Section 5.2.7).

Climate change awareness is crucial for effective climate change adaptation and decision-making because awareness helps to improve preparedness against future extreme weather/climate events (Eakin and Patt, 2011). The climate change awareness of the participants enhanced their verbal description of climate change (Ndah and Odihi, 2017a; Rana *et al.*, 2020). However, their climate change awareness level is not enough to help them adapt by making preparations for anticipated future climate crises since the rural communities in the study area are still grappling with different scales of societal vulnerabilities (Section 5.3.2). This result is supported by the finding of Salami *et al*. (2017) who reported that climate change awareness and preparations against climate change do not have a significant association. This implies that having climate change awareness does not necessarily translate into preparedness for future climate disasters because preparation requires livelihood resources that may not be available. Therefore, learning about climate change is not enough for adaptation actions.

Assessing the level of climate change knowledge in rural households revealed that 68.3% of household heads have heard about climate change from radio, television, friends, or family members (Table 5.2). The majority (89.1%) of people who have this knowledge of climate change are between the ages of 18-49 years implying that younger people have more knowledge of climate change than older people. This may be because they are more educated and have better access to other sources of information like the Internet (Section 5.2.19). Due to the knowledge of climate change of rural people, some of the farmers in the study area were able to observe changes in the weather/climate of their communities (Table 5.4) yet do not understand how it connects to climate change (Section 5.3.2). This may suggest that knowing climate change neither translated to proper climate risk awareness nor reduced vulnerability amongst household heads in the study area. Learning about climate change does not mean the household heads understand or know the correct actions to take against its negative impacts. This is because government agencies responsible for climate change awareness creation are not doing enough to inform the rural people and educate them properly on actions to lower their vulnerability during climate disasters (Section 5.3.2). The group of farmers that observed changes in the weather/climatic conditions around their

locality, however, was ready to learn and widen their climate change knowledge and awareness through climate change education to improve their resilience against climate change impacts (Section 5.3.2). The farmers also believe that through climate change education, their climate change perception will improve and they will be able to make requisite preparations against future extreme weather/climate events (Section 5.3.2). Farmers during the FGDs were open to new training and climate change education after complaining that extension workers do not give time to educating them but are always in a hurry to leave the few times they come to the rural communities (Section 5.3.2). This implies that climate change education is necessary for preparations for adaptation against anticipated climate-related disasters (Ebi and Bowen, 2016). Therefore, having climate change knowledge and risk awareness is not enough for adequate preparation and adaptation actions.

Further, it was found that climate change awareness was also a function of educational level since 96.3% of those with tertiary educational qualifications are aware of climate change. Only 10% of those with no formal education have heard of and know what climate change entails (Section 5.2.13). These were amongst farmers who claimed that their children talk about climate change after returning from school yet the term (climate change) was still unclear. However, the overall responses from household heads, farmers, and local stakeholders confirm that the majority of rural households in the selected communities are aware of climate change (Section 5.2.13).

Due to the level of awareness amongst rural household heads, they described climate change based on their personal views to either mean a shift in weather, normal/natural occurrence of weather/climate, irregular rainfall pattern, or increase in temperature (Table 5.3). Household heads with higher educational qualifications have better descriptions of climate change than those with less education. They made statements most related to climate change compared to the uneducated participants (Section 5.2.14). For example, participants with at least a secondary educational background said climate change can be described as a change in weather, irregular rainfall patterns, and an increase in temperature whereas, the illiterate ones described climate change to mean natural/normal occurrence of weather/climate (Section 5.2.14).

The farmers used their observations of weather/climate over time to describe what they think climate change entails, hence saying whether it is a normal and natural occurrence. About 6.7% of the participants

who are not sure of any changes nor have seen or noticed any significant changes in the weather/climate of their communities are among people who have recently relocated there (lived less than 10 years in the communities) and those who are less educated and therefore have low climate change awareness. Observation of changes in weather/climate of the study area was influenced by experiences over time since most participants (71.1%) who lived longer (more than 10 years) in the communities were able to describe the weather/climate events which may help them to improve their adaptive capacity by preparing for future disasters.

Due to the level of awareness of climate change and observation of weather/climate over time, rural household heads were able to indicate weather/climate events they experienced in these communities (Table 5.5). These include floods, high temperatures, excessive rainfall, and delays in the onset of seasonal rains (Table 5.5). However, floods are the most common. (Tables 5.5, 5.22). This result is in line with the report of Akande *et al*. (2017) where the floods were also named a major climate disaster in rural communities of Nigeria. This may be due to the location of such communities along the coast and the lack of structural systems like levees, dams, and embankments to help improve their adaptive capacity during river overflow or from coastal erosion. This result is also supported Oladipo (2010) that rainfall in Nigeria has increased in duration and intensity for decades leading to runoffs and floods in many parts of the country. Further, the household heads reported that floods occur every year while the more catastrophic floods occur every three years and the most affected portion of the farms are grazing and arable lands, farmsteads (farmers' residences), and livestock buildings (Section 5.3.3). When these structures are destroyed during climate disasters, the farmers are helpless and out of business for a long time especially the most vulnerable ones who may not have the financial strength to rebuild those structures quickly. The frequency of events may most likely exacerbate the social vulnerability of rural communities in the study area. This means that rural residents will keep adjusting and readjusting to cope with the impacts of extreme events. Participants who mentioned flooding as the most common extreme event may have at one time or other been directly affected by floods, while those who named high temperature as their most common weather/climate event are mainly from the Etekwuru community where the topographical configuration spares one part of the community from being flooded (Section 5.4.2). The upland of the Etekwuru community is mainly for residency while the lowland is for farming. Excessive rainfall reported by 13.8% of study participants has also caused significant damage through flash floods, and storms. Excessive rains cause waterlogging of farmlands, businesses (markets), and

residential areas, hampering economic and social activities. Meanwhile, 5.4% of the participants who have not spent a long time (less than 10 years) in the communities and have less experience with the weather and climate of the study area claimed they are disturbed by high cloud cover, pollution, and lack of rain. Since this group has less experience, their report is not reliable for this study.

Apart from getting information on weather/climate, rural household heads' experiences of previous events were key to climate change awareness, perception, and preparations for future climate disasters (Table 5.6). This implies that in rural communities, experiences with previous extreme events provide stronger grounds for building resilience against future climate change impacts because the actors may have evaluated the success and failures of previous actions to inform their current adaptation decisions and actions. For example, a participant (town union member) from the Opuoma community said his family relocated quickly from their home to a safer place when they received a flood alert for 2022 to avoid incurring similar damages suffered during the flood events of 2012-2021. It is through such experiences that rural community members were able to explain their challenges with conventional coping strategies (Section 5.3.4). Further, the majority (97.7%) of rural household heads revealed that weather/climate events occur every year (Table 5.7) suggesting that rural communities in the study area are highly exposed. All the participants (100%) who reported that weather/climate events occur every year were the same people who described the major climate events in their communities to be flooding, high temperatures, and excessive rainfall. It therefore suggests that weather/climate events in these communities could be referred to as seasonal events which most rural residents anticipate at certain periods of the year (NiMET, 2012). Therefore, there is a likelihood that rural communities in the study area may experience one form or the other of an extreme event every year. Given that the communities have a low adaptive capacity due to their social, economic, and political challenges, frequent occurrence of weather/climate events will increase their social vulnerability because for socially vulnerable groups to prepare for future weather/climate events, there must be adequate provisions for protecting personal, social, and economic assets (Scolobig *et al.*, 2012). If events occur frequently, there will be limited time for rural residents who were affected by previous events to recover, thereby causing an accumulation of impacts. However, the conditions for effective adaptation are not in place implying that rural communities in the study area will be vulnerable to any extreme weather/climate events that may occur in their localities (Section 5.4.2.4).

Weather/climate information is crucial in adaptation decision-making and access to this form of information is likely to improve climate change adaptive capacity and counteract social vulnerability (Dumenu and Obeng, 2016). The amount and quality of climate information at the disposal of rural community members also influence the level of their climate change awareness, and perceptions and may consequently improve their levels of preparation in anticipation of future extreme weather/climate events. This study reveals that the majority of rural community members source their information from radios and televisions (Table 5.8). However, they complained that lack of electricity is a constraint to getting this information daily. Further, people who use radio and televisions are persons with some degree of education and 68.4% of them are older adults between the ages of 40 to 69 years (Table 5.8). The results further show that younger persons (18-39 years old) who also have better educational backgrounds (18.3% of the research participants) prefer using the internet and social media as sources of weather/climate information suggesting that technological advancement has positively impacted climate change information dissemination. Participants who do not have formal education and those with only primary education rely on the information given to them by their neighbours, friends, families, and personal experiences over time (Section 5.2.20). Information from this group of persons may not be correct because of misconceptions, misinterpretation, and cultural/traditional knowledge may affect interpretations of the messages. Therefore, those who depend on their friends, families, and neighbours for weather/climate information may be vulnerable to the next climate-related disasters due to wrong information.

Although weather/climate information is made available for public consumption by agencies such as NiMET, NIHSA, and NEMA in their annual weather predictions, flood outlooks, and disaster alerts yet many rural residents do not have access to the information due to poor information dissemination methods used by the government agencies. This is a concern for climate change adaptation since sharing information with the general people, as well as access to important climate change information may likely enhance resilience in the face of climate change disasters. However, access to essential climate change information is limited, which increases vulnerability in the study area. Further, the lack of use of local languages in climate change terms may limit the understanding of weather/climate information among rural people. For instance, despite having heard of climate change, participant 3 from mmahu community said during the FGD that she did not grasp what it implies. This scenario increases vulnerability during climate-related disasters because household heads who do not have a good

knowledge of climate change may not utilize the warning alerts from NEMA to make adaptation action plans or emergency responses.

The perception of climate change by rural households in these communities was influenced by their level of awareness, religious beliefs, and experiences of weather/climate events over time (Table 5.10). A significant proportion (21.7%) of the participants said the time of climate disaster is regarded as a time of food shortage and hunger due to scarcity of food items especially during floods. Therefore, the perception of climate change impacts by rural residents may have raised their climate change risk awareness which is important in the reduction of their vulnerability to weather/climate events.

6.4 Environmental, Human, and Economic Impacts of Extreme Weather/Climate Events in Rural Communities

Weather/climate events have environmental, human, and economic impacts on the rural populace in the study area (Tables 5.11, 5.23). For environmental impacts, the study participants said climate disasters are responsible for the destruction of farmlands and crops which poses a risk of food insecurity during and after the weather/climate events. Rural residents claimed that floods submerge their farmlands, washing off crops, and excessive rainfall also makes their farms waterlogged and difficult to operate while high temperatures kill crops and prevent seeds from germinating (Section 5.4.2.2). Extreme weather/climate events also destroy residential and farm buildings/structures, displacing people from their homes (Figure 5.8). These extreme weather/climate events (floods in particular) have made temporary or permanent refugees (internally displaced persons) even after the disaster (Figure 5.9). This condition increases the vulnerability of rural households because when there is no alternative housing for people whose homes are destroyed by climate disasters, the implication is that the affected persons/households may become permanent refugees while people whose houses were submerged or taken over by water may become temporary refugees who may return when the water dries off. Further, roads and other construction works like bridges are destroyed during flooding and when it recedes, the roads are permanently damaged cutting off access to farms, businesses, and other communities (Figure 5.16). This result corroborates the argument of Ward *et al*. (2020) that after a climate-related disaster like a flood, roads are damaged and require a huge financial commitment to repair. The roads in the study area are left unattended after major flooding events resulting in more damage for a longer period which

reduces the societal resilience of rural communities. This condition can make very short distances take longer time to commute, especially during relocation or emergency responses.

Extreme weather/climate events especially floods and high temperatures have human (health) impacts in the study area (Sections 5.2.22, 5.4.2.2). The participants claimed that high temperatures cause discomfort (heat stress) which makes them sick and sleepless at night. Those participants who feel heat stress due to high temperatures (15.8%) are mainly people from the Etekwuru community and those living close to gas flaring stations because of the presence of oil companies in the study area (Sections 5.2.22, 5.4.2.2). Again, due to pollution of the environment especially of land and water during climate disasters, breeding foci for mosquitoes are created which increase the cases of malaria amongst community members during flooding (report by local stakeholders). Further, the consumption of contaminated water causes the contraction of cholera and typhoid diseases leaving people sick and dead during flood periods (Figure 5.18). Since the sources of water for the communities are taken over by floods and there are no external supplies, rural households who cannot afford safe drinking water may resort to consuming the contaminated flood water which makes them vulnerable to waterborne diseases. Also, about 5.4% of the participants reported that human and livestock deaths characterize weather/climate events in their communities. For example, a town union member from the Etekwuru community claimed to have lost a relative who drowned in the last flood event while animals were seen floating in the water during the 2022 flood event.

Extreme weather conditions like heat waves and floods are examples of climate change's direct health effects. Malnutrition caused by decreased food production, the development of infectious diseases and water-borne illnesses, and increasing air pollution are examples of indirect consequences of climate change on health (Section 5.4.2.2). Therefore, to improve rural people's resilience, NASPA (2011) supports promoting and facilitating the adoption of practices and technologies that reduce exposure and health impacts from extreme heat, establishing early warning and health surveillance programs, and strengthening disease prevention and treatment for those diseases expected to increase as a result of climate change in Nigeria.

Economically, weather/climate events also impact rural communities negatively (IPCC, 2014; Abaje *et al.,* 2014). For example, in rural communities, the majority (94.4%) of farmers lose their farmlands and

crops to flooding in the study area. This implies that farmers' means of livelihood are affected by climate disasters directly affecting the living conditions of entire households. This is supported by the argument that households/communities that depend on primary economic activities and rain-fed agriculture will be vulnerable to climate change (Abaje *et al.,* 2014). When the destruction of farmlands and crops occurs, food shortages set in, resulting in food insecurity and malnutrition (Mertz *et al.,* 2009). This is because available foods may become too expensive and unaffordable for average-income earners during climate-related disasters (reported by participant 5 from the Opuoma community). This result is in tandem with the findings of Ekanem and Umoh (2021) who reported that rural localities in Akwa Ibom State in Nigeria were unable to raise enough food for survival due to the impact of climate change on food crop yields and agricultural production in general.

Extreme weather/climate events in rural communities will impact rural livelihood by disrupting economic activities as in the case of rural farmers in this study (Table 5.6). Extreme weather/climate events, for instance, will exacerbate the degradation of poorly maintained road networks, which will have a detrimental effect on rural communities' overall economies (businesses). Many businesses have closed down due to the damage caused to business structures like shops and markets. During flooding, markets are waterlogged resulting in low turnover for traders. This implies that extreme weather/climate events may result in both temporary and permanent loss of jobs and employment (Section 5.4.2.2). In all this, rural household livelihoods may be affected resulting in lower incomes during climate disasters. These conditions exacerbate the social vulnerability of rural community households to climate change impacts.

6.5 Adaptive Strategies Practiced by Rural Communities of Egbema

The goal of adaptation strategies in climate change discourse is not to slow or stop climate change but to respond to it and lessen its negative effects (Forino *et al.*, 2015; Yaro and Hesselberg, 2016; Shrestha *et al.*, 2017; Selseng *et al.*, 2021). An increased emphasis is placed on taking proactive measures and developing climate change adaptation strategies as people become more aware of climate change and its accompanying impacts. Rural households and farmers in the study area employed different strategies to cope with extreme weather/climate events.

Every season, farmers target the early onset of rains to begin their planting (usually around February-March) to enable their crops to mature for harvest before floods come by September/October of the year

(Table 5.24). Rainfall patterns may be changing due to climate variability hence the need for farmers to carefully monitor climatic conditions through observations and the information at their disposal. When rains start early in a planting season, crops like maize can be grown twice a year due to their short time (at least three months) to reach maturity. This strategy may be easy to practice but may require networking of farmers to share climate information, labour, seeds, or equipment because sometimes rains may begin in February and cease before March to start again in April or May. The farmers accomplish this early planting and early harvesting of crops by using hired labourers, a family labour force, or free labour rendered by other farmers. Although rural farmers have been practicing this method for a long time (said participant 6 from the Opuoma community), they still fall short of the aim to adapt to climate change due to wrong timing for planting as a result of inadequate training by extension workers, lack of funds, loans, incentives, and credit facilities.

More so, most (66.7%) of the farmers in the study area prefer the use of early maturing seeds, tubers, and stems of cassava (trukem) to cope with weather/climate events (Section 5.3.4). However, these early maturing crops are not easily affordable or readily available which implies that farmers who may not get these crops may be vulnerable because since flood is likely to occur between September – October of every year (Section 5.3.4). Farmers practicing crop diversification use flood-resistant varieties but due to the level, volume, and the time the flood water lasts before receding, this method may not be effective. Therefore, increased access to crops and livestock feeds that can withstand extreme weather/climate events, improved rangeland management, implementation of better soil management techniques, and utilization of early warning/meteorological forecasts and related information from NiMET and NEMA are just a few examples of improved agricultural systems that could be used for both crops and livestock to improve the adaptive capacity of farmers in the study area (Thornton *et al.*, 2010; Tesso *et al*., 2012; Boansi *et al*., 2017). However, not every farmer receives and uses the information on conservation agriculture put out by government agencies.

Since farmers hardly get support from the government and may not be able to afford artificial fertilizers, they try out different methods to cope during weather/climate extreme events (Section 5.3.4). For example, to avoid recording losses, farmers try to stay away from flood-prone areas leading to cultivation on marginal lands like soils around residential buildings (spaces between the roads and fences) which may result in food shortages due to low production (Section 5.3.4). The advantage of this measure is that

it is cheap to practice and crops may have time to mature properly before harvesting while the disadvantage is that this adaptation method does not allow for large farm sizes and consequently may lead to food scarcity and food price hikes due to low annual food production. Also, farmers cope with climate-related disasters by selling off their animals, and preparing and building alternative shelters for their livestock especially when they get flood alerts for the year (Tesso *et al*., 2012). Constructing new livestock houses is capital intensive and not all farmers who rear livestock can afford to build alternative structures to save their animals or move them away during the flood. Therefore this particular adaptation strategy may be used by a few affluent farmers. Trying out different farming methods (Figures 5.2, 5.3) may help farmers understand the practices most suitable for improving their resilience to the impacts of climate change on their farm businesses. For example, farmers learn from each other how to make mounds and ridges, and use of organic manures to enhance soil nutrients and reduce soil erosion. When the farmers learn any of the new methods to help them cope for a particular season, they stick to it without considering that climatic conditions might change and will likely require readjustment. Since the awareness of the farmers is not inclined towards readjustment, they are likely to be vulnerable when the climatic condition changes over time. This is why extension workers must visit rural farmers constantly to train and retrain them. The finding of this study suggests that the likelihood of rural farmers adapting to climate change is dependent on their agricultural expertise, income (financial strength), training, social capital, and good communication (Shrestha *et al.,* 2017). These adaptation measures are different from those reported in Imo State, Nigeria by Umunakwe *et al.* (2015) which include growing drought-resistant crop varieties, use of pest/disease-resistant crop varieties, harvesting water from rooftops, sinking more wells, and harvesting groundwater. This is because the study area is not so water-stressed.

Households with alternative houses are at an advantage and less vulnerable if the houses are not flooded while people without alternative homes are more vulnerable and therefore may migrate to open fields, schools, churches, and other community members' homes for safety (Section 5.4.2.2). A local stakeholder (a town union member 5) in the Mmahu community disclosed that the community has an emergency flood house for victims of flood disasters but this structure has fallen apart and there is no plan to fix it. Therefore, rural households and communities living in flood-prone zones may have to build their structures on raised platforms to reduce the vulnerability brought on by flooding.

Due to religious and cultural beliefs, and the distrust rural people have for the government (claimed by local stakeholders), farmers go to worship centers to make special prayers against climate disasters rather than believing that help would come from government authorities. A town union member 5 who is also a clergy from the Etekwuru community disclosed how he prays with his church members against climate disasters. They believe that praying to their God will help to avert the dangers of climate disasters rather than trusting that the government will support them.

However, due to factors such as political marginalization, environmental degradation, and the increasing severity and frequency of impacts brought on by climate change, rural communities' social resilience may have been reduced, making them less able to provide informal social safety nets for the highly dependent households, such as those with disabled residents. Despite the challenges household heads face during adaptation, they do not take appropriate coping measures which often have consequences after the disaster because households that sell their assets may not be able to continue their livelihood operations once the disaster is over since their operational capacity has already been compromised (Tesso *et al.,* 2012). Through the ability to use personal, group, and institutional resources and competencies to deal with, adapt to, and learn from the demands, challenges, and changes encountered before, during, and after climate disasters, rural community members may be able to reduce their social vulnerability and increase their resilience against climate change impacts (Tesso *et al*., 2012).

6.6 Role of Social Capital in Adaptation and Building Social Resilience Against Climate Change Impacts

Social capital plays an important role in climate change adaptation of rural communities in the study area. Harnessing social capital assets in rural communities can enhance adaptive capacity and social resilience to the effects of extreme weather/climate events (Shrestha *et al*., 2017). This is because social networks build a sense of community that contributes to the resilience of individuals and groups as well as their health and wellbeing. The use of social capital and its networks for climate change adaptation helped to reduce social vulnerability in the study area. For example, the relationships community members share culminate in support for rural households during extreme weather/climate events (Section 5.2.26). A farmer's social capacity for coping with the impacts of climate change is typically greater if he/she participates actively in social gatherings, have a large number of relatives in the community, and has a large family that can offer farm labour (Martins and Gasalla, 2020).

In the study area, important networks identified are families, friends, neighbours, and social groups/organizations (Figure 6.3). These social networks can be formal, informal, temporary, or permanent depending on the bonding social capital existing within the groups involved. The family comprises people closely related by kin in the community. They show compassion to their members in times of difficulty by sharing their pains and providing necessary support when needed. Family networks could be extended to relatives from nearby communities who may provide alternative housing to their brothers/sisters affected by climate disasters. People of the same family, ethnic/tribe share trust and assets which may increase their social resilience to climate change impacts. Neighbors as another social network may not be related by blood but may be seen as the closest individuals around a locality. Given that neighbours are close, they may be the first to help each other during climate disasters. For example, neighbours could help in the evacuation or harvesting of crops from flooded farmlands and homes. Social groups/organizations comprise groups of persons who share the same aims and objectives. The members of this group collaborate to achieve the purpose for which the organization/group is created and at the same time share a relationship of trust and reciprocity. Social group members may be mandated to provide certain support to other members affected by climate disasters. These social networks were found in the study area which translated into good community relationships (82.9%) and family ties (85%) necessary for lowering social vulnerability while increasing social resilience to climate change (Table 5.1). These relationships may help to strengthen bonds within social groups, give a sense of belonging to members of a social group, encourage social support, and strengthen linkages to other groups capable of bringing additional social, financial, and political resources. People who belong to social groups may be doing so due to the benefits they could get from linking with people of different social, political, and economic status.

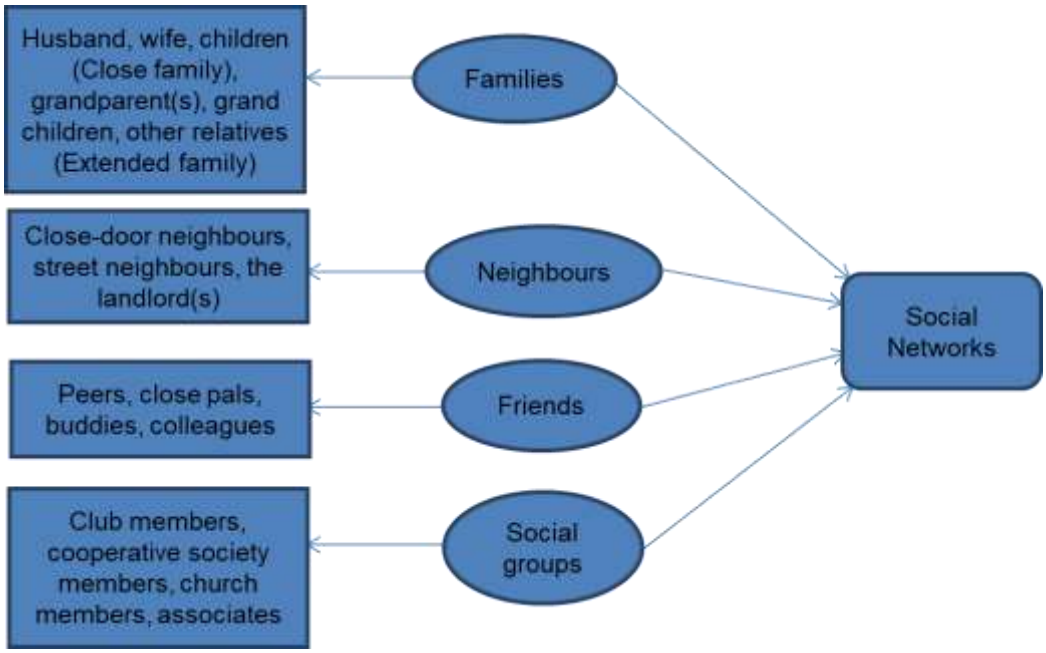


Figure 6.3: Identified social networks in the study area.

Also, community relationships and family ties may foster collaborations and collective efforts toward climate change adaptation in the study area. For example, people who have lived in rural communities for several years and those that have lived there for a lifetime naturally develop bonds over time and have at one time or another provided assistance (Tables 5.16, 5.17) as neighbours, friends, church members, or family members during extreme weather/climate event like a flood. Also, belonging to farmers' groups helps rural farmers improve their social resilience by pooling their resources to purchase farm tools, seeds, stems, and tubers, sharing expertise/knowledge, and other requirements for farming activities. By sharing risks and expenses, social capital bonds help farmers to more efficiently utilize their little resources profitably (Woolcock and Narayan, 2000). This result is in line with findings in northeastern Burkina Faso where it was discovered that farmers' natural resource management efforts benefited from social capital in the form of cooperation (Yameogo *et al*., 2018). In contrast, Paul *et al*. (2016) investigated a link between social capital and behaviours related to climate change adaptation in Ethiopia and found a negative correlation between social capital and individual adaptive actions. This is because the use of social capital to build resilience against climate change is more efficient within a group or community than individually. However, the finding of this study is supported by Putnam's social capital theory which argues that social networks offer benefits to people individually implying that

social capital impacts both individuals and groups (Putnam, 1995). The theory emphasizes trust, norms, and networks found within social groups/organizations that promote societal resilience through coordinated actions. Rural households took advantage of these norms, trust, and networks to render support to vulnerable community members affected by climate disasters (Tables 5.12, 5.15, 5.19). Similarly, Bourdieu's social capital theory (Bourdieu, 1983) which argues that certain products and services can only be obtained through social relationships, or social commitments, also supports the findings of this study. This means that assistance received by vulnerable community members from their families, friends, and neighbours during climate disasters is a result of social commitments because people are willing to render help and are not compelled to do so. Bourdieu's argument that the volume of social capital one enjoys is tied to the extent of one's social networks implies that rural households with more social networks are likely to be more resilient to extreme weather/climate events because they may likely draw support from their social capital assets. In contrast, Agrawal (2010) argued that strong social networks may encourage the spreading of false information and gossip, which could affect decision-making and reduce the incentives to adopt new technology in climate change adaptation. This implies that rural people who depend on their social group members, relatives, neighbours, and friends for climate change information may be misinformed thereby exacerbating their vulnerability to climate change impacts. From the evidence presented in this study, using social capital especially by farmers in rural communities to adapt to climate change may be of importance in improving social resilience in the study area. This is because farmers enjoy support from their colleagues in the form of free labour, seedlings, and loan of farm tools.

6.6.1 Roles of social groups/organizations in climate change adaptation

Membership of social groups/organizations has further strengthened the community relationships rural people share, especially amongst farmers (Sections 5.2.2.6, 5.3.1). Several social groups were named by participants of the study to which they belong and the roles they play in helping their members before, during, and after disasters. However, the prominent ones were age-grade groups, social clubs including cooperative societies where many farmers belong, and church organizations (Table 5.15). The age-grade group is an organization in which people of a certain age bracket (mainly 1-4 years age difference) form on their own as a social organization like the Otuchimereze age-grade group (a group of men and women within a certain age bracket) in Mmahu community. These groups are many in the rural communities with 38.3% of the rural populace belonging to such groups. However, older community members have

more interest in age-grade groups than younger ones. The age-grade groups make efforts to assist their members during difficult periods such as during climate disasters. The members of age groups enjoy certain benefits like financial assistance, food donations, and moral support that help to improve their social resilience (Section 5.2.30). Age-grade groups provide social security and support their members during ceremonies such as marriages, burials, and childbirth ceremonies.

Social groups are numerous in the rural communities including farmers' groups, church organizations, and cultural groups. Before, during, and after climate disasters, farmers who are affected by previous flood events are assisted by the social groups they belong to continue in their farming business (Section 5.2.26). This may help to enhance their adaptive capacity and may enable them to recoup losses and recover after climate disasters affect their livelihood. Due to the religious beliefs of the rural people, 23.8% belong to church organizations where they draw support during difficult times. According to a town union member from the Etekwuru community, during worship times, programs, or activities, presiding church officials may make announcements for special offerings or contributions for people affected by extreme weather/climate events. Some church organizations make welfare preparations for their members who may be affected by any disaster ahead of time. Many vulnerable rural households believe that taking refuge in church premises will be better for their survival than elsewhere (Section 5.2.2.3).

The type of support rendered by social groups to their members includes financial assistance, food donations, accommodation, and moral support (Table 5.19). The majority (59.2%) of rural community members are willing to offer support to others, especially to people affected by climate disasters (Table 5.16). However, people who barely get assistance during disasters are people who hardly associate with others (Section 5.2.30).

6.6.2 Constraints to climate change adaptation in rural communities

There are several institutional, socio-political, and socio-economic constraints against climate change adaptation highlighted by rural households and local stakeholders in the study area (Sections 5.2.31, 5.3.4, 5.4.2.4). These barriers also present themselves as societal vulnerabilities and are presented under this section. A review of these constraints shows that rural communities are vulnerable to extreme weather/climate events due to marginalization occasioned by political exclusion (Table 5.25). Reports

from town union members and traditional leaders suggest that people in the study area are not considered for key political positions at the state and federal levels. Excluding these rural people from political positions may have made it difficult to attract developmental projects that could improve the climate change adaptive capacity of the communities. This is in line with the findings of Akpe and Solomon (2017) and Gibb (2018) who argued that climate change adaptation capacity is affected by the involvement of rural communities in governance. Rural community members decried the government's neglect of their people during key political appointments which affected the development of the communities (Section 5.4.2.4). This implies that local stakeholders in these rural communities may not be involved in decision-making and policy formulation if this trend is not addressed. The rural communities of Egbema are also vulnerable to climate change impacts because they do not enjoy the dividends of good governance and mainly rely on community efforts to foster developments in the study area. Community taxation systems and voluntary donations (free-will donations of building facilities, electricity transformers, and financial support from wealthy rural residents) are utilized by rural community leaders to help champion some developments that may improve the social resilience of community members to climate change.

Electricity being one of the basic needs of every society is lacking in supply, thereby reducing the resilience of households including farmers in rural communities of the study area (Table 5.20). Lack of electricity supply increases the vulnerability of rural communities to climate change impacts given that it affects the storage of agricultural products, especially perishable goods like vegetables and fruit resulting in wastages and loss for the farmers, and increasing the cost of production. Because the majority of rural households are farmers, they may not be able to afford personal generators to generate electricity that could help them power their refrigerators used for preserving farm products and providing warmth for their livestock (Section 5.4.2.4). Community members rely on domestic electricity supply and personal electricity generators for power generation to cope with heat stress in hot weather conditions.

Further, poverty increases social vulnerability because it is one of the biggest challenges rural community members encounter in coping with weather/climate events in the study area (Table 5.25). Poverty in this context encompasses a lack of funds, good housing units, healthy food, and credit facilities reported mostly by farmers, hunters, fishermen/women in the study area. Any community or household unable to make preparations for anticipated weather/climate is most likely a result of financial constraints,

inadequate social ties, or lack of assistance (Blake *et al*., 2017). The farmers complained of having no financial support, credit facilities, and incentives necessary to encourage and sustain their farm businesses (Section 5.3.4). Many of the farmers have abandoned ambitions of expanding their farmlands for commercial purposes due to inadequate support from the government (Section 5.3.4). Farmers feel their economic activities do not give them the required return on investment due to the low scale (capacity) they operate under and lack of incentives from the government (statement by participant 2 from Opuoma community), and therefore are ready to consider other means of livelihood (Section 5.3.4). This shows that poverty persists in rural communities because of the kind of jobs rural residents do, unemployment, and inadequate infrastructure, and for these reasons, the number of farmers willing to continue operations may likely reduce significantly in future.

Further, basic infrastructural deficits like schools, markets, water schemes (water pipes and networks), road networks, and healthcare facilities create societal vulnerability that reduces the resilience of rural communities to climate change. The lack of good roads, healthcare facilities, schools, markets, and safe drinking water schemes in the study area lowers rural communities' adaptive capacity to the impacts of extreme weather/climate events (Figure 5.16). For example, rural communities in the study area record high mortality during floods due to the absence of emergency response system and good healthcare facilities (Sections 5.3.4, 5.4.2.4). Due to a lack of a water scheme to provide safe drinking water, rural community members are exposed to contaminated water from streams and wells making them vulnerable to communicable diseases (Section 5.3.4). Observation shows that every traditional household in the rural communities has a well that supplies water for domestic use. Farmers in the rural settlements of Egbema find it challenging to reach the next town to sell what they produce, purchase food, and fulfill other basic needs because of inadequate infrastructure, such as good road networks and vehicle access (Section 5.4.2.4). For instance, residents from the study region go to the next town, which should take no more than 45 minutes, in around two hours because of the poor state of the roads. Due to this circumstance, rural areas are more vulnerable to the harmful effects of climate-related disasters, particularly when there are people who require immediate medical assistance that can only be provided in a town, or when there is a need for emergency response to climate disasters. In addition to having poor access to fundamental services like health and education, remote areas frequently have restricted or disadvantageous access to standard markets (FAO, 2015). There are no good markets or shopping malls within the communities which necessitates traveling to the nearest towns for shopping. Since most

manufactured goods come from towns and cities, traveling along poor road networks to access standard markets and shopping malls may expose rural households to more hardships reducing their social resilience since they will spend more resources and time making such a journey.

Another major challenge to climate change adaptation is food shortages recorded mostly during and after climate disasters like floods because farmers may be forced to harvest their crops prematurely or abandon the crops due to high levels of water (Table 5.25). During this period, some farmers are forced to harvest their crops matured or pre-matured to avoid losing them to floods and thereafter sell them off immediately while some others who were overwhelmed by the event may lose everything in their farms resulting in food shortages (Section 5.4.2.2). Presently, garri (processed cassava) which used to be one of the cheapest commodities in the study area is no longer affordable due to the 2022 floods (Section 5.4.2.2). The available garri is currently sold at a high cost because the 2022 flood forced farmers to harvest early and after the flood event, so the commodity became scarce (Section 5.4.2.2). Food insecurity may further increase the vulnerability of rural households to climate change impacts in the study area as household heads reported malnutrition cases within their family due to poor food quality and quantity (Section 5.4.2.2).

6.6.3 Social vulnerability and resilience to climate change

Figure 6.3 emphasizes the roles of social vulnerability and resilience of rural communities to climate change adaptation. Demographic and socio-economic characteristics of the household heads (Table 5.1) depict the social vulnerability factors (Figures 6.1, 6.2, 6.4) that exacerbate the impacts of climate change on the rural communities of the study area. Figure 6.4 illustrates that the factors of social vulnerability may expose rural communities to climate change impacts and that may increase their sensitivities. This implies that the challenges rural communities face in climate change adaptation may be attributed to social vulnerability as a result of the poor socio-economic status of rural households (Sections 5.2.31, 5.3.4, 5.4.2.4). Due to the frequency of extreme weather/climate events in the study area, there is a need for adaptation measures to cope. However, this adaptation may not be effective due to the absence of creating climate change risk awareness and improving climate change knowledge amongst rural households. Since more than 80% of the participants are aware of climate change (Table 5.2), they were able to describe the most common weather/climate events in their localities through experiences with previous weather/climate events, impacts on the environment, economy, and human health, and the

coping strategies that may strengthen their adaptive capacity. Meanwhile, social capital and social networks helped rural communities to improve their social resilience and adaptation capacity through benefits from relationships within the community and other social groups/organizations they belong to (Sections 5.2.23, 5.2.27, 5.2.28, 5.2.30).

From the Theory of Planned Behaviour (TPB) point of view (Zhang *et al*., 2020), rural communities engaged in certain climate change coping strategies with the intention that their behaviours (actions) will enhance their social resilience and help them adapt to climate change impacts. Due to the will of rural community members to perform such actions, they are likely to continue and will be willing to develop more efficient adaptation strategies that extension workers or other climate actors may teach them. Also, the willingness of rural community members to help engendered support rendered to vulnerable households affected by previous extreme weather/climate events. The TPB further states that groups/organizations have codes of behaviour that control their actions (Zhang *et al.,* 2020) which supports the finding of the study that social groups/organizations have obligations arising from mandates from their social groups to support vulnerable members of their groups. Because of this mandate and the willingness of social group members to provide support, vulnerable rural households received different forms of assistance that improved their resilience to climate change impacts (Sections 5.2.23, 5.2.24, 5.4.2.6). More so, according to the assumptions of TPB, there are perceived factors such as social capital and networks to improve social resilience in rural communities of Egbema while other perceived factors such as political marginalization, exclusion from decision-making (governance), infrastructural deficits, and economic challenges can impede climate change adaptation (Section 5.4.2.4).

Based on the Generalized Resistant Resources (GRRs) model (Idan *et al.,* 2016), households that earn higher incomes are likely to have greater GRRs and therefore more resilience to climate change impacts because of their higher economic status (a measure of GRRs) and therefore tend to have consistent, balanced life experiences and higher participation in decision-making. More so, households with disabled persons are said to have lower levels of Sense of Coherence (SOC) (Idan *et al.,* 2016) and therefore are more vulnerable than households without any disabled members. This is because these households with disabled members will require extra coping strategies during extreme weather/climate events when compared to others without disabled (physically challenged) members. Similarly, households with higher literacy, income, and better sources of livelihood (non-climatically sensitive economic activities) will

likely have higher GRRs which translate to higher SOC capable of raising the adaptive capacities of such rural households to climate change impacts. More so, the GRRs model supports the findings that individual household members feel more secure and satisfied due to the relationship of trust among them. These relationships from social networks enabled community members to assist other members in times of need which improves their social resilience. Therefore, rural residents or communities with high GRRs may likely have better climate change adaptive capacity compared to those with Generalized Resistance Deficits (GRDs) who may be more vulnerable and less resilient (Idan *et al.*, 2016). Societal vulnerabilities inherent in rural communities of the study area encourage GRDs and may exacerbate the social vulnerability to climate change impacts by reducing rural residents' GRRs.

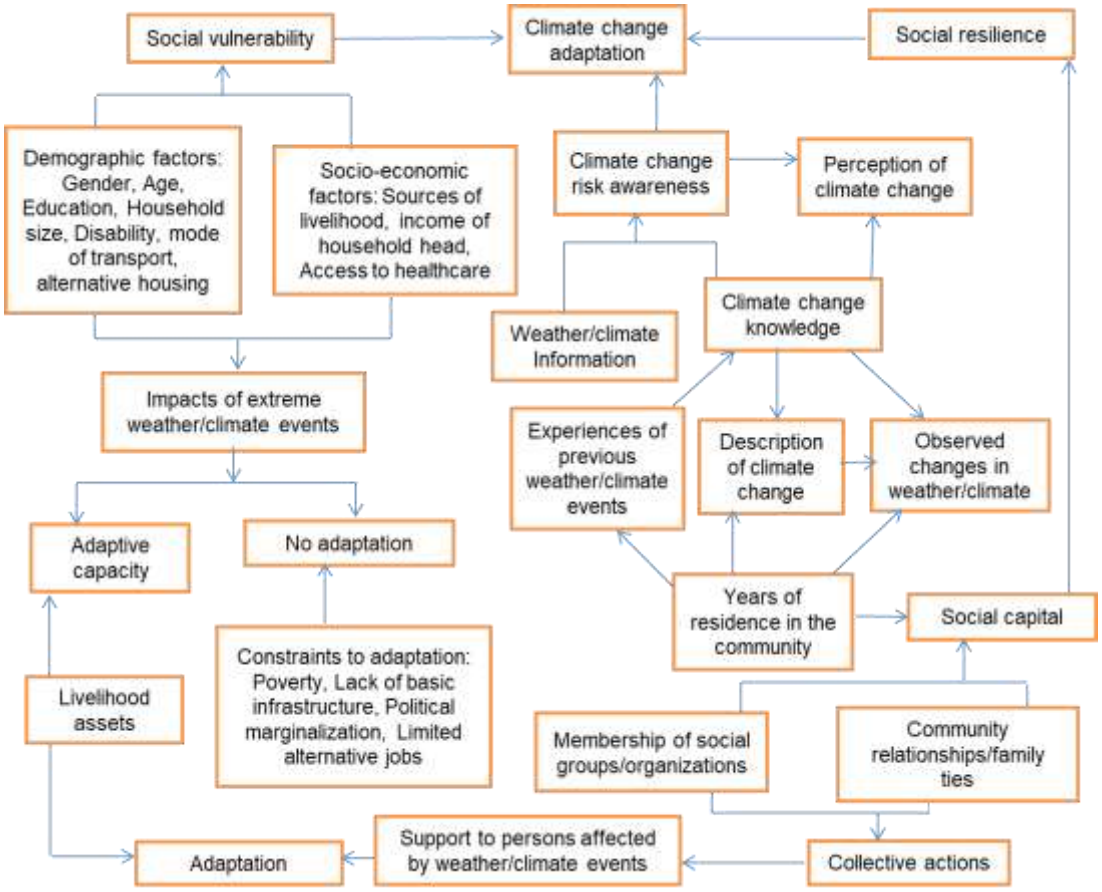


Figure 6.4: Roles of social vulnerability and resilience in climate change adaptation. The arrows show connections and relationships between different elements of social vulnerability and social resilience that influence climate adaptation.

6.7 Developing Sustainable Adaptation Measures through Collective Efforts, Participatory Adaptation, Political Inclusion, and Social Interactions

Rural community members especially farmers collaborate through interactions and engagements with other community members and local stakeholders to cope with weather/climate events (Section 5.3.1). The links between farmers of different communities within the study area create opportunities for collective efforts in their farming activities. Farmers improve their climate change awareness by sharing information and ideas within and outside the farms (Section 5.3.1). For example, farmers interact with each other, customers, seed, stem, and tuber sellers, and livestock, and feed sellers during market days. From these discussions, farmers learn new ideas, and innovations, share information, and also learn about early maturing seeds, stems and tubers used as measures for coping with climate change (Section 5.3.1). Also, collaborations enable farmers to borrow farm implements from their colleagues without making any payment. As a collective effort for climate change adaptation, farmers pool their resources to purchase seedlings, tubers, cassava stems, and farm tools at cheaper rates helping to conserve farmers' meager earnings for other purposes, thereby providing a social safety net for vulnerable farmers during difficult times like periods of climate disasters (Section 5.3.1).

The poor relationships between extension workers and farmers during the few times the former visited the study area during the regime of the former governor of Imo State in 2015 through the Agricultural Development Programme (ADP) have made farmers rely on the ideas and information they pass to each other to survive during weather/climate events (Section 5.3.1). Farmers and extension workers are meant to interact continuously to help teach farmers new ideas, innovations, and modern farm practices that are climate resilient. However, the near absence of useful and timely interactions between farmers and extension workers has left rural farmers struggling to adapt to adverse weather/climate conditions in the study area (Section 5.3.1).

6.7.1 Participation of rural community stakeholders in climate change adaptation decision-making

Both rural households and local stakeholders disclosed their opinions on their involvement in the formulation of climate change adaptation policies. Although rural people are not involved in climate change adaptation decision-making (Sections 5.2.29, 5.4.2.6), the responses indicated that the majority

(86.2%) of rural community members are positive that involving them in the climate change decision-making process will help to formulate more effective policies that will enhance their resilience to climate change effects (Table 5.18). They believe that climate change adaptation measures formulated through collaborations between rural people and policymakers will improve their capacity to cope and recover from the effects of extreme weather/climate events (Section 5.4.2.6). On the contrary, 13.8% of the participants said that involving them in formulating any policy will have no positive impact. This may be because of the distrust rural residents have for the government or their lack of knowledge, interest or time. Also, local stakeholders reported that governments at the state and federal levels neglect rural community leaders and fail to communicate with them when making decisions that directly affect them (Section 5.4.2.6). This suggests that although rural community members are willing to get involved in climate change politics/governance, the government authorities may not be willing to collaborate with them (section 5.4.1.2), hence formulating ineffective climate change adaptation measures that do not address the specific needs of their communities during weather/climate events.

6.7.2 Roles of local stakeholders and government agencies in building climate change resilience

Social resilience against climate change in rural communities of Sub-Saharan Africa involves encouraging collaborations between various stakeholders and relevant social organizations (Nkiaka, 2019). In the context of this study, the local stakeholders involved are traditional leaders, and the council chairman of the local government area (LGA). Meanwhile, the government agencies involved in the study are mainly NEMA and NESREA. Although NiMET and NIHSA were other stakeholders involved in climate change actions, they worked with NEMA as sister agencies. All the government stakeholders (agencies) are under the national Ministry of Environment that interacted through meetings and workshops to play key roles in climate change adaptation processes in rural communities.

6.7.2.1 *Local stakeholders' interactions*

Town union members help to provide stability in leadership by ensuring peace, unity, and orderliness in the rural communities of Egbema which improves community relationships that support social capital for climate change adaptation (Section 5.4.1.1). Town union members (executives) and traditional leaders achieve this by organizing social-cultural events, town hall meetings, and general assemblies that provide avenues for associations and social interactions (Section 5.4.1.1). When people gather for meetings or other events, they create avenues for sharing climate change information which gives room

for weather/climate information sharing, new coping methods, and ways to tackle challenges to climate change adaptation (Section 5.4.1.1). For instance, during these gatherings/events, leaders of the communities make announcements and give out important information like annual rainfall and temperature predictions from NiMET, annual flood outlook from NIHSA, and calculated probable flood areas by NEMA (Section 5.4.1.1). These are part of early warnings and awareness against disasters reported by local stakeholders during interviews that when utilized would help to reduce the vulnerability of rural people to anticipated climate risks.

According to town union members, local stakeholders make efforts to ensure that everyone in the community is aware of information on climate events by using town criers who go around the communities to spread the information mainly during morning and evening hours when it is presumed that people are in their homes (Section 5.4.1.1). However, these warnings and awareness have not done enough to help vulnerable rural households prepare for the anticipated climate-related disasters. This may be due to other challenges (social, political, and economic challenges) faced by vulnerable rural households in the study area. The study shows that town union members have close links with traditional leaders and other community members which may foster collective adaptation actions (community-based adaptation). The traditional leaders claimed they functioned better with town union members on their sides. For example, the traditional leader of the Mmahu community claimed that town unions are the most vital arm of local leadership given the important role they play in attracting certain developments to the community. Further, when important information on security or disasters is received from the government or its agencies, traditional leaders usually call for emergency meetings involving town union members, the council of chiefs or palace chiefs, and elders in the council. Involving town union members in security matters helps to create favourable conditions for economic activities in the study area. Also, town union members help to channel community problems to the right government authority for action. For example, during weather/climate events such as floods, town union members with the permission of the traditional leaders write to NEMA for support and assistance on behalf of the communities (Sections 5.3.3, 5.4.1.1, 5.4.2.6). The local people however noted the efforts of town union members in soliciting support from government agencies but claimed that their efforts yielded little result because government agencies respond too late to climate-related disasters (Sections 5.3.4, 5.2.24).

6.7.2.2 *Government agencies' interactions with local stakeholders*

Building climate change resilience and adaptive capacity also requires multi-stakeholder collaborations (Djalante, 2012; Boansi *et al.,* 2017). However, local stakeholders in the study area do not have strong links with the government and its agencies due to hurdles caused by unnecessary bureaucratic processes on one hand, selfish interest of leaders, and government negligence of rural stakeholders on the other (Figure 5.6). It takes unnecessary processes and time for local stakeholders to access government agencies for support unless there are highly placed individuals who can help (Section 5.4.1.2). This disjointed linkage has resulted in the formulation of faulty climate change policies that have not helped rural communities to effectively cope with the impacts of climate disasters since local stakeholders are not allowed to contribute to decision-making or given positions of authority within the government. Also, due to the poor relationship between local stakeholders and government agencies (Figure 5.6), help during climate disasters comes very late and sometimes nothing is done by the government (Section 5.4.1.2). This is contrary to the claims of the local government chairman who acts as a conduit for the state government. The local government chairman claims that the government sends support during climate disasters after receiving complaints from local leaders but evidence from rural households and local stakeholders confirms that responses to these complaints are mostly delayed (Section 5.4.1.2). The attitude of the government and its agencies has left rural communities in Egbema to feel politically marginalized (Section 5.4.1.2) which is one of the major challenges to climate change adaptation in the study area (Table 5.25). The rural communities do not trust the government for any substantial help during weather/climate events but rather their friends, neighbours, relatives, social group members, and church members (Sections 5.4.1.2, 5.2.23). This is because of the negligence of government agencies like NEMA and NESREA.

Further, NEMA and NESREA as the government agencies in the context of this study collaborate with other sister agencies like NiMET and NIHSA during stakeholder forums where environmental and climate-related issues are discussed. During these interactions, they give reports of previous weather/climate events, and predictions for future occurrences to help reduce the vulnerability of rural people by making preparations for anticipated extreme weather/climate events. However, there is no evidence that rural people are given special consideration during such meetings/workshops, and if there is, local stakeholders from rural communities are only partially involved in these efforts although the DGs of NEMA and NESREA had claimed otherwise (Section 5.4.1.2). During the annual conventions

and workshops of these government agencies, climate change adaptation is discussed. For example, the NESREA forms the National Regulatory Dialogue (NRD) and National Council on Environment (NCE) annually where climate actors convene to discuss ecosystem issues in Nigeria. NESREA brings these different stakeholders together to deliberate and brainstorm ideas that will help to protect the environment and reduce natural disaster impacts. Achieving the aims of these meetings may help to reduce the frequency of disasters thereby reducing the exposure of vulnerable households to the impacts of these disasters. Similarly, NEMA usually holds workshops for stakeholders in Abuja and one such workshop was a national consultative workshop in August 2021. In attendance were ministries of Environment, Humanitarian Affairs, Disaster Management, and Social Development, representatives of the Centre for Disaster Risk Management Studies, professionals from universities, and the executive secretaries of the State Emergency Management Agency (SEMA). They deliberated on how to strengthen community resilience to flood in the country through the activation of emergency operation centers to enable the agency to conduct search and rescue as well as assessment of affected areas. The shortfall of this consultative workshop is the exclusion of local stakeholders from rural communities and eventually when a flood occurred in October 2022, most coastal communities like the study area were affected. This is because these workshops are at the national scale and not at the very local scale.

The Department of Climate Change under the Ministry of Environment is concerned with the mitigation of climate change impacts. The Department of Climate Change works with NESREA to implement international laws and policies to reduce activities that emit greenhouse gases. However, these efforts are usually based on urban areas and there is no evidence that they consider rural communities when carrying out such obligations (Section 5.4.3). Similarly, the Ministry of Humanitarian Affairs, Disaster Management, and Social Development created by President Muhammadu Buhari works in collaboration with NEMA for emergency responses during climate disasters. The ministry is to collaborate with the Department of Climate Change, and NEMA to help identify the most vulnerable persons through its social and humanitarian programs aimed at helping these vulnerable persons to survive harsh economic and weather conditions. The poor implementation and the eventual failure of this program (Adibe, 2023) to achieve its target may be attributed to corruption and the negligence of local stakeholders in the decision process. For example, the Social Cash Transfer (SCT) program in Nigeria (2015-2023) targeted poor households to reduce extreme poverty and inter-generational transfer of poverty by giving them

5,000 naira monthly. However, this program was hijacked by corrupt politicians which defeated the aims and objectives that propelled the initiative.

NEMA depends on the information from other sister agencies like NiMET (which provides annual weather predictions) and NIHSA (which provides annual flood outlooks) to identify probable flood risk areas and subsequently create awareness by releasing warning alerts and preparing for emergency responses. The information from these agencies is shared during annual conventions, workshops, seminars, and conferences through their executive directors, director generals, or representatives designated for such duties. At the end of these meetings, the outcomes are published in newspapers and other print media like the Sun, Guardian, Dailypost, and Cable newspapers for public consumption. There is no evidence that local community leaders or ordinary community members take part in such meetings. The implication is that the peculiarities of rural communities are not considered thereby leading to social vulnerability when disasters occur. As reported by traditional leader of the Mmahu community, rural people rely on radios, televisions, newspapers, magazines, and social media to get climate information. Only two local stakeholders reported having met with NEMA during weather/climate events, suggesting that the link between government agencies and local stakeholders is weak and needs improvement (Figure 5.7). There is no reported direct link between ordinary rural community members and government agencies, suggesting that community members do not connect with government agencies. This implies that ordinary community members rely on their leaders to get support from the government and its agencies. Therefore, if these local leaders hoard weather and climate information, the effect will be upon other community members. Rural community members have to communicate their problems to local stakeholders for transmission to government agencies and rely on any information given by these local stakeholders. Since local stakeholders also find it difficult to access the government, rural residents may not access assistance from government agencies during climate disasters. This finding is in contrast to a report by Nkombi and Wentink (2012) that local stakeholders feel reluctant to engage in disaster reduction initiatives in Katlehong township of South Africa. This shows that while local stakeholders are provided with platforms to participate in DRR in other countries like South Africa, the local community stakeholders willing to participate in DRR are not availed of the same opportunities in Nigeria.

6.8 Integrating Adaptation Measures and Disaster Risk Reduction (DRR) Approaches in Building Climate Change Resilience

DRR is a comprehensive approach to long-term community development that integrates disaster preparedness and mitigation efforts (Adnan *et al.,* 2016; Cuthbertson *et al*., 2019; Booth *et al.,* 2020). Given that disaster management initiatives also cover climate-related crises, climate change adaptation can be considered as a subset of disaster risk reduction (Kelman, 2015; Nalau *et al*., 2016; Schipper *et al.,* 2016; Forino *et al*., 2018; Mysiak *et al.,* 2018). For long, managing climate-related disasters has been the norm but most recently, climate actors and researchers advocated for a paradigm shift from management to risk reduction (Adnan and Kreibich, 2016). To improve climate change resilience and reduce vulnerability to climate-related disasters in rural communities of the study area, there is a need to integrate disaster risk reduction approaches and climate change adaptation measures (Adnan and Kreibich, 2016). The major aim of integrating climate change adaptation and disaster risk reduction is to manage hazards by reducing vulnerability and exposure, increasing resilience, and transferring and sharing risks (Birkmann and von Teichman, 2010; Kelman, 2015). The integration of climate change adaptation and DRR approaches also aims to mitigate the severity of climate-related crises and potential consequences and encourage preemptive comprehensive and long-term strategies for disaster risk management. The United Nations Framework Convention on Climate Change (UNFCCC, 2007) emphasizes the advantages of using DRR solutions to cope with extreme weather/climate events while UNISDR (2009) advocated for a functional relationship between climate change adaptation and DRR to not only reduce poverty but to champion developments. This implies that the combination of climate change adaptation and DRR strategies will help reduce social vulnerability and at the same time enhance adaptive capacity and social resilience against climate change. To achieve this, the four priorities and seven targets of the Sendai Framework for Disaster Risk Reduction (Djalente and Lassa, 2019) form the basis for the practice of disaster risk reduction by NEMA. To achieve the integration of climate change adaptation and DRR in rural communities of Nigeria according to the DG, NEMA is suggesting an efficient collaboration with local stakeholders (e.g. Djalante, 2012) through the Local Government Emergency Management Committee (LGEMC) and the State Emergency Management Agency (SEMA). However, since the Local Government Emergency Management Committee is not functional in the study area, the collaborations of NEMA, local stakeholders, and LGEMC may not be achieved until the gap between the agencies and the stakeholders is bridged. This is a challenge to fulfilling three of the priorities of the 2015 Sendai Framework. For instance, weak links between NEMA and local stakeholders

(Figures 5.6, 5.7) may make it difficult for rural people in the study area to “understand disaster risks” and not getting these rural people fully involved in contributing to disaster risk reduction will be a challenge to "strengthening disaster risk governance." Given that local stakeholders in the study area do not have good knowledge of disaster risk and are excluded from decision-making, rural communities may become more vulnerable and less resilient to climate change impacts because they lack effective preparedness for response (adaptation) to and recovery from climate change impacts.

Integrating DRR and climate change adaptation encourages the concurrent practice of climate change adaptation while actively making efforts to reduce risks associated with climate-related disasters before the occurrence of such disasters (Schipper *et al.,* 2016; Mysiak *et al*., 2018). This implies that as rural community members try to cope with extreme weather/climate events by practicing early planting/harvesting, use of early maturing seedlings, and relocation, they may also plan for activities that will reduce the risks associated with the anticipated climate-related disasters like desilting drainage channels through compulsory community tasks and using sandbags to prevent flood water from entering their houses. Some of these DRR approaches could be structural like the preparation of retention ponds, dams, river improvements, drainage systems, levees, and dykes to store flood water, reduce peak stage, and retain flood water, or non-structural actions like early flood warning, flood emergency preparation and response, and environmental education (Kita, 2017; Bajracharya *et al.*, 2021). The combination of both structural and non-structural approaches to DRR with climate change approaches will be more effective in coping with climate change impacts in rural communities (Abad *et al*., 2020; Booth *et al.,* 2020). There is need for government to build more resilient infrastructure to increase societal resilience of rural communities. It is the responsibility of NEMA, the Ministry of Environment, NIHSA, and the Ministry of Works to collaborate in building structures required for DRR. The combination of structural and non-structural approaches of DRR will help to achieve the fourth target in the Sendai Framework "significantly reducing disaster damages to critical infrastructure and disruption of basic services" and the seventh target "significantly increasing the availability of and access to multi-hazard early warning systems and disaster risk information." (Maini *et al.,* 2017). However, the structural approach to DRR is capital intensive on the part of the rural communities, the local and state government, and may likely not be achieved due to the government’s negligence of rural communities and also the trust deficit between rural community members and the government. This implies that rural communities will most likely employ the combination of climate change adaptation strategies and a non-structural approach (measures

not involving physical constructions) to DRR because it is more proactive but less difficult and inexpensive to practice. The integration involves the adoption of disaster management strategies of active participation, preparation, and implementation of climate change adaptation measures by rural residents. For example, stockpiling of warehouses with foods and other essentials for human survival, and emergency response systems, are strategies for disaster risk reduction capable of improving resilience and reducing disaster mortality by NEMA. However, there is no evidence that these strategies improve climate change adaptation capacities in rural communities. This is because government attention is centered in urban areas and these DRR strategies are implemented in urban areas while isolating rural areas thereby encouraging their vulnerability during climate-related disasters (Sardi *et al.*, 2019). For instance, there are no emergency-response facilities or warehouses to stockpile relief materials in the study area. However, the proper implementation of integrating DRR and climate change adaptation may further reduce vulnerability when rural residents learn to take appropriate actions before the occurrence of weather/climate events without waiting for external support. This can be achieved by NEMA through educating rural residents on the actions to reduce disaster risks (non-structural approach) in their communities and through the involvement of local stakeholders in the activities of disaster risk management. Disaster risk education is a priority according to the Sendai Framework but is not adequately done by NEMA.

6.9 Chapter Summary

The results of this study show that while weather/climate events occur every year in the study area, rural community members are still grappling with the effects as a result of low adaptive capacity. The level of social vulnerability to climate change is relatively high due mainly to the existential societal vulnerabilities created by political challenges, poverty, and inadequate infrastructure like healthcare facilities. The interplay of societal and social vulnerabilities further influenced the resilience of rural residents and communities to climate change. However, the social capital potentials of the communities which are supposed to improve social resilience to climate change impacts have not been fully exploited. Notwithstanding this, rural community members survived previous climate disasters due to the relationships of trust and reciprocity that culminated in various supports from social groups and organizations. Membership in social organizations/groups like age-grade groups, social clubs, and church organizations helped victims of extreme weather/climate events to access support. Although integrating disaster risk reduction into climate change adaptation is a new paradigm for building

improved adaptive capacity, the weak links between government agencies, local stakeholders, and community members are a major concern against this practice. The roles played by government agencies and local stakeholders shaped the current DRR situations in rural communities. There is need for improved mechanisms and strategies by government agencies to achieve the aim of mainstreaming climate change adaptation into DRR efforts for better results in the Nigerian context. These results are summarized and set in a wider future research context in the next chapter (Chapter 7), where the conclusions and recommendations of this study are presented.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter summarizes the major findings of this study and lessons learned from how rural communities utilize their social capital to lower their social vulnerability, improve their social resilience to climate change impacts, and the potential of using social capital and societal resilience as a tool to achieving disaster risk reduction in rural Nigeria. Four components are discussed in this chapter. These are a major summary of the major findings of the study and their implications in line with the study's aim and objectives; recommendations for different stakeholders such as government and its agencies, local stakeholders, policymakers, and decision-makers; limitations to the study; and possible future research directions focusing on social vulnerability in rural communities in Africa.

7.2 Summary of Findings

This study aims to discover the root causes of social vulnerability to climate change adaptation in rural communities in Nigeria and how rural people can use their social capital and social networks to improve their adaptive capacity and resilience. This is important because rural communities in sub-Sahara Africa, especially in the study area, grapple with societal vulnerabilities in the form of poor living conditions, inadequate infrastructure, and inadequate essential amenities that reduce their resilience and exacerbate their social vulnerability to climate change impacts. From the findings of this study, social vulnerability in the study area is identified as a function of gender, age, education, household size, disability, sources of livelihoods, income, means of transportation, access to healthcare, and political marginalization.

The study shows that social vulnerability to climate change effects is high in Nigeria's rural communities given that farming, which is the mainstay of the study area's economy, is climate-sensitive and is dominated by women and young people. Not only that farming in the study area is rain-fed, but the women in these rural communities who dominate farming activities are less educated, earn lower incomes, and are less able to diversify their sources of livelihood. More so, the educational background of the rural populace influences their level of climate change awareness, perception, and preparedness for future climate risks because the more educated household heads have better perception and understanding of climate change risks than the illiterate ones. However, the level of climate change awareness was inadequate in preparation for future climate risks due to a myriad of challenges faced by

rural communities in Africa. Further, the rural households in the study area are vulnerable to climate change since the majority of the rural residents live below the national poverty line because their monthly income is a direct reflection of their sources of livelihood which is mainly agriculture and the fact that their agricultural system of farming is traditional and technologically intensive. These household heads struggle to survive since most of them have large household sizes (average of 7 household members). Given that some of the households have family members (mostly the elderly) who are disabled and require special care and attention, this further increase household vulnerability and reduces their social resilience when climate-related disasters occur. Due to high poverty levels, the majority of rural community residents can only travel on foot or bicycle and most of the rural households self-medicate because they can afford only drugs from patent medicine dealers or traditional medicines from herbalists when they fall sick. These conditions increase the vulnerability of rural households since they cannot effectively adapt to the impacts of climate disasters as a result of their low adaptive capacity occasioned by poor living conditions and education. The study found that political marginalization worsened the social vulnerability of the rural communities. This is because government commonly neglects rural areas and there are no developmental projects present, and basic infrastructure such as hospitals, good schools, standard markets, and roads are inadequate, aggravating societal vulnerability.

However, rural household heads were able to perceive and describe weather/climate events that occurred in their communities, and also observe changes in weather/climate conditions due to the length of years they have spent in the area. Cultural lenses (looking back at the implications of certain practices in the communities) and length of residence of rural households in the localities play important roles in their climate change awareness because people who had resided in the communities for at least 10 years or longer have more clear descriptions of previous weather/climate. This formed the basis of their explained experiences with extreme weather/climate. Although the study area experiences irregular rainfall, rising temperature, and delayed rainfall onset, the major climate event (disaster) experienced in the rural communities of Egbema is flooding caused by weather/climate events that impacts the environment, economic activities, and human health. Flooding has become more frequent in recent years (worst in 2022) and requires better adaptation measures for rural communities to cope. To get information on these extreme weather/climate events, rural community members rely on radios, televisions, social media, friends, and families. Warning alerts and predictions from government agencies like NEMA and NiMET come mainly through annual bulletins, and magazines accessed mostly by the leaders of the communities.

Information on climate change is also disseminated through town hall meetings, general assemblies, town criers, and during cultural events or festivals. This implies that other community members also rely on the weather/climate information given by their traditional leaders. Therefore any misinformation by the traditional leaders may increase the social vulnerability of a significant number of rural residents since it will influence the response of rural households to the next extreme weather/climate event.

Rural community members of the study area share strong ties/relationships both at family and community levels. These strong relationships form grounds for interactions, collective efforts towards climate change adaptation, and emergency responses during climate disasters. Vulnerable households affected by flood events could find alternative homes either from family members, friends, neighbours, or other persons in the community due to good relationships among them.

Further, during weather/climate events, individuals and communities source help from the government, NGOs, oil companies, family members, friends, neighbours, and church members. This help was rendered in the form of food items, cash/funds, relief materials, and words of encouragement. The government through its agencies provided food items such as tomatoes, cooking oils, garri, rice, noodles, and relief materials like blankets, mosquito nets, pillows, and mattresses usually in small quantities which do not benefit many or help them to recover from the impacts of climate disasters. However, people who were impacted by climate-related disasters preferred support from other community members because that of the government, oil companies, and NGOs does not just come in small quantities but arrives very late after the disaster.

Membership in social groups/organizations such as age-grade groups, social clubs, cooperatives, and church organizations also create pathways to social interactions. These social interactions bring about collective efforts and collaboration among community members who belong to one or more social groups. Social groups and organizations in rural communities are built on the principles of trust and reciprocity that are leveraged by people who are impacted by climate-related disasters to access help from other members of their social groups. Trust and reciprocity help farmers to borrow farm tools without pay, and access free farm labour from their colleagues. Community assistance to individuals affected by extreme weather/climate events is influenced by the existing relationships of individual household members with other community members and the social groups to which they belong.

Adapting to climate change through early warnings, early planting and harvesting, use of early maturing seedlings, and migration/relocation from disaster-prone areas, may not be adequate in lowering the vulnerability of farmers to impacts of extreme weather/climate events in the study area. Despite taking these adaptation actions, farmers in the study area still feel the impacts of previous climate disasters (Section 5.4.2.2). Given that family members, friends, church members, neighbours, and social group members in the communities are willing and in most cases provide support to people affected by climate disasters, they help to increase the social resilience of vulnerable rural households.

Although NESREA, which is a government agency responsible for the management and conservation of ecosystems in Nigeria, has measures in place to protect the national environment, the agency has performed poorly in rural communities, including the study area. Since NESREA is not functional in rural communities of Egbema, the rural residents have to deal with environmental problems through community efforts and according to their judgment. Similarly, NEMA advocates for the mainstreaming of climate change adaptation into disaster risk management through the integration of climate change adaptation into disaster risk reduction measures at the national level without clear plans for rural areas. However, cultural and religious beliefs, bureaucratic bottlenecks, and government negligence of environmental challenges hinder the efforts of NESREA and NEMA. Also, government agencies have weak links with local stakeholders and other community members which is one of the major problems in achieving a resilient rural society against climate change impacts.

7.3 Conclusions

The following are the conclusions drawn from this study:

1. The rural communities in Egbema are socially vulnerable to previous extreme weather/climate events due to the composition of their population (demographic factors), socio-economic characteristics, and their societal vulnerabilities.
2. Household heads' over-reliance on primary economic activities such as farming, fishing, and hunting and the non-diversification of their sources of livelihood further exacerbate social vulnerability in the study area.
3. The study revealed that the majority of rural households earn low incomes from their economic activities which do not satisfy their basic needs. Poverty is the major constraint to climate change

adaptation in rural communities. Farmers in rural communities no longer see farming as a profitable venture due to the hardship they encounter during and after climate disasters as a result of low adaptive capacities. The presence of dependent members (mainly disabled, young and aged members) increase the social vulnerability of households during climate disasters because the little income rural households earn does not provide adequate social safety net for them. Societal vulnerability caused by poor transport networks/modes, poor access to healthcare systems, and poor educational system exacerbates the vulnerability of rural residents to extreme weather/climate events in the study area. For example, poor transport networks/modes affect access to business locations, farms, schools, healthcare facilities, evacuation points (alternative houses), and emergency response time during climate disasters. Similarly, poor access to healthcare encourages the spread of communicable diseases during and after climate disasters (Section 5.2.12). Having large family sizes contribute to social vulnerability since more persons may likely slide into poverty and more persons may depend on the little resources provided by few members of the household. Also, large family sizes mean that farm produce is mostly consumed by the household members with little or nothing for the market. Poor implementation of government policies, and programs, and the exclusion of local stakeholders from crucial decisions and policy formulation processes contribute to the societal vulnerability that exacerbates the social vulnerability of rural residents.

4. Social networks such as families, friends, and neighbours help to strengthen social resilience during climate disasters. For instance, large household sizes provided free labour for farmers to cultivate and harvest large farmlands, and family members, friends, and neighbours provide accommodation and material support to people affected by weather/climate events.

5. Previous extreme weather/climate events in the study area caused a reduction in food production (food shortage), impacted businesses, and the health of the rural populace who have low adaptive capacity and social resilience due to the lack of livelihood assets, infrastructure like healthcare facilities, good roads, standard markets, and alternative jobs to adapt and recover after extreme events.

6. Despite the level of climate change awareness, the study area is still vulnerable since climate change knowledge does not necessarily translate into resilience and adaptation actions. Although the majority of the rural populace claimed awareness of climate change, their actions and responses have not lowered their vulnerability and if the current state of things remains, more persons may be vulnerable to future extreme weather/climate events.

7. Given that extension workers barely visit (once in many years) farmers in the study area, household heads who are mainly farmers lack training and education on the use of modern adaptation methods in their farm operations and therefore rely on indigenous adaptation strategies.
8. After previous extreme weather/climate events, household heads receive support from different quarters which potentially improve the resilience of rural residents that received them. However, the majority of the people who recovered through this help were persons that got support from their social networks, and social groups.
9. NEMA is mainly concerned with the dissemination of predicted annual weather conditions, flood outlooks, and disaster warnings/alerts. However, the agency is yet to put measures in place to facilitate the understanding of this information by the rural residents.
10. NEMA's aspiration for a change from disaster management to disaster risk reduction may be a fulcrum to integration of DRR and climate change adaptation yet the agency has not shown genuine commitment to the practice (Section 5.4.4).

7.4 Recommendations

Based on the results of this study, the following recommendations for household heads, community leaders, the government, the NEMA, NESREA, and other government agencies concerned are proposed.

7.4.1 Recommendations for government and its agencies, policymakers, and local stakeholders

1. Climate change risk awareness should be improved at all levels in Nigeria. The study recommends that school curricula should be designed to accommodate environmental education in local languages for easy understanding and information transfer. For example, NEMA, NESREA, NiMET, NIHSA, the Department of Climate Change in the Ministry of Environment, and other concerned government agencies like the National Orientation Agency (NOA), and the Ministry of Humanitarian Affairs, Social Development, and Disaster Management in Nigeria should translate warning alerts in local dialects of rural communities instead of communicating only the English language.
2. To formulate appropriate and effective climate change adaptation measures, policymakers and decision-makers in African countries include rural community leaders (local stakeholders) in the process. The inclusion of local stakeholders will help to reduce political marginalization and enable policymakers to consider the particular needs of the rural communities while formulating climate change adaptation techniques. Since climate change adaptation at the community level requires collective efforts,

collaborations between all stakeholders must be strengthened. Also, local stakeholders in African rural communities must be willing to genuinely cooperate with government agencies for the interests of the wider society. To improve the ability of rural households to cope with and adapt to changes, local populations should be encouraged to participate in climate change research and governance. This effort is crucial to increasing understanding of climate change challenges and consequently, to help to effectively execute adaptation measures.

3. To achieve the integration of Disaster Risk Reduction (DRR) and climate change adaptation in developing countries, local government emergency committees must function better at full capacity just like NEMA does at the federal level of government in Nigeria. If this is achieved, rural residents will be closer to the government agency responsible for disaster risk management and there will be collaboration between them to bring about DRR to improve resilience to climate change in African rural communities.

4. To achieve resilient rural communities in developing countries through the integration of DRR and climate change adaptation requires that DRR approaches should be carried out simultaneously with climate change adaptation efforts. Therefore, government agencies such as NEMA in Nigeria should design appropriate schemes that will help to establish flood management structures in rural communities of Nigeria that will run concurrently with climate change awareness programs, environmental education, and climate change adaptation efforts. Governments of African countries should endeavor to formulate implementable and sustainable flood management policies, and environmental laws that will help in achieving DRR in rural communities. Due to the huge financial capital outlay involved in the construction of infrastructure like bridges, levees, dams, and water retention ponds, this study recommends public-private partnerships in Africa, and inter-agency collaborations for government agencies like NEMA in Nigeria and other concerned agencies to invest in soft engineering like beach scraping, soak ways, riparian planting, and sand fencing to lower the vulnerability of rural communities to climate disasters such as floods.

5. African countries should endeavor to build emergency flood houses/homes (evacuation shelters) in every rural community to cushion the effects of displacements during climate disasters like flood events. The flood houses will be alternative homes for people affected by flood events or Internally Displaced Persons (IDPs). There should be emergency planning procedures in place to minimize the impacts of disasters on rural communities in developing countries.

6. The Imo State government in Nigeria likewise in other states needs to set up compensation schemes to help persons affected by flood rebuild their financial foundations and living conditions over time. Additionally, this would lessen non-insurable public damage.
7. The study recommends local-level climate change vulnerability assessment in Africa and the need for local actions/policies to reduce vulnerability and enhance adaptation in rural communities.

7.4.2 Recommendations for rural communities

1. African rural communities are more susceptible to climate change effects due to high levels of social and societal vulnerability as a result of low adaptive capacities. This can be checked by addressing societal vulnerability factors, and socio-economic and demographic factors responsible for low social resilience in African rural communities like low income, poor access to education and healthcare, and poor means of transport. Such factors as poor access to the healthcare system should be given adequate attention by governments of African countries to reduce mortality rates in rural communities through free medical outreaches and the establishment of equipped primary healthcare facilities in every rural community. There should be employment opportunities to serve as alternatives to farming which most of the rural residents rely on for survival. Therefore, alternative means of livelihood will improve rural residents' social resilience against weather/climate events (climate-related disasters). Giving rural households financial and technical support may encourage them to start small and medium-sized businesses like poultry farming.
2. Cooperative societies and other social organizations especially for farmers in rural African communities should be encouraged to improve adaptive capacity through training, grants, credit facilities using their social capital and social networks. Also, community members should be encouraged to participate in social groups of their choice to improve their social security, cohesion, collaboration with other community members, and support derived from social organizations when affected by climate disasters.

7.4.3 Recommendations for farmers

1. Farmers of most rural communities in Africa feel discouraged because they are not given adequate incentives, loans, and training for efficient farm operation. Therefore, this study advocates for direct links between agricultural extension workers, climate change actors like government agencies, rural community leaders, and rural farmers in Africa to bring about advancements in farming practices through

modern knowledge of agricultural production. The training by extension workers may enable farmers to combine their local adaptation techniques with modern measures to cope with extreme weather/climate events. The governments of African countries should endeavor to encourage rural farmers through the approval of credit facilities, loans, and the provision of incentives like fertilizers, seeds, water management systems (irrigation facilities), and modern farm implements. The combination of these efforts will help strengthen farmers' adaptive capacity and reduce the challenges of food insecurity during climate-related disasters.

2. The adverse impacts of climate change on farmlands and crop production compromise the attainment of the Sustainable Development Goals in Africa, especially Goal 1 "Eradicate Extreme Poverty and Hunger." Therefore, to increase resilience to climate change, rural farmers in African countries are encouraged to use genetically modified crops, drought, and flood-resistant crop varieties, and crops that have better resilience to reduce the risk of crop failure and resist the adverse impacts of climate change to increase food production.

3. Developing countries should release funds to facilitate the development of climate change resilient crops, early maturing seedlings, tubers, and stems to strengthen the adaptive capacity of rural farmers in their countries. Early-maturing crops will allow farmers to cultivate and harvest in a shorter time before the time of extreme weather/climate events. The minimization of climate change consequences on farmers will be aided by new, better crop varieties.

7.5 Limitations of the study

Participants in this study included diverse climate change stakeholders from various areas and offices. Visiting the DGs of government agencies for interviews was time-consuming because meetings were often booked and delayed, particularly for the NESREA DG and the local council chairman. During data collection, some participants would deviate from the topics given, and formal interviews and focus group discussions ran longer than intended in several circumstances. When this happened, the researcher would try to refocus on the interview schedule questions and focus group questions. Because some participants did not give consent to be audio-recorded or photographed, the researcher wrote down their comments exclusively.

Despite having a research assistant from the same area who described my position as a researcher and the purpose of my research to the community people, several participants mistook me for a government

official and were expecting something from me. Some refused to let the researcher explain himself before leaving in the name of 'it is the government's worthless activity that brings no benefits to their life'. It was quite difficult to persuade such people that this was not a government survey but rather an academic project for the researcher. Although the open-ended questions employed in all of the study instruments assisted in reducing response bias by not limiting the replies, bias was not eliminated. Some individuals would provide responses that they believed to be correct but were prejudiced. Some traditional leaders, the local government chairman, the DG of NEMA, and the DG of NESREA provided calculated responses to safeguard their positions as leaders. As a result, some of their replies to the issues they faced were insufficient because they were conservative with words.

The researcher visited the study area twice, once during the planting season and once during the harvest period, which was accompanied by high floods that restricted travel in many parts of the communities. Farmers who participated in the field observation refused to be photographed while operating on their farms which reduced the number of evidence presented in the study.

Although the researcher interviewed the number of proposed local stakeholders, time could have been saved and more participants could have taken part in the study if they were available during the data collection period. Many of the local stakeholders (town union members) were difficult to access. The researcher had to run after some of them along the roads and workplaces for the interviews. In the case of the local government chairman in the study area, appointments were scheduled and rescheduled severally before the interview was granted.

Finally, due to the difficulties researchers encounter while quantifying vulnerability indicators, the study was limited to about ten resulting to omission of other important indicators. The study could have investigated more interesting communities within the study area, but was limited by inadequate infrastructure like road networks.

7.6 Future Research Directions

1. Since rural communities are vulnerable to climate-related risks due to social, economic, and political challenges, there is a need to further evaluate rural residents' participation in disaster risk reduction. This will avail researchers and climate actors in developing countries with knowledge of areas of strength

(prospects) and areas of weakness of rural communities to climate change adaptation and therefore design pathways to improve adaptive capacity and strengthen social resilience, especially in Africa. This study is suggested for developing countries that are most vulnerable to extreme weather/climate events due to their low climate change adaptive capacities.

2. Many rural communities in sub-Sahara Africa live in disaster-prone areas, therefore conducting a multi-hazard mapping of socially vulnerable communities and societal vulnerability factors that aggravate climate change impacts in rural communities of sub-Sahara Africa will avail climate actors and policymakers with required information for actions against future climate-related disasters. This can be done by reviewing, evaluating, and analyzing previous and current government policies using Principal Component Analysis (PCA) to ascertain their effectiveness in disaster risk reduction and chart a new pathway to improve community resilience.

3. Given the abundance of social capital and networks in typical African rural communities, assessing and evaluating the roles played by various social groups/organizations in climate change adaptation will be vital in designing policies that will strengthen resilience against climate change in rural communities.

4. Since women in rural communities are the most vulnerable gender during weather/climate events, there is need to assess gender-based training, workshop, entrepreneurial initiatives, skill acquisition programs, social and health plans to ascertain better ways of improving resilience amongst women. This can be done through evaluation of results recorded by existing human capital development initiatives for women in rural communities.

5. Given that rural communities in Africa have low adaptive capacity, and their vulnerability are differential, there is need to explore other factors contributing to social and societal vulnerability to recommend suggestions for improving rural community resilience.

7.7 Contribution to knowledge

The study examined communities' social cohesion using existing social capital to improve resilience against future climate risk thereby contributing to the body of knowledge on climate change in the community and household level through the integration of climate change adaption into disaster risk reduction strategies and by providing more insight into the requirements for practical policy intervention assessment and implementation.

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Appendix 1: Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

R14/49 Okoro

CLEARANCE CERTIFICATE PROTOCOL NUMBER: H22/01/24

PROJECT TITLE	Social Vulnerability in the Adaptation of Rural Communities toClimate Change in Imo State, Nigeria
INVESTIGATOR(S)	Mr F Okoro
SCHOOL/DEPARTMENT	Geography, Archeology and Environmental Studies/
DATE CONSIDERED	28 January 2022
DECISION OF THE COMMITTEE	Approved
Risk Level: Low	
EXPIRY DATE	01 March 2025
DATE 02 March 2022	**CHAIRPERSON** (Professor J Watermeyer)

cc: Supervisor : Professor J Knight

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House,University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completionof a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium andHigh Risk studies, this is due twice annually on 30 June and 31 December.**

30/ 03 / 2022

Appendix 2: Participant information sheets for key informant interview

Dear Sir / Madam,

My name is Franklin Okoro and I am a PhD Student in Geography, Archeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake aresearch project, and I am investigating social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria under the supervision of Prof. Jasper Knight. The aim of this research project is to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resistance to climate change impacts by combining collective efforts and disaster risk reduction approach.

As part of this project, I would like to invite you to take part in an interview. This activity will involve answering questions and will take around 45 minutes. With your permission, I would also like to audio record the interview using a digital device. This recording will be stored in a device with strong password and only the researcher will have access to this recording. It will be deleted after 6 years.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for yourname or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stopthe interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in a device with strong password and will be destroyed after 6 years. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,
Franklin Okoro

Researcher:
Franklin Okoro, 2371090@students.wits.ac.za

Supervisor:
Prof. Jasper Knight, Jasper.Knight@wits.ac.za, +27(0) 11 717 1408

Appendix 3: Letter seeking permission to conduct interviews with rural residents

16 December, 2021
Egbema Traditional Rulers Council,
Ohaji/Egbema Local Government Area,
Imo State, Nigeria.
Dear Sir,

REUEST FOR PERMISSION TO CONDUCT INTERVIEWS WITH RURAL RESIDENTS

My name is Franklin Chimaobi Okoro, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Social vulnerability in the adaptation of rural communities to climate change in Imo state, Nigeria. This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience to climate change impacts by combining collective efforts and a disaster risk reduction approach.

This interview could be face to face. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 40 minutes with rural household heads, traditional leaders, local stakeholders (town union members) who are directly and indirectly affected by weather/climate events. I wish to discuss about how your community members are adapting to climate change using their social capital and networks. I hope this request meets your most favourable consideration.

Yours faithfully

Franklin Chimaobi Okoro
Email: 2371090@students.wits.ac.za cell number +2348061422027

Appendix 4: Household survey questionnaire

Date: ……

Name of researcher: ……

SECTION A: SOCIO-ECONOMIC AND DEMOGRAPHIC DATA

A1 Name of community…….

A2 Respondent No ☐

A3 Sex of Respondent Male ☐ Female ☐

A4 Age of Household head

(a) 18 - 29 years ☐

(b) 30 - 39 years ☐

(c) 40 - 49 years ☐

(d) 50 - 59years ☐

(e) 60 - 69 years ☐

(f) 70 - 79 years ☐

(g) 80 - and above years ☐

A5 Educational Background of household head

01 No Formal Education ☐

02 Primary Education ☐

03 Secondary Education ☐

04 University/Polytechnic/College of Education ☐

A6 How many people are in your household? ☐

A7 How many of them are males and females?

.....

A8 What are their ages?

.....

A9 What are the sources of Livelihood for this household?

.....

……...

A10 Household income per Month

01	Less than N 10,000	06	N50,000 – N60,000
02	N10,000 – N20,000	07	N60,000 - N70,000
03	N20,000 - N30,000	08	N70,000 - N80,000
04	N30,000 - N40,000	09	N80,000 - N90,000
05	N40,000 - N50,000	10	N90,000 – N100,000
11	N100, 000 and above		

A11 How long have you lived in this community?

.....

A12 Do you have any relatives in this community?

.....

A13 Tell me about your relationship with them

……..

A14 How do you move around the community?

01 Taxi 02 Motorcycle

03 Bicycle 04 Personal vehicle

05 Others
……..

A15 Do you have or have had any of the following? (You can indicate more than one if applicable)

(a) Malaria ☐ (b) Typhoid ☐ (c) Cholera ☐

(d) Diabetes ☐ (e) Arthritis ☐ (f) Ulcer

(g) Covid19 ☐

A17 Do you have any disability or is there anyone with a disability in this household?

.....

……

……..…….……..

A15 Where do you often go for treatment when sick?

(a) Hospital ☐ (b) Clinic (c) Chemist shop ☐
(d) Herbalist ☐ (e) Others (Specify)……

SECTION B: CLIMATE RISK, AWARENESS, PERCEPTION, AND PREPARATION

B1 Have you heard about climate change?

.....

B2 What do you think climate change means?

.....

B3 Have you noticed any changes in weather/climate in this community?

.....

B4 Can you describe a big weather/climate extreme events that have taken place here?

.....

…….

B5 Tell me about these events and your experience

..……...……

…….……

……

B6 How often do you experience these weather events?

……

……

B7 How do you get information on weather/climate?

……

B8 How often do you get the information?

……..

B9 What comes to your mind when weather events occur?

……

……

……

B10 What impacts do they have on people of this community and the environment?

……

……

SECTION C: ADAPTATION AND COPING STRATEGIES

C1 If you are to ask for help during extreme weather events, who renders this help?

……

C2 What type of support do you receive?

……

……

……

C3 Did the support help you recover?

.....

C4 How supportive were neighbours during this time?

.....

C5 Have you ever received support from the government, your local leaders, Non-Governmental organizations, or any other concerned groups during or after weather/climate events in this community?

……

……

C6 What type of support do you and your community get before, during, and after climate events?.....

.....

C7 Do you have any alternative place to live if your home gets affected by weather/climate events? .....

……

…….....

SECTION D: COMMUNITY ADAPTATION

D1 What organization or groups do you belong to in this community?

…….....

……

……

D2 Do you think people in your community will assist you when you need help?

.....

……

D3 Do you think helps from neighbours or other community members will make you

recover?.....……

…….

D4 Do you think getting community members involved in formulating adaptation policies will make it easier for people to cope with weather/climate
events?.....

D5 With many social organizations in this community, do you think they can help you cope with extreme weather
events?.....

.....

D6 What type of help do you get from them?

……

…….....

D7 What are your challenges in coping with weather/climate events?

…….....

Appendix 5: Participant information sheet for household survey

Dear Sir / Madam,

My name is Franklin Okoro and I am a PhD Student in Geography, Archeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake aresearch project, and I am investigating social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria under the supervision of Prof. Jasper Knight. The aim of this research project is to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resistance to climate change impacts by combining collective efforts and disaster risk reduction approach.

As part of this project, I would like to invite you to take part in answering questions from a semi-structured questionnaire. This activity will involve answering questions from a structured questionnaire and will take around 30 minutes of your time.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The questions and answers will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stop the interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in a device with strong password and will be destroyed after 6 years. If you have any concerns or complaints regarding theethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours
sincerely,
Franklin
Okoro

Researcher:
Franklin Okoro, 2371090@students.wits.ac.za

Supervisor:
Prof. Jasper Knight, Jasper.Knight@wits.ac.za, +27(0) 11 717 1408

Appendix 6: Consent form for household survey participant

Consent Form

Household survey participants

Aim of the Research: This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience toclimate change impacts by combining collective efforts and a disaster risk reduction approach.

Researcher: Franklin Chimaobi Okoro

I, …….. agree to participate in this research project. The project has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous **YES NO**

I agree that the researcher may use anonymous quotes in his research report **YES NO**

I agree that the interview may be audio recorded **YES NO**

I agree that photographs of observed farm and farming activities may be taken **YES NO**

I agree that the information provided may be used anonymously after this project has ended, for academic purposes by other researchers subject to their own ethics clearance being obtained

YES NO

Name of participant

……

Signature …….....

Date …….

Name of researcher

……

Signature …….

Date ……..

Appendix 7: Participant information sheet for farmers' group discussion

Dear Sir / Madam,

My name is Franklin Okoro and I am a PhD Student in Geography, Archeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake aresearch project, and I am investigating social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria under the supervision of Prof. Jasper Knight. The aim of this research project is to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resistance to climate change impacts by combining collective efforts and disaster risk reduction approach.

As part of this project, I would like to invite you to take part in a Focus Group Discussion. This activity will involve discussions with group of farmers and will take around 45 minutes. With your permission, I would also like to audio record the discussions using a digital device. This recording will be stored in a device with strong password and only the researcher will have access to this recording. It will be destroyed after 6 years.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The Focus Group Discussion cannot be confidential or anonymous but the information you will give to me will be held securely and will not be disclosed to anyone else. If you experience any distress or discomfort at any point in this process, we will stop the discussion or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in a device with strong password and destroyed after 6 years. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours
sincerely,
Franklin
Okoro

Researcher:
Franklin Okoro, 2371090@students.wits.ac.za

Supervisor:
Prof. Jasper Knight, Jasper.Knight@wits.ac.za, +27(0) 11 717 1408

Appendix 8: Consent form for focus group discussion participants

Consent Form
Focus group discussion

Aim of the Research: This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience toclimate change impacts by combining collective efforts and a disaster risk reduction approach.

Researcher: Franklin Chimaobi Okoro

I, …….. agree to participate in this research project. The project has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous **YES NO**

I agree that the researcher may use anonymous quotes in his research report **YES NO**

I agree that the FGD activities may be audio recorded **YES NO**

I agree that photographs may be taken **YES NO**

I agree that the information provided may be used anonymously after this project has ended, for academic purposes by other researchers subject to their own ethics clearance being obtained **YES NO**

Name of participant

……

Signature …….....

Date …….

Name of researcher

……

Signature …….

Date ……..

Appendix 9: Interview schedule for key informant interview with NEMA DG

Interview schedule for key informant interview with NEMA DG

This interview will last for about 45 minutes

1. What are the government policies and legislations guiding the activities of NEMA?

2. What are the policies formulated by NEMA to tackle climate related disasters?

3. How are these policies implemented at the local level?

4. In what ways do you collaborate with local authorities during climate disasters?

5. Why do you think is important to get local stakeholders involved during disaster managementin their communities?

6. To what extent do you engage these local stakeholders? In what ways do you engage them?

7. If climate disasters take place in rural communities, what does NEMA do?

8. Could you please discuss NEMA's emergency response strategies especially for ruralcommunities?

9. What are the disaster risk management strategies used by NEMA for disaster preparedness andresponse in rural communities?

10. Does this agency have collaboration or alliance with other agencies like Nigerian Meteorological Agency (NIMET), National Environmental Standard Regulation andEnforcement Agency (NESREA), and others?

11. How do you interact with these agencies?

12. In what ways have these interactions improved the capacity of NEMA to manageweather/climate-related disasters?

13. How do you think climate change adaptation policies could be formulated in relation todisaster risk reduction and management?

14. Outline the challenges of NEMA in responding to climate risks in rural areas.

Appendix 10: Interview schedule for key informant interview with NESREA DG

Interview schedule for key informant interview with NESREA DG

This interview will be for about
45minutes

1. How do you ensure that guidelines are followed in ecosystem management and conservationof biodiversity in rural communities?

2. Do you inspect the environment in rural communities? How do you make the results of theinspection available for community consumption?

3. Do you have environmental education programs for rural communities? How do you carry outthis obligation?

4. Do you have any warning system against climate risks for rural communities? How do youcarry out this responsibility?

5. Are there climate change adaptive laws initiated by this agency? Please give details of howthey have helped in solving the problems of climate change amongst rural households.

6. How do you ensure that international agreements, conventions, and protocols to which Nigeriais a signatory to are implemented?

7. What are the institutional barriers you think are hurdles to the implementation of climatechange policies?

8. How do you promote useful dialogue and deliberations amongst climate change actors toidentify technically, environmentally, socially, and economically acceptable climate changeadaptation measures?

Appendix 11: Consent form for interviews with NEMA and NESREA DGs

Consent Form
Key informant interviews

Aim of the Research: This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience toclimate change impacts by combining collective efforts and a disaster risk reduction approach.

Researcher: Franklin Chimaobi Okoro

I, …….. agree to participate in this research project. The project has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous **YES NO**

I agree that the researcher may use anonymous quotes in his research report **YES NO**

I agree that the interview may be audio recorded **YES NO**

I agree that photographs may be taken **YES NO**

I agree that the information provided may be used anonymously after this project has ended, for academic purposes by other researchers subject to their own ethics clearance being obtained **YES NO**

Name of participant

……

Signature …….....

Date …….

Name of researcher

……

Signature …….

Date ……..

Appendix 12: Interview schedule for key informant interview with Local Government Chairman

Interview schedule for key informant interview with Local Government Chairman

This interview will last for about
45minutes

1. How often do you interact with traditional leaders in your local council?

2. How do you pass on information from state and federal government to communities withinyour local council?

3. Are there agricultural programs by this council to support agricultural activities ofcommunities before, during, and after weather/climate events?

4. Have there been any interventions or assistance rendered to vulnerable communities withinyour local council during and after weather/climate events?

5. Where did the interventions/supports come from?

6. In what form did the supports come?

7. Who were the beneficiaries of such interventions/supports?

8. Have there been any stakeholder meetings involving government officials and community leaders to discuss climate-related issues? If yes, please how often does this meeting take place?Who constitutes this forum? And what is discussed?

9. What are the outcomes of this type of meeting?

10. In what ways does this local government council support communities and households whoincur losses and damages during extreme weather events?

11. In what ways does this council encourage communities to prepare for future extremeweather/climate events?

Appendix 13: Participant information sheets for interview with Local Government Chairman

Dear Sir / Madam,

My name is Franklin Okoro and I am a PhD Student in Geography, Archeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake aresearch project, and I am investigating social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria under the supervision of Prof. Jasper Knight. The aim of this research project is to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resistance to climate change impacts by combining collective efforts and disaster risk reduction approach.

As part of this project, I would like to invite you to take part in an interview. This activity will involve answering questions and will take around 45 minutes. With your permission, I would also like to audio record the interview using a digital device. This recording will be stored in a device with strong password and only the researcher will have access to this recording. It will be deleted after 6 years.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for yourname or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stopthe interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in a device with strong password and will be destroyed after 6 years. If you have any concerns or complaints regarding theethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,
Franklin Okoro

Researcher:
Franklin Okoro, 2371090@students.wits.ac.za

Supervisor:
Prof. Jasper Knight, Jasper.Knight@wits.ac.za, +27(0) 11 717 1408

Appendix 14: Consent form for interviews with Local Government Chairman

Consent Form
Key informant interviews

Aim of the Research: This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience toclimate change impacts by combining collective efforts and a disaster risk reduction approach.

Researcher: Franklin Chimaobi Okoro

I, …….. agree to participate in this research project. The project has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous **YES NO**

I agree that the researcher may use anonymous quotes in his research report **YES NO**

I agree that the interview may be audio recorded **YES NO**

I agree that photographs may be taken **YES NO**

I agree that the information provided may be used anonymously after this project has ended, for academic purposes by other researchers subject to their own ethics clearance being obtained **YES NO**

Name of participant

……

Signature …….....

Date …….

Name of researcher

……

Signature …….

Date ……..

Appendix 15: Interview schedule for key informant interview with Traditional leaders

Interview schedule for key informant interview with Traditional leaders

This interview will last for about
45minutes.

1. In what ways do individuals interact with each other in your community?

2. How do you interact with government officials, Non-Governmental Organizations, and otherlocal stakeholders?

3. Where and how do you get weather/climate information?

4. How do you pass on this information to your community members?

5. Do you discuss climate change-related issues in traditional rulers' council meetings?

6. Have you or any other traditional ruler called for stakeholder meetings where issues of climatechange impacts were discussed? What were the outcomes of such meetings?

7. Tell me about weather/climate events usually experienced in this community.

8. Could you please tell me about supports received from the government, NGOs, Local stakeholders, or any other organization during weather/climate events that affected yourcommunity?

9. What type of support did your community receive?

10. How does this support benefit your community?

11. Does the government consult your leadership while making decisions that affect yourcommunity?

12. Does the government consult you during the formulation of climate change adaptationpolicies?

13. What do you suggest could be done to reduce the vulnerability of your community membersto extreme weather events?

Appendix 16: Participant information sheets for interview with traditional leaders

Dear Sir / Madam,

My name is Franklin Okoro and I am a PhD Student in Geography, Archeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake aresearch project, and I am investigating social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria under the supervision of Prof. Jasper Knight. The aim of this research project is to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resistance to climate change impacts by combining collective efforts and disaster risk reduction approach.

As part of this project, I would like to invite you to take part in an interview. This activity will involve answering questions and will take around 45 minutes. With your permission, I would also like to audio record the interview using a digital device. This recording will be stored in a device with strong password and only the researcher will have access to this recording. It will be deleted after 6 years.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for yourname or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stopthe interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in a device with strong password and will be destroyed after 6 years. If you have any concerns or complaints regarding theethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours
sincerely,
Franklin
Okoro

Researcher:
Franklin Okoro, 2371090@students.wits.ac.za

Supervisor:
Prof. Jasper Knight, Jasper.Knight@wits.ac.za, +27(0) 11 717 1408

Appendix 17: Consent form for interviews with traditional leaders

Consent Form
Key informant interviews

Aim of the Research: This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience toclimate change impacts by combining collective efforts and a disaster risk reduction approach.

Researcher: Franklin Chimaobi Okoro

I, …….. agree to participate in this research project. The project has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous **YES NO**

I agree that the researcher may use anonymous quotes in his research report **YES NO**

I agree that the interview may be audio recorded **YES NO**

I agree that photographs may be taken **YES NO**

I agree that the information provided may be used anonymously after this project has ended, for academic purposes by other researchers subject to their own ethics clearance being obtained **YES NO**

Name of participant

……

Signature …….....

Date …….

Name of researcher

……

Signature …….

Date ……..

Appendix 18: Interview schedule for key informant interview with Town union members

Interview schedule for key informant interview with Town union members

This interview will last for
45 minutes.

1. As a town union member, what efforts do you make to bring community members together?

2. How do town union members pass on information from stakeholder meetings to othercommunity members?

3. When something like weather/climate events happen in your community, what do you do as atown union member?

4. How do you interact with traditional leaders and government representatives on behalf of yourcommunity?

5. In what ways have you assisted vulnerable community members during weather/climateevents?

6. How does this community cope with extreme weather events?

7. What are the situations that could make your community members vulnerable toweather/climate events?

8. How do town union members assist in addressing those situations or challenges?

Appendix 19: Participant information sheets for interview with town union members

Dear Sir / Madam,

My name is Franklin Okoro and I am a PhD Student in Geography, Archeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake aresearch project, and I am investigating social vulnerability in the adaptation of rural communities to climate change in Imo State, Nigeria under the supervision of Prof. Jasper Knight. The aim of this research project is to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resistance to climate change impacts by combining collective efforts and disaster risk reduction approach.

As part of this project, I would like to invite you to take part in an interview. This activity will involve answering questions and will take around 45 minutes. With your permission, I would also like to audio record the interview using a digital device. This recording will be stored in a device with strong password and only the researcher will have access to this recording. It will be deleted after 6 years.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for yourname or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stopthe interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in a device with strong password and will be destroyed after 6 years. If you have any concerns or complaints regarding theethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours
sincerely,
Franklin
Okoro

Researcher:
Franklin Okoro, 2371090@students.wits.ac.za

Supervisor:
Prof. Jasper Knight, Jasper.Knight@wits.ac.za, +27(0) 11 717 1408

Appendix 20: Consent form for interviews with town union members

Consent Form
Key informant interviews

Aim of the Research: This research project aims to look into what makes rural communities vulnerable and evaluate the importance of using community social capital in improving resilience toclimate change impacts by combining collective efforts and a disaster risk reduction approach.

Researcher: Franklin Chimaobi Okoro

I, …….. agree to participate in this research project. The project has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous **YES NO**

I agree that the researcher may use anonymous quotes in his research report **YES NO**

I agree that the interview may be audio recorded **YES NO**

I agree that photographs may be taken **YES NO**

I agree that the information provided may be used anonymously after this project has ended, for academic purposes by other researchers subject to their own ethics clearance being obtained **YES NO**

Name of participant

……

Signature …….....

Date …….

Name of researcher

……

Signature …….

Date ……..

Appendix 21: Farm observation schedule

Farm observation schedule

Checklist to guide in the making of field notes:

1. Space: The physical place or places

2. Actor: The people involved in farming activities

3. Activity: a set of related acts farmers do

4. Object: the physical things that are present in the farmlands

5. Act: single actions that farmers do

6. Event: a set of related activities that farmers carry out to adapt to harsh weather conditions

7. Goal: The things rural farmers are trying to accomplish

9. Feeling: the emotions felt and expressed during farming activities

Appendix 22: Farmers group discussion schedule

Interview Schedule for Farmers' Group Discussion

This discussion will last for about 45 minutes.

1. As a group of farmers, how do you interact with each other in your community?

2. Do you cooperate to share things like seeds, fertilizers, farm tools, and others?

3. What links exist between farmers in your community and farmers in other communities?

4. How do you interact with extension workers and stakeholders in this community?

5. How do you interact with people who sell seeds to you, shop owners, marketers, and livestock owners?

6. How often do you interact with them?

7. What are the outcomes of these interactions?

8. Tell me about any new training you had. Who gave the training and what was it for?

9. When was this training organized? How was it conducted and why?

10. How has this training helped you to improve in your farming activities?

11. Tell me about the weather events you often experience in this community?

12. If there is a flood, drought, excess rainfall, or heat wave, how does it affect your crops?

13. How does this weather event affect your planting system?

14. Which section of your farm is affected the most?

15. How do you cope with extreme weather events?

16. Can you describe to me the ways you might use your local knowledge like changing planting days, types of crop, cultivation/tillage systems to cope with climate change?

17. Compare these traditional methods to conventional methods.

18. Tell me about your challenges in coping with extreme weather events in this commu

Appendix 23: Field assistants' confidentiality agreement form

CONFIDENTIALITY AGREEMENT

This agreement is to acknowledge that the information provided by research participants during the data collection process on the research titled **"Social vulnerability in adaptation to climate change in rural communities in Imo state, Nigeria"** is confidential. Therefore, research assistants and translators involved in the handling of data agree not to disclose any of the information provided without the express permission of the researcher and research participants.

Name of Researcher: ……..
Signature: ……
Date: …….

Name of Research Assistant/Translator: ……
Signature: ……...
Date:……