FACULTY OF HUMANITIES AND SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY

DOCTORAL SCHOOL OF ARTS AND HUMANITIES

West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)

DOCTORAL PROGRAMME « *Climate Change and Disaster Risk Management* »

FLOOD RISK AND FARMING HOUSEHOLDS' DECISION-MAKING TO FLOOD DISASTERS IN KOGI STATE, NIGERIA



A Thesis submitted in partial fulfilment of the requirements for the degree of
DOCTOR OF PHILOSOPHY in Climate Change and Disaster Risk Management

Presented and publicly defended by:

Peter Boluwaji OYEDELE

Under the supervision of:

Edinam KOLA
Professor of Geography, Université de Lomé, Togo

And co-supervision of:

Felix OLORUNFEMI
Professor of Geography and Environmental Management,
Nigerian Institute of Social and Economic Research (NISER) Ibadan, Nigeria

Dr. Yvonne WALZ
Institute of Environmental and Human Security, United Nations University, Bonn, Germany

Members of the jury:

President : Professor **Kouami KOKOU,** Université de Lomé, Togo
Rapporteurs : Professor **Edinam KOLA,** Université de Lomé, Togo
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Dr. **Yvonne WALZ,** UNU Bonn, Germany
Examiners : Professor **Euloge OGOUWALE**, Université d'Abomey-Calavi, Bénin
Associate Professor **Koko Zébéto HOUEDAKOR**, Université de Lomé, Togo

Lomé, 10 May 2023.

WASCAL
West African Science Service Centre on Climate Change and Adapted Land Use

Federal Ministry of Education and Research

Université de Lomé

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SUMMARY

DEDICATION

To

GOD ALMIGHTY, the all sufficient, and giver of knowledge,

Queen, Esther Bolanle OYEDELE, my beautiful wife,

Boluwatife, Bobola, and Bolarinwa OYEDELE, my lovely children and strengths

I dedicate this Ph.D. Thesis

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It is my prayer that the Almighty God will reward all of you abundantly (Amen).

LIST OF ABBREVIATIONS AND ACRONYMS

IPCC	: Intergovernmental Panel on Climate Change
UNISDR	: United Nations Office for Disaster Risk Reduction
UNFCCC	: United Nations Framework Convention on Climate Change
COVID-19	: Coronavirus Disease 2019
FGN	: Federal Government of Nigeria
CRED	: Centre for Research on the Epidemiology of Disasters
EM-DAT	: Emergency Events Database
WMO	: World Meteorological Organization
NISER	: Nigerian Institute of Social and Economic Research
DMSG	: Disaster Management Support Group
GHG	: Greenhouse Gas
NEMA	: National Emergency Management Agency
HFA	: Hyogo Framework for Action
FVI	: Flood Vulnerability Index
LGA	: Local Government Area
GIS	: Geographic Information System
AHP	: Analytical Hierarchy Process
SDG	: Sustainable Development Goal
UN	: United Nations
AIDS	: Acquired Immunodeficiency Syndrome
HIV	: Human Immunodeficiency Virus
USA	: United States of America
DRM	: Disaster Risk Management
CCA	: Climate Change Adaptation
ERCC	: Emergency Response Coordination Centre
RN	: River Niger
RB	: River Benue
PDNA	: Post-Disaster Needs Assessment
FAO	: Food and Agriculture Organization
NiMet	: Nigerian Meteorological Agency
SEMA	: State Emergency Management Agency
FGD	: Focus Group Discussions
TW	: Transect Walk
LARDYMES	: Laboratoire de Recherche sur la Dynamique des Milieux et des Sociétés
GPS	: Global Positioning System
NACETEM	: National Centre for Technology Management
NIWA	: National Inland Waterways Authority
PRA	: Participatory Rural Appraisal
NGO	: Non-Governmental Organization
IFRC	: International Federation of Red Cross and Red Crescent Societies
IDP	: Internally Displaced Persons
DEM	: Digital elevation model
USGS	: United States Geological Survey
NASA	: National Aeronautics and Space Administration
CGIAR	: Consultative Group on International Agricultural Research
SRTM	: Shuttle Radar Topography Mission
NPC	: Nigerian Population Commission
KSADP	: Kogi State Agricultural Development Programme
NASRDA	: National Space Research and Development Agency

ABSTRACT

In West Africa, the impacts of flooding are becoming more severe with climate warming. Flood-prone communities in Kogi State in north-central Nigeria are affected by annual flooding and some extreme flood events. The negative impacts remain a major obstacle to development, environmental sustainability, and human security, exacerbating poverty in the region. Within these contexts, the research critically assesses the vulnerability of households to flooding. Also, it explores households' perception of flood risk, examines the realities and dynamics of adaptation measures employed by households to face floods, and sought to understand the factors and processes that motivate them in deciding to leave or live in flood-prone areas. The study was conducted purposively in 8 local government areas of the State with cases of flood disaster, to evaluate the flood vulnerability of the population using the Improvement of Vulnerability Assessment in Europe (MOVE) framework. Following this framework, extensive literature review was conducted to develop relevant proxy indicators. Structured questionnaires were used for household surveys to collect data from 400 households in twenty selected communities through purposive sampling methods. These communities were selected purposely because they were reported to be submerged in flood water during the year 2019 disastrous flood events in Kogi State which caused significant damage. The vulnerability factors, exposure, susceptibility, and lack of resilience as well as the overall vulnerability were calculated and compared using the QGIS tool. The study also uses in-depth interviews, participant observation, and 4 focus group discussions with the respondents. Findings show that firstly, the overall vulnerability and the factor of the vulnerability of the studied locations were very high. Susceptibility and exposure factors were found to greatly influence vulnerability, and communities had a high lack of resilience in the face of flood hazards. Thirdly, the results show that farming households are not willing to abandon their land and relocate to the upland because floods were indicated as part of their lives and livelihood strategies. These decisions were largely influenced by the cultural and economic importance of households derived from flood-prone areas. The findings of this study recommend the need to generate flood disaster awareness among the vulnerable populations exposed to flooding through community programs, support them to implement flood preparation and mitigation measures, as well as bridge the gap between local administration and the public by adopting a humanistic approach, which will enable collaborative efforts for effective flood risk reduction/management and increase flood resilience. When and where the resettlement scheme proves very difficult due to strong cultural attachment, flood prevention mechanisms via engineering construction such as dykes, embankments, and ditches should be adopted.

Keywords: Vulnerability, flood, adaptation, perception, resilience, Kogi State, Nigeria

RÉSUMÉ

En Afrique de l'Ouest, les conséquences des inondations s'aggravent avec le réchauffement climatique. Les communautés exposées aux inondations dans l'État de Kogi, dans le centre-nord du Nigeria, sont touchées par des inondations annuelles et des inondations extrêmes. Les impacts négatifs restent un obstacle majeur au développement, à la durabilité environnementale et à la sécurité humaine, exacerbant la pauvreté dans la région. Dans ce contexte, la recherche évalue de manière critique la vulnérabilité des ménages aux inondations. Elle explore également la perception du risque d'inondation par les ménages, examine les réalités et la dynamique des mesures d'adaptation employées par les ménages pour faire face aux inondations, et cherche à comprendre les facteurs et les processus qui les motivent à décider de quitter ou de vivre dans des zones sujettes aux inondations. L'étude a été menée à dessein dans 8 zones de gouvernement local de l'État ayant connu des inondations catastrophiques, afin d'évaluer la vulnérabilité de la population aux inondations en utilisant le cadre MOVE (Improvement of Vulnerability Assessment in Europe - Amélioration de l'évaluation de la vulnérabilité en Europe). En suivant ce cadre, une analyse approfondie de la littérature a été menée pour développer des indicateurs de substitution pertinents. Des questionnaires structurés ont été utilisés pour les enquêtes auprès des ménages afin de collecter des données auprès de 400 ménages dans vingt communautés sélectionnées par des méthodes d'échantillonnage raisonné. Ces communautés ont été sélectionnées à dessein parce qu'elles ont été submergées par les eaux lors des inondations catastrophiques de l'année 2019 dans l'État de Kogi, qui ont causé d'importants dégâts. Les facteurs de vulnérabilité, l'exposition, la susceptibilité et le manque de résilience ainsi que la vulnérabilité globale ont été calculés et comparés à l'aide de l'outil QGIS. L'étude s'appuie également sur des entretiens approfondis, des observations participantes et quatre discussions de groupe avec les personnes interrogées. Les résultats montrent tout d'abord que la vulnérabilité globale et les facteurs de vulnérabilité des sites étudiés sont très élevés. Les facteurs de susceptibilité et d'exposition influencent grandement la vulnérabilité, et les communautés manquent cruellement de résilience face aux risques d'inondation. Troisièmement, les résultats montrent que les ménages agricoles ne sont pas disposés à abandonner leurs terres et à se réinstaller dans les hautes terres parce que les inondations font partie de leur vie et de leurs stratégies de subsistance. Ces décisions ont été largement influencées par l'importance culturelle et économique des ménages vivant dans des zones inondables. Les résultats de cette étude soulignent la nécessité de sensibiliser les populations vulnérables exposées aux inondations aux catastrophes par le biais de programmes communautaires, de les aider à mettre en œuvre des mesures de préparation et d'atténuation des inondations, ainsi que de combler le fossé entre l'administration locale et le public en adoptant une approche humaniste, ce qui permettra de collaborer à la réduction/gestion efficace des risques d'inondation et d'accroître la résilience face aux inondations. Lorsque le programme de réinstallation s'avère très difficile en raison d'un fort attachement culturel, il convient d'adopter des mécanismes de prévention des inondations par le biais de constructions techniques telles que des digues, des remblais et des fossés.

Mots clés : Vulnérabilité, inondation, adaptation, perception, résilience, État de Kogi, Nigeria.

GENERAL INTRODUCTION

The two interconnected 21st-century challenges are enhancing the quality of life for the most vulnerable people on the earth and stabilizing the planet's climate more sustainably. With varying degrees of impact around the world, climate change is becoming a global issue. According to the latest Intergovernmental Panel on Climate Change (IPCC) contributions of the working group two (WG II) to the sixth assessment report (AR6), "climate change is an unequivocal threat: it is already causing irreversible damage to our well-being and planetary health." (IPCC, 2022, p. vii). This support the earlier assertion of Shahi (2021) that climate change is killing and destroying people all around the world, and it will only get worse in the nearer future. In particular, climate change is increasing the risk of heavy rains, strong storms, rising sea levels, higher temperatures, and droughts (IPCC, 2022; Kola et al., 2019; Tullos, 2018).

Significant uncertainty within climate change projections presents problems for decision-makers and practitioners on how to deal with the threat of climate change (Reynard et al., 2017). Extreme weather events such as heat waves and floods have become more frequent and intense, bringing increasingly irreversible losses (IPCC, 2022). According to the World Meteorological Organization (WMO, 2021), climate change has made extreme rainfall events similar to those that triggered the floods more likely to happen and led to recent floods in Germany, Belgium, the Netherlands, and Luxembourg by a factor of between 1.2 and 9 times more likely to happen. These floods have shown us that even developed countries are not safe from the severe impacts of extreme weather that have been seen and are known to get worse with climate change.

Globally, rising flood risk is widely recognized as one of, if not the most serious threat(s) from climate change and mismanagement of natural resources coupled with rapid population growth in developing countries (Tullos, 2018). As the World Bank report observes, whenever disaster strikes, it leaves more than just a trail of devastation—it also leaves communities further in the grip of poverty (World Bank, 2016). Flood is widely regarded as the most frequent and devastating natural hazards in the world, leading to more significant economic and social damages than any other natural hazards (Nkeki et al., 2013). Flooding has become a major issue of global concern threatening human security especially sustainable food production (Nathaniel et al., 2019). Floods are wrecking threats not only to the life of the individuals but also result in long-term destruction to the economy, environment, and psychological state of the affected individuals (Aldardasawi & Eren, 2021).

The United Nations Disaster Risk Reduction (UNDRR) compiled the human cost of disasters in the last 20 years (2000-2019). According to the report, there were 7,348 major disaster events claiming 1.23 million lives, affecting 4.2 billion people (many on many occasion) resulting in approximately US$2.97 trillion in global economic losses. Furthermore, the last twenty years have seen the number of major floods more than double, from 1,389 to 3,254, while the incidence of storm are from 1,457 to 2,034. Hence, floods and storm were the most prevalent events as noted in the report (Cred, U.N.D.R.R., 2020). This is an urgent global challenge that needs urgent attention in other to safeguard the environment and therefore make it habitable for all. In recent times, the phenomenon has also ravaged parts of Africa with its attendant food shortages due to production failures. This in part may be why natural disasters alone push 26 million more people around the world into poverty each year (World Bank, 2016).

Kousky and Shabman (2015) assert that these choices were chosen as a result of a variety of interrelated factors, one of which being the possibility of flooding and other disasters. For example, residents of flood-prone areas make the decision to settle down in such areas despite the challenges being faced as a result of flooding owing to their high exposure and vulnerability nature to hazardous, floods. Poor people around the world live in homes that are vulnerable to disaster (World Bank, 2016). In the more than 200 countries for which data are included in the report, the poorest 20 percent of people in terms of consumption are 1.8 times more likely to live in fragile homes (Hallegatte et al., 2017).

Similarly, Fothergill and Peek (2004) established between disaster risk and the perception of an individual. They found that people who were poorer and with lower incomes perceived more risk and felt more concern regarding both natural and technological disasters. This implies from their research that poverty is a factor that too is considered in the perception of risk. In the (World Bank, 2016) report, it was concluded that people in poverty around the world are more likely than others to live in areas at high risk of disaster impacts. According to Hallegatte et al. (2017), natural disasters make it more likely that people in poverty will remain in poverty, especially when there are no ways of overcoming such financial challenges in terms of capacity to recover from disastrous conditions. Socio-economic constraints or setbacks of people can ultimately influence the decision of an individual to react and respond to disaster risk. In other words, socioeconomic status should be considered as a possible contributor to, and predictor of, how risks are perceived and interpreted by people (Fothergill & Peek, 2004).

Risk perception and risk-related behaviour can amplify the social, political, and economic impact of disasters far beyond their consequences (Burns et al., 2012). How people (households, businesses, governance bodies, etc.) perceive and understand flood risk shapes the judgments or better the decisions they make and the actions they take in preparing for and responding to flood events (Birkholz et al., 2014). The perception of flood risks and the resulting behavioural motivations have been recognized for some time as crucial factors in the development of effective flood management strategies and the resilience of communities to floods (Birkholz et al., 2014).

West Africa, like the rest of the world, is also affected by many natural disasters that have increased in frequency and intensity in recent decades (Defrance et al., 2017; IPCC, 2012a). Floods, droughts, disruption of rainy seasons, strong coastal erosion along the entire coastline, and heat waves are the most tangible extreme weather events affecting West African populations (Ayodotun et al., 2019). According to the United Nations International Strategy for Disaster Risk Reduction (UNISDR, 2012), natural disasters such as droughts and floods have affected more than 34 million people in all of Africa, including 19 million in West Africa in 2012. The number of people affected by floods in West Africa increased significantly between the years 2007 and 2012 and a dozen countries in West Africa are suffering from severe floods that killed more than 159 people and affected nearly 600,000 people in 2012 according to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA, 2012). On the account of reports from the Emergency Events Database (EM-DAT, 2013), countries in many of West Africa including Ghana, Togo, Nigeria, Burkina Faso, Senegal, Benin, and Cote d'Ivoire have suffered from negative impacts of devastating flooding in their respective major cities and rural areas.

With the high vulnerability of West Africa to natural hazards and disasters, which cause loss of life, destruction of infrastructures, and damage to our ecological systems, climate change is expected to exacerbate the impacts of these problems (Adeoye et al., 2009). The repercussions of frequent and severe droughts and floods are substantial enough to undermine development efforts and reverse gains gained thus far on the African continent, which contributes comparatively little to greenhouse gas (GHG) emissions and where most economies are built on rain-fed agriculture (Fineberg, 2018).

Vulnerability to extreme climatic change in Nigeria is becoming more intense as accelerated urbanization continues to push more people into the capital cities in different regions of the country (Durodola, 2022). Nigeria has reported some fatal flooding events within the Western African domain such that Cirella and Iyalomhe (2018) opined that the overwhelming consequences of the flood disasters, the actual figures for dislodgement, and the overall casualty could not be genuinely ascertained. In Nigeria, aside from droughts, floods cause almost 90% of damages resulting from natural hazards (Adeoye et al., 2009). Flood menace in Nigeria has become a normal and re-occurring phenomenon that sometimes has devastating impacts[1] on human livelihoods and infrastructural development (Agbonkhese et al., 2014). Floods have broad impacts not only socially and economically but also on the environment. Floods affect the agricultural sector[2] by causing over-saturation, infertility, and soil erosion, damaging the crop fields, especially the winter crops (Aldardasawi & Eren, 2021).

Flood does not only damage properties and endanger the lives of people and animals; it equally leads to environmental degradation in the form of soil erosion, landslides, sediment deposition, and the destruction of fish spawning substrates. As noted by Aja and Olaore (2014), the majority of Nigeria's states are increasingly suffering from annual flooding during the rainy seasons caused by increased precipitation linked to climate change. Rapid population growth, poor governance, extreme rainfall, drainage blockage, dam failures, poor facilities, decaying infrastructures, lack of proper environmental planning and management strategies, the poor practice of dumping waste/refuse, and climate change coupled with inadequate preparedness have been traced among others as the major causes of flooding in Nigeria (Agbonkhese et al., 2014; Jeb & Aggarwal, 2008). As a result, more than 700,000 hectares of arable land and built-up areas are damaged, there has been an incidence of high spread of diseases, loss of thousands of lives and properties worth billions of naira were being destroyed (Agbonkhese et al., 2014; Jeb & Aggarwal, 2008; NEMA, 2018). Other recorded damages include the destruction of schools, houses built with mud brick

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[1] Thirteen states of Benue, Borno, Delta, Ebonyi, Lagos, Imo, Jigawa, Kano, Katsina, Oyo, Sokoto, Taraba and Yobe reported incidents of flooding in the month of August, 2011, of these thirteen states, Nine (Zamfara, Oyo, Delta, Ebonyi, Borno, Imo, Taraba, Yobe and Benue) were the worst hit having higher number of casualties as reported in the National Early Warning System (NEWS). The flood claimed about one hundred and forty lives with thousands displaced and properties worth millions of Naira destroyed, sadly children and the elderly accounted for a larger percentage of the dead from the flood (Agbonkhese et al., 2014, p. 34)

[2] The upper fertile soil layer of the cultivable land is washed off with the high-speed flow of the flooding water. The productivity of such agricultural lands is reduced by 40 percent (Aldardasawi & Eren, 2021, p. 44)

and other traditional building materials, bridges, markets, and the washing away of agricultural lands (Adeoye et al., 2009).

The frequency and intensity of flooding in Nigerian cities are attributed to many factors. These include inadequate drainage, haphazard physical developments, and blockage of drainage channels by solid waste (Okunola, 2022). Population growth and the illegal erection of buildings and other structures are also cited. Additionally, a connection has been shown between rising flood frequency, vulnerability, people's choices to stay in flood-prone locations, and climate change. A combination of these challenges is a recipe for flood disaster communities in Nigeria as noted by Okunola (2022). For instance, individuals in households, businesses owners, and local government officials make decisions on how best they can put in use flood-prone areas. These uses may vary which may include for farmlands and farm settlements, the building of houses, companies, or recreational centers, among others.

In recognizing the fact that the risks associated with natural hazards and the threats to human security cannot be reduced by focusing solely on the hazards, on one hand, while people will continue to live with changing environmental conditions on the other hand, (Birkmann et al., 2013) reiterated the call made by the Hyogo Framework of Action (HFA) to build resilience by reducing vulnerability to natural hazards. According to Harvatt et al. (2011), flood management requires a careful combination of individual, community, and national action, and in the case of floods, the response needs to increase with repeated exposure, susceptibility, lack of resilience as well as the overall vulnerability are therefore essential to be investigated particularly in the riverine communities of Kogi State where, flooding has become a yearly events among the people. Understanding the factors that influence people perception of risk, behaviour as well as their decision to remain or settle in flood prone areas, is a worthwhile effort so as to reduce the negative effect of flooding not only the lives and livelihoods but also on the environment. This then, becomes the crux of the current research.

Firstly, this assessment will help in identifying farming communities and areas that are prone to flood. Secondly, it will provide a basis for planning and help in preventing development in risky zones. Thirdly, flood vulnerability assessment provides an understanding of the nature of the flood, its impacts as well as the coping and adaptive capacity of affected communities, which will help in designing the appropriate flood-related climate change adaptation policies and strategies. Lastly, flood vulnerability assessment provides a comparison among flood-prone communities via ranking, which is crucial in identifying communities whose capacity and resilience building must be prioritized. In addition, the study aims to analyse the perception of the farming households as they decide to either quit or reside in an identified flood-prone area and also to document their means of adaptation measures in response to frequent flood incidents.

Against this background, the thesis is structured around two main parts, each part is subdivided into three different chapters and presented as follows:

The first part presents the “conceptual and methodological framework” of the research consist of three chapters. Chapter 1, titled "background and statement of research problem". Chapter 2 focuses on the conceptual, theoretical, and review of relevant literature. Chapter 3 presents the “description of the study area and research methodology”. This was followed by conclusions.

The second part of the thesis tagged “results and discussion” is made up of three chapters with each presenting the result of the analysis of set objectives for the study. Chapter 4 title: “vulnerability of farm households in Kogi communities to flooding”. Chapter 5 is “households’ socio-demographic characteristics and perception of flood risk”. Chapter 6 presents: “households’ adaptation strategies and decision-making to flood disasters”. Finally, it ended with general conclusions and relevant recommendations from the study.

PART ONE: CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

INTRODUCTION TO PART ONE

This first part of the work is devoted to the presentation of the conceptual, methodological, and geographical framework of the study area. It first describes the statement of problem and justification of the study, research questions, general and specific objectives for the study, the research hypotheses, and a theoretical framework that was developed around the clarification of concepts, the literature review, and a partial conclusion.

Chapter 1 presents on the analysis and documentation of people's vulnerability to annual flooding with its gross negative consequences and the factors influencing their decision to remain in the inundated places remain the backbone of this study. In the first step, which was to understand the problem relating to flooding in the areas, the problematic was established, enriched, oriented, and developed. These helped in putting the research topic into perspective and allowed the development of relevant research questions, statements of objectives, and hypotheses to give them full significance.

Chapter 2 focuses on the definition and clarification of relevant concepts in relation the flooding, vulnerability, resilience, issues of adaptation, and many more. This was followed by a detailed review of the literature, to understand what has been done by previous authors, how it was done, and what they were able to achieve. These were found important for the understanding of the topic. This chapter enumerates, describes, summarizes, objectively evaluates, and clarifies this previous research on the topic comprehensively. This was achieved through the use of scholarly articles, books, and sources relevant to the subject of flood, vulnerability, and perception studies.

Chapter 3 documented the methodological approaches to the study. All scientific research is based on an appropriate methodological approach, the choice of which depends on the objectives pursued the context and the specificities of the field. In particular, this methodological approach extensively describes the research documentary process, data and information collected, methods of data collection, survey data collection methods, data processing analysis methods, difficulties encountered, and partial conclusion. Conclusions, which sum up all the points and discourse highlighted in the three chapters were used to end this part.

CHAPTER ONE

BACKGROUND AND STATEMENT OF PROBLEM

Introduction

All scientific inquiries begin with the identification of the root cause of any problem under investigation and the extent to which the issue has already been thoroughly explored in prior studies. Taking careful note of what was and what is, to identify the gap that the current study aims to fill. The knowledge base of the study is the first thing addressed in this chapter. In addition, it contains the rationale of the study, the key statement of the research problem and justification, general and specific objectives that were addressing the identified research problems, and research questions. It also presents the overall and specific hypotheses of the study. The plan of the thesis was documented followed by following a conclusion to this chapter.

1.1. Background

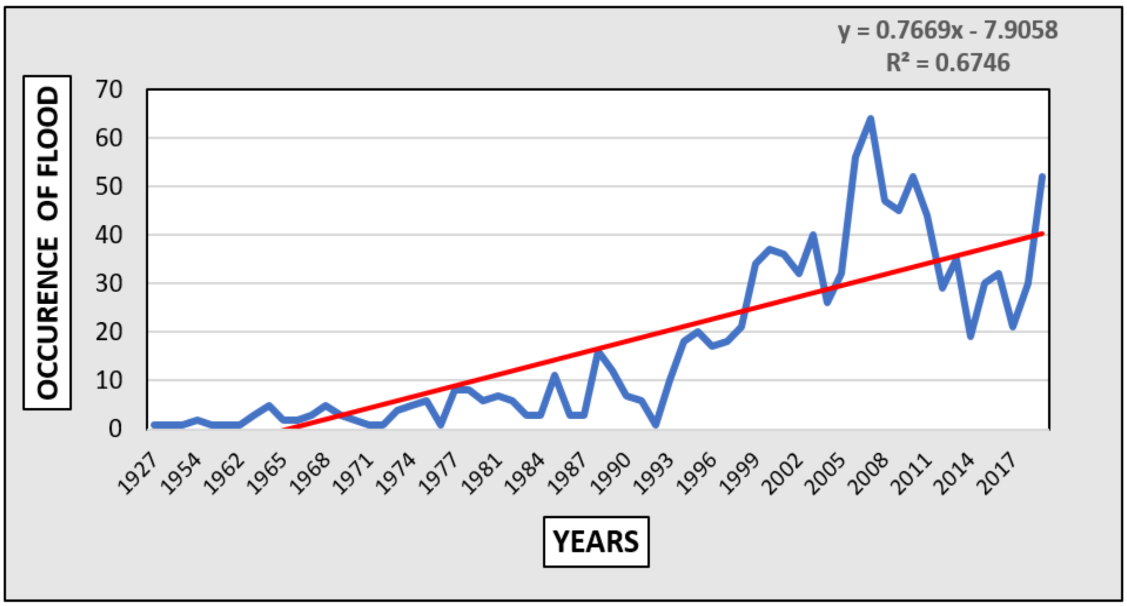
The Intergovernmental Panel on Climate Change (IPCC WGII AR5) revealed that the potential climate changes are expected to cause a rise in the frequency as well as, the intensity of rainfall, which may lead to a more widespread and severe natural disaster (van der Geest & Warner, 2020). The likelihood that extreme rainfall events like those that caused the floods will occur has increased by a factor of between 1.2 and 9 times due to climate change, according to the World Meteorological Organization (WMO, 2021). These events have caused recent floods in Germany, Belgium, the Netherlands, and Luxembourg (WMO, 2021). These floods have demonstrated to us that even industrialized nations are not immune to the devastating effects of extreme weather, which have already been observed and are predicted to become more often due to climate change.

According to reports, urban floods have affected the majority of the world's countries in the past ten years, including the USA, Europe, Asia, and Africa (Balica et al., 2009; Depietri et al., 2012;

Sané et al., 2015). Urban floods are frequently linked to risks in the developed world, including climate change, storm surges, flash floods, and a string of severe precipitation (UNISDR, 2015a). However, Zhou (2014) pointed out that in addition to the aforementioned factors that are prevalent in developed nations, flooding in developing countries is also a result of the fragility of the drainage system, the neglect of infrastructure, and the improper waste management of household waste.

According to EM-DAT, (2019), there is an upward trend of flood event occurrence in Africa[3] with huge damage to the population[4]. The trend of the flood event in Africa is shown in Figure 1.

Figure 1: The trend of flood in Africa



Source: EM-DAT, (2019)

West Africa is part of the regions most affected by the flood event over the continent. In this zone, flood count for 64% of disaster events from 2000-2019 and represent the deadliest disaster type after the drought (EM-DAT, 2019). In their work, Komi et al. (2016) noted that flood damage in

[3] Some analyses suggest that the population at risk of increased water stress in Africa is projected to be 75–250 million by the 2020s and 350–600 million by the 2050s (Hope, 2009, p. 456).

[4] At the peak of the disaster, 345,273 people were internally displaced, numerous building and industries were fully or partially submerged for more than four (5) months (Aderoju et al., 2014).

West Africa has increased appreciably during the last two decades. Various climate projections over West Africa indicated an exacerbating occurrence of flood events in the future (Adegoke et al., 2019). Therefore, in Africa, the floods hazards are likely to exacerbate due to the rapid growth in population and the Intergovernmental Panel on Climate Change (IPCC) has opined that “Sub-Saharan Africa has experienced more frequent and intense climate extremes in previous decades as a result of climate change, a trend that is likely to continue as the impacts of climate change intensify (EM-DAT, 2019).

For Adeoye et al. (2009), the increasing climate change, accompanied by excessive rainfalls and its devastating consequences remains indelible in the lives of many people and the environment. This is unmistakable to say that prolonged rainfall events are the most common causes of flooding worldwide and their impacts are obvious all over as noted by Komolafe et al. (2015). Any increase in disasters, whether large or small, will threaten development gains and hinder the implementation of the Sustainable Development Goals (UNISDR, 2015a). Despite its middle-income status, the incidence of poverty in Nigeria is high compared to its neighbors, with increasing population growth and expansion of settlements making the country highly vulnerable to climate change and as such being classified as one of the ten most vulnerable countries in the world, according to the 2017 Climate Change Vulnerability Index (Rentschler & Salhab, 2020).

There is no doubt that weather-related events such as floods are increasing both in frequency and intensity (Kron, 2014) due to worsening hazards related to urbanization and the effects of uncertainties of climate change (Kundzewicz et al., 2017). Climate change is likely to increasingly affect hydrological regimes and flood hazards over the coming decades (Meresa et al., 2021). Floods remain one of the most recurring and devastating natural hazards, impacting human lives and causing severe economic losses worldwide[5] (Khan et al., 2011; Komi et al., 2016; Rentschler & Salhab, 2020; Walz et al., 2021). Nigeria has also recently experienced recurrent flooding that has cost lives and property (Rentschler and Salhab, 2020).

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[5] Floods cause about one third of all deaths, one third of all injuries and one third of all damage from natural disasters (Ozim et al., 2021).

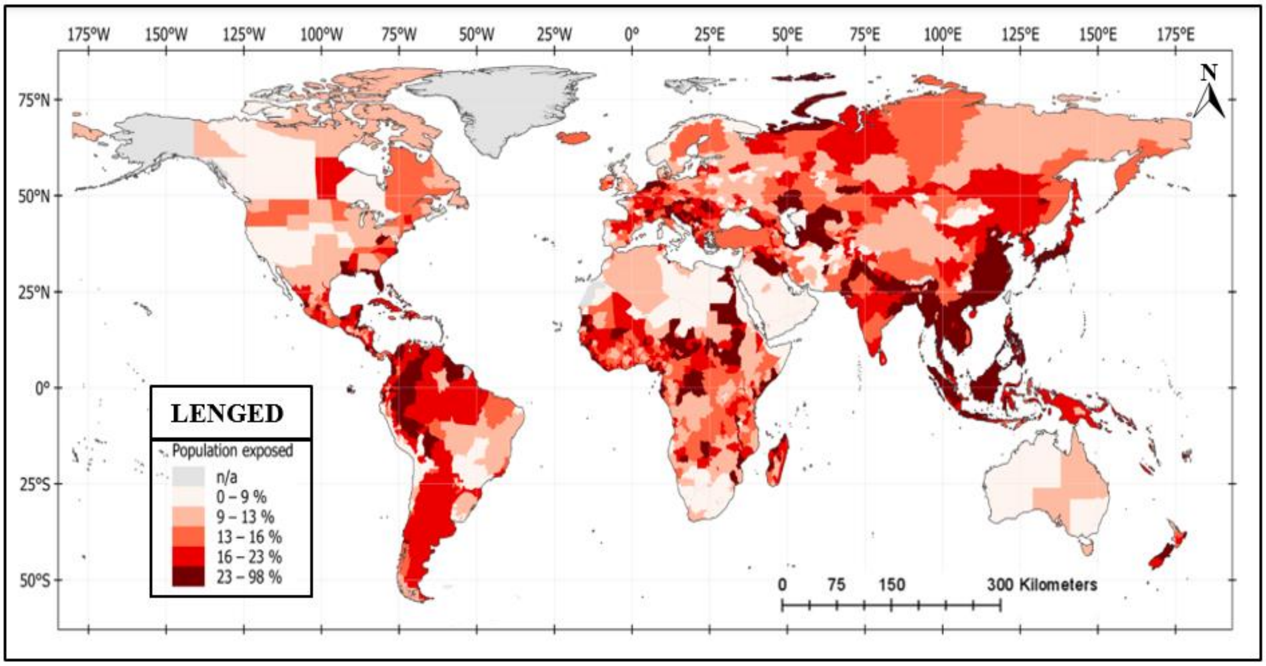
The phenomenon has also ravaged parts of Africa with its attendant food shortages due to production failures. According to reports from the Emergency Events Database (EM-DAT, 2013), several West African nations, including Benin, Burkina Faso, Cote d'Ivoire, Ghana, Nigeria, Senegal, and Togo, have been adversely affected by disastrous flooding in both their urban and rural areas. Climate change is predicted to worsen the effects of these issues due to West Africa's high vulnerability to natural hazards and disasters, which destroy infrastructure and harm our ecological systems[6] (Adeoye et al., 2009; Walz et al., 2021).

1.2. Statement of the problem

Globally, floods remain one of the most recurring and devastating natural hazards, impacting human lives and causing severe economic damage throughout the world (Khan et al., 2011; Komi et al., 2016; Rentschler & Salhab, 2020). According to Rentschler et al. (2022), flood is among the most prevalent natural hazards, with particularly disastrous impacts in low-income countries. Flood risks are also driven by socioeconomic change, as the number of people, assets, and value of economic activities increase over time (Winsemius et al., 2016). Recent disastrous floods in countries as diverse as Nigeria, Bangladesh, Vietnam, the United States, and the United Kingdom illustrate that the threat is a global reality (Rentschler et al., 2022, p. 2). Map 1 shows the percentage of population exposed to flood risk across the globe.

[6] The 2010 flood events rampaged over 8 communities in Togo, caused great negative impacts on human security and resulted in a total cost of damages and losses of over US$ 38 million (Ntajal et al., 2017)

Map 1: The percentage of the population exposed to flood risk globally

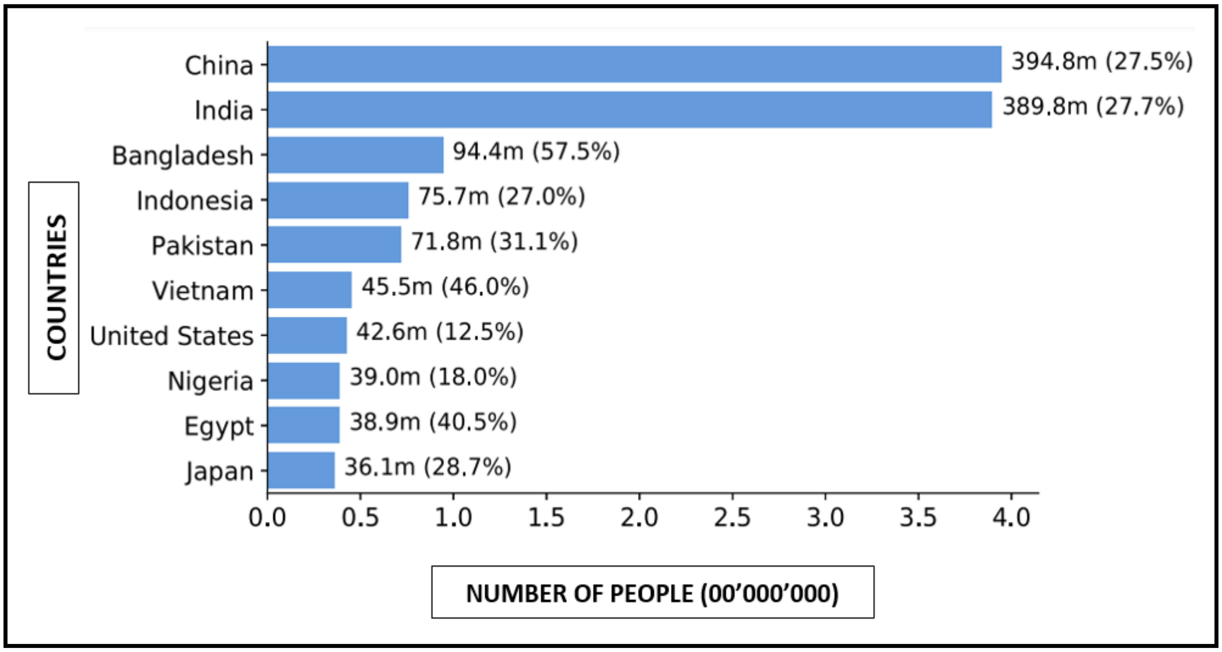


Source: Rentschler et al., 2022, p. 4

From the figure, it is evident that flood is truly a global issue as it affects populations across all the continents as stated by researchers (Kron, 2014). More populous countries are more likely to have large numbers of people living in direct exposure to flood risk. The two most populous countries, India and China, have the highest absolute exposure headcounts with 390 million and 395 million, respectively, and account for about one-third of all people exposed to flood risk globally (Rentschler et al., 2022, p. 3).

Komi et al. (2016) noted that in West Africa, poor communities are more at risk due to the vulnerability of their livelihoods, especially in rural areas where access to services and infrastructures is limited. Moreover, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) observed a trend of more frequent occurrences of river floods in West Africa since the 1980s and projected increased monsoon precipitation coupled with a delayed onset and retreat for the future (IPCC, 2021). Figure 2 shows the countries of the world that are home to the largest exposed population to flood risk.

Figure 2: Top 10 Countries showing the number of people exposed to high flood risk

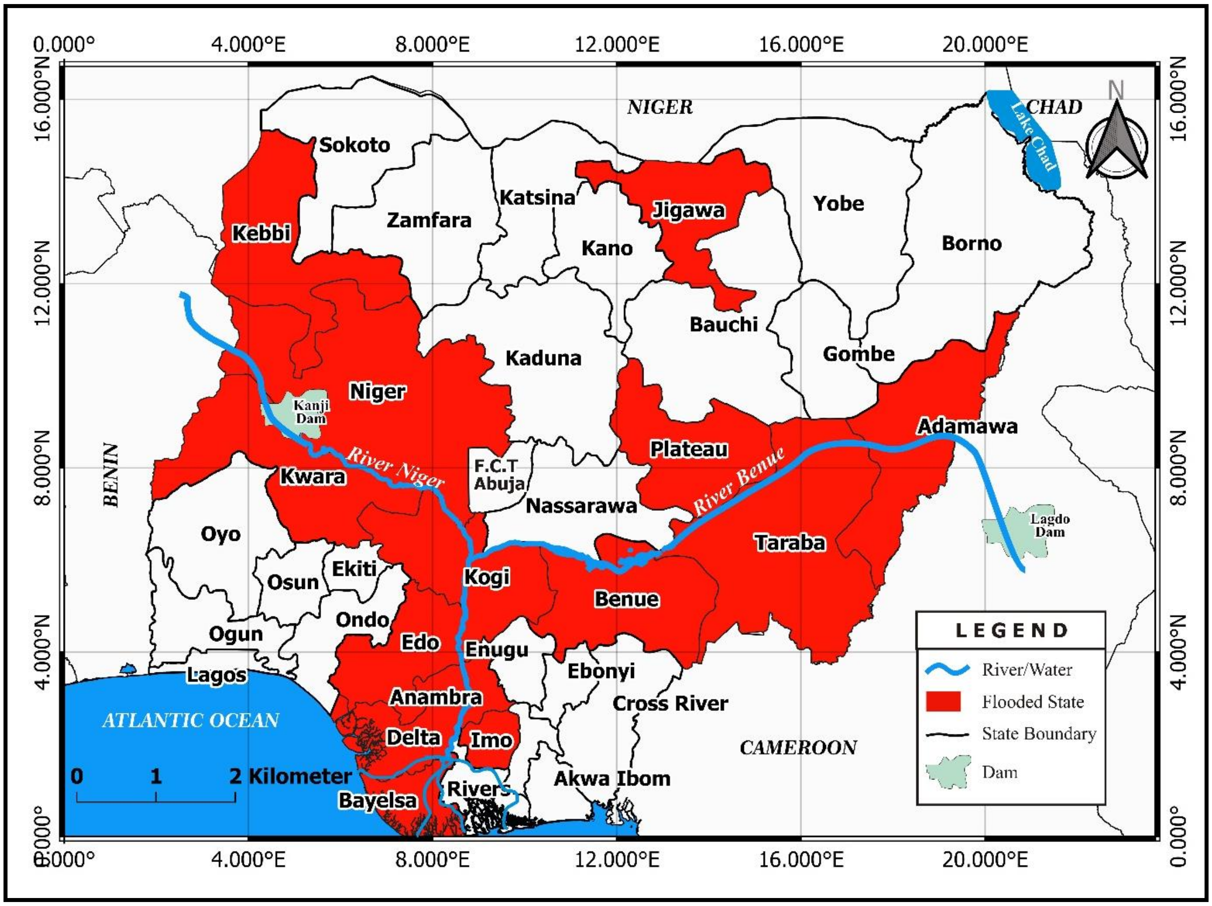


Source: Rentschler et al., 2022, p. 5

From Figure 3, Rentschler et al. (2022) revealed that Nigeria remains one of the top 10 countries in terms of absolute exposure headcounts feature countries in which large population groups are exposed to flood risk. With low capacity and poor infrastructural design, the nation will continue to face the impacts of flooding. Hence, an indication of the need to urgently give priority to the region for flood mitigation measures to support resilient development among the population.

Nigeria has experienced devastating floods which affected millions of people and resulted in financial losses amounting to billions of US dollars (National Emergency Management Agency [NEMA], 2013). Aside from droughts, flooding in Nigeria caused almost 90% of damages resulting from natural hazards (Adeoye et al., 2009). According to the National Emergency Management Agency (NEMA), the 2012 flood events experienced by Nigeria remain the worst flooding in over forty years. The incidence was considered severe as it affected 14 states of the federation (NEMA, 2012). Several communities in different local government areas (LGAs) of the States were affected (Map 2).

Map 2: Nigeria map showing the most affected State by the 2012 flood event

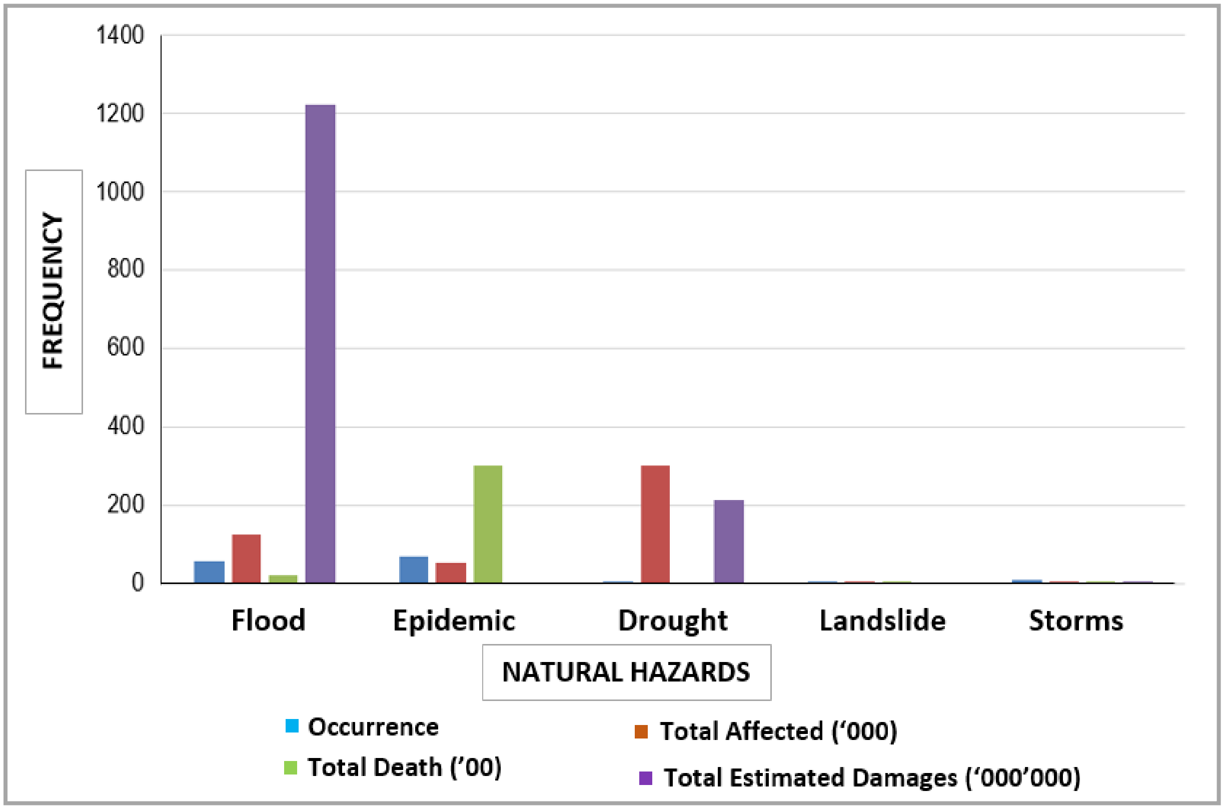


Source: Author 2022, Adapted from NEMA, 2012

The affected States as reported were flooded as a result of heavy rainfall that lasted several days and the release of water from the Lagdo dam (Cameroon) and Kanji dam (Niger State) into Rivers Benue and Niger respectively as rightly displayed in the map. Furthermore, the National Emergency Management Agency estimated that a total of N2.29 trillion which represents 2.83 percent of the rebased Gross Domestic Product of N81 million for 2013 was lost as a result of the floods (Nemine, 2015). The vulnerability of Nigerian cities to hazards is compounded by uncontrolled urbanization, widespread urban and rural poverty, degradation of the environment resulting from the mismanagement of natural resources, weak socio-economic infrastructure, and inefficient public policies (Olorunfemi, 2009).

According to the Centre for Research on the Epidemiology of Disasters database (EM-DAT), flooding is the second most occurring natural hazard, after epidemics (EM-DAT, 2013). From the database of the EM-DAT, natural hazards in Nigeria between 1969 and 2022 were assessed and documented as displayed in Figure 3.

Figure 3: Natural hazards in Nigeria from 1969 to 2022



Source: Authors' construct with data from EM-DAT, CRED database, 2022

According to observed data, it was noted that in terms of fatality, flood events are the highest when compared with all other hazards such as epidemics, drought, landslides, and storms. Floods accounted for about 2,030 deaths, an estimated damages of about one hundred and twenty-two million US dollars (US$122 million) in monetary value, and about 1,260,000 people were affected between 1969 to 2022.

The frequency and intensity of disasters arising from floods have increased significantly in recent years in Nigeria (NEMA, 2013). These floods have resulted in devastation and economic damages worth billions of dollars. NEMA disclosed that the comprehensive Post Disaster Needs Assessment conducted from November 2012 to March 2013 put the estimated combined value of damages and losses resulting from the 2012 flood disaster at US$16.9 billion. The disaster, which resulted in 363 deaths, affected seven million people, displaced 2.3 million others and damaged 597,476 houses (FGN, 2013). Table 1 summarises the affected LAGS, households, and population.

Table 1: LGAs, households, and population affected by 2012 flood disasters in Nigeria

S/N	Affected states	Total population (2012)	Number of LGAs per state	The total population in affected LGAs	Number of LGAs affected	Total affected population in LGAs	Number of affected households
1	Adamawa	3,764,021	21	1,470,990,	9	189,706	27,101
2	Anambra	4,932,272	21	1,177,199	8	89,909	12,844
3	Bayelsa	2,023,760	8	1.770,790	7	387,360	55,337
4	Benue	5,040,516	23	1,497,707	5	62,303	8,900
5	Delta	4,950,041	25	2,359,262	13	483,517	69,074
6	Edo	3,774,746	18	838,832	4	20,505	2,929
7	Imo	4,752,575	27	388,343	2	1,587	227
8	Jigawa	5,166,630	36	3,564,528	18	491,843	70,263
9	Kebbi	3,890,292	21	2,654,871	14	362,355	51,765
10	Kogi	3,916,641	21	1,641,503	9	199,511	28,502
11	Kwara	2,832,619	15	521,215	3	12,468	1,781
12	Niger	4,832,087	25	2,452,419	15	248,934	35,562
13	Plateau	3,728,276	17	1,304,916	8	123,316	17,617
14	Taraba	2,733,504	16	1,025,064	6	96,100	13,729
Total		**56,337,980**	**294**	**19,425,859**	**121**	**2,769,414**	**395,631**

Source: NEMA in FGN, 2013

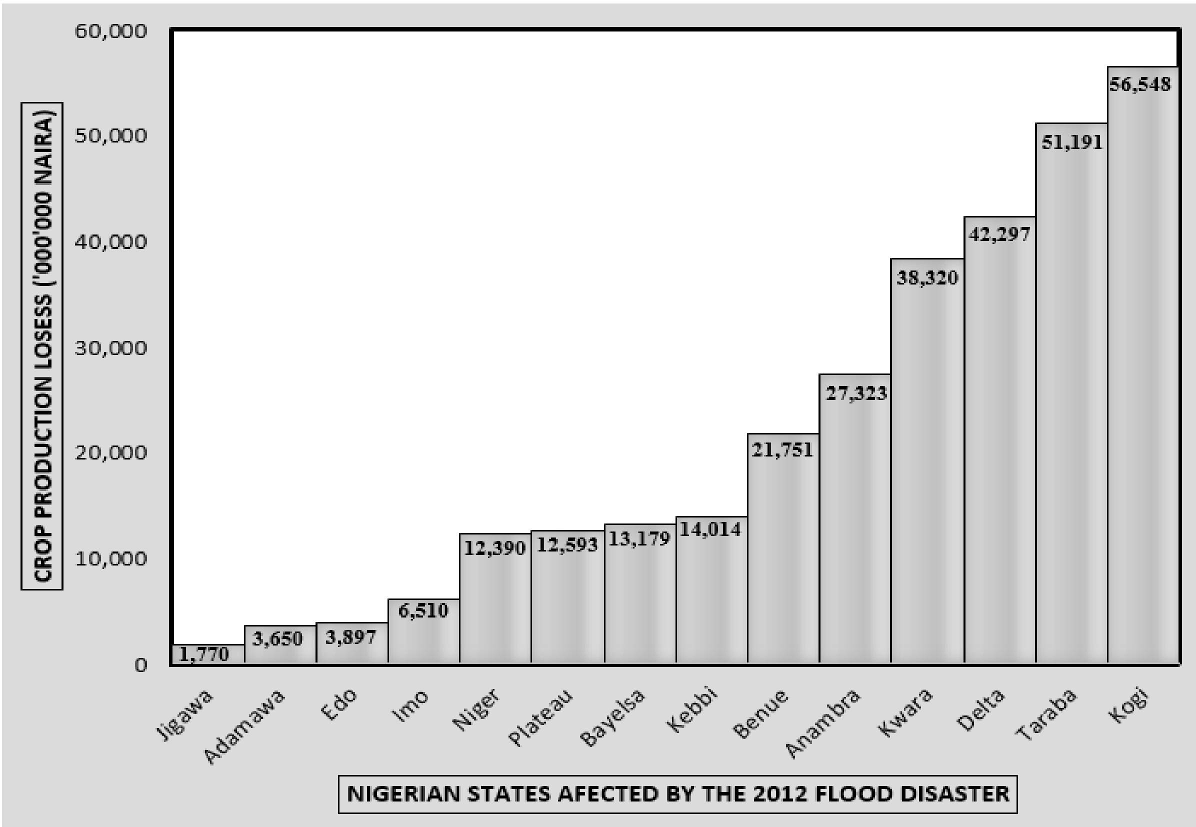
The devastating flood event of 2012 as shown in Table 1 affected 2,769,414 populations in 121 affected LGAs, displaced about 395,631 households, and caused serious damage to all the sectors including the agricultural sector (NEMA in FGN, 2013). Photo 1 shows the aerial view of the flooding in Lokoja, Kogi State in 2012.

Photo 1: Aerial view of the 2012 flooding in Kogi State

Source: NEMA in FGN, 2013

Historically, Nigeria as a nation has experienced and suffered from highly devastating climate extremes between 2012 and 2016 (Akande et al., 2017; Amanchukwu et al., 2015). According to EM-DAT (2016), Nigeria reported 109 natural hazard events during the period 1975–2015 in which flood events were reported to be responsible for 30% of the total occurrence with great impacts resulting in more than 24,500 deaths and affecting more than 13 million people. Floods are the most common, recurring disaster in the country (FGN, 2013). The impacts of flooding in Nigeria will continue to trigger concerns for food security as well as the vulnerability of the general public (Nkwunonwo et al., 2016). To this effect, Figure 4 shows the estimated crop losses in millions of naira due to flooding in Nigeria.

Figure 4: Estimated crops production losses in the flood-affected States



Source: NEMA in FGN, 2013

It was seen from the Figure that Kogi State remains the most affected state where several crop losses and destruction of farmlands were recorded. It recorded the highest estimated production of losses amounting to about 57 million Naira. This has led to a serious setback in food production and food availability for the people in the region and beyond, hence, plunging the region into extreme poverty (Oluwaseun et al., 2013). Being a largely agrarian state, Ojigi et al. (2013) noted that farmers in Kogi are mostly hit whenever floods occur owing to their lack of access to low capacity to prepare and withstand the shock. Earlier, Kolawole et al., (2011) had noted that flash flooding destroys agricultural activities and products such as crops, rice paddy, fruit trees, and vegetables thereby posing the risk of hunger to those engaged in subsistence farming and a great loss to those engaged in a commercial scale. Riverine communities in Kogi State are no exception among those affected across the country (Okpala-Okaka et al., 2013).

According to Madu (2016), the impact of natural hazards like floods on agriculture in Nigeria, which appear to be due to climate change, has become increasingly severe yearly. The pattern of vulnerability to climate change also corresponds to the dominance of climate-sensitive agricultural activities like farming. The sensitization of the population, therefore, becomes more important to reduce the effect of the occurrence on them. Since the 2012 floods event warnings were issued by several authorities to the population, in particular, Nigeria's Hydrological Services Agency (NIHSA), despite this warning however, floods still destroyed properties worth more than 2 billion Naira, and over 89,547 people were affected by the 2018 flood in Kogi State (NEMA, 2018).

In 2019, about 150 communities across nine LGAs located along the banks of Rivers Niger and Benue were submerged in flood water which caused significant damage (Adaoyichie, 2019). Fast forward to 2020, it was reported that over 50,000 people were displaced due to flooding from the overflowing of the River Niger (FloodList, 2020). Following the trends of the flood events in Kogi state, it was clear that the incidence had become a reoccurrence phenomenon on yearly basis. Hence, the negative impacts of the annual flooding in the area as evident from the literature remain a critical obstacle to agriculture, development, food, and human security (Aderoju et al., 2014; Ajodo & Olawepo, 2021; FloodList, 2020; KSMENR, 2021; NEMA, 2018; Ozim et al., 2021). This is causing a serious challenge to the people, thereby plunging thousands of farmers and their households in the area into abject poverty.

Recently, the International Organisation for Migration (IOM, 2022) reported that the Displacement Tracking Matrix (DTM) in collaboration with the National Emergency Management Agency (NEMA), the Kogi State Emergency Management Agency (KGSEMA) and the Nigerian Red Cross Society (NCRS) identified 31 locations in nine LGAs were affected by the 2022 disastrous flooding incidence in Kogi State where several persons were affected and displayed (Table 2).

Table 2: Number of persons displaced and affected by the 2022 flood disaster in Kogi State

LGA	Location	Displaced persons	Affected persons
Ajaokuta	Ami-Ero	210	594
	Ganaja Village	7,489	54,542
	Kabawa	123	123
	Molumoh	571	889
	Up-Garage	46	122
Total		8,439	56,270
Bassa	Eroko	-	38,936
	Eroko/Abom	1,023	1,023
	Oguro	255	255
Total		1,278	40,214
Ibaji	Onyedega	-	133,395
Idah	Icala Edike	210	334
	Ichekene	156	728
	St. Kizito Seminary	169	169
	Ugwoda Ichabi	-	33,490
Total		535	34,721
Igalamela-Odolu	Ala Akabe	513	513
	Ala Okpaga	697	697
	Alla Ojobage	-	906
	Alla Ojobaje	-	21,702
Total		1,210	23,818
Kogi	Adankolo New Layout	1,300	2,500
	Akpaku	1,676	1,676
	Edeha	383	383
	Ikumo	14,268	62,934
	Odama	832	1,448
	Ugwo	1,197	3,377
Total		19,656	72,318
Lokoja	Adankolo	12,120	72,601
	Galili	2,600	2,600
Total		14,720	73,201
Ofu	Kabawa Itobe	360	1,512
	Ofoke	-	23,136
Total		360	24,648
Omala	Abejukolo	969	9,871
	Otutubata	3,108	3,762
Total		4,077	13,633
Grand Total		50,275	472,218

Source: International Organisation for Migration (IOM, 2022), https://dtm.iom.int/nigeria

From the foregoing, one can ask to know why and how are there repeated losses of properties, and death of animals and individuals, due to floods and even on yearly basis in the region. Meanwhile, the International Federation of Red Cross and Red Crescent Societies [IFRC], (2009) defines "disaster as a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope, using its resources. Though often caused by nature, disaster can have human origins". The definition shows that disasters like floods as experienced in Kogi state disrupt community functions and serious threats to people's lives and livelihood. However, the definition also revealed that disasters do have a human origin, in the sense that they may be due to some factors caused by humans themselves. This then forms the onus of the study, to investigate and comprehend why people remain in a supposedly disastrous environment and thereby received a great impact when a disaster occurs.

Adaoyichie (2019) reported that households in the flood-affected communities remain in the area due to the presence of fertile land for agriculture, and water availability for plant irrigation and fishing purposes, which they believed makes life easier. Unfortunately, when the river does flood, these communities are severely damaged and people suffer as evidenced in literature (Aderoju et al., 2014; Ajodo & Olawepo, 2021; FloodList, 2020; KSMENR, 2021; NEMA, 2018; Ozim et al., 2021). To reduce the damages from disaster on the people, there is the need to critically understand the vulnerability of the people, their perception of the flood hazards, as well as understand their disposition and decisions as to either remain or quit the flood-prone area.

A link has also been made between increasing flood incidence, vulnerability, the decision of people to remain in flood-prone areas, as well as the changing climate (Kousky & Shabman, 2015). A combination of these challenges is a recipe for flood disaster communities in Nigeria as noted by Okunola (2022). For instance, individuals in households, businesses, and local governments decide how to use flood-prone areas. These uses may include farmlands and farm settlements, the building of houses, companies, or recreational centers. These decisions according to Kousky and Shabman (2015) made are the outcome of multiple interacting influences, with one being the consideration of flood risk and disaster.

In an attempt to assess the vulnerability to flooding in Kogi state, many studies have been carried out using different approaches. First, Ojigi et al. (2013), assessed the vulnerability of the affected villages and towns during the 2012 flood by using remote sensing and GIS. The study revealed flood extent as well as vulnerable cities and villages within the region. Similarly, Nkeki et al. (2013) were able to extract the flood plain and delineate the population at risk of flood disaster in the basin. In their work, Ajodo and Olawepo (2021) assessed flood vulnerability in the Ibaji local government area and establish the relationship between flood-causative factors and their role in the occurrence of flooding. In another study, households' lack of flood preparedness was found to increase their vulnerability (Ismail & Saanyol, 2013).

Also, Ozim et al. (2021) employed GIS techniques to analyze the Niger-Benue river flood risk and vulnerability of 256 communities in Kogi State. However, up on till now, the hotspots of flooding in the area are not yet known. In addition to this, the factors that keep driving households' vulnerability to devastating flooding are also not yet established. Kellens et al. (2011) reported that understanding people's risk perception is a necessary tool in modern-day flood risk management vulnerability reduction and mitigation strategies. Risk perception and vulnerability to a hazard are seemingly connected. For instance, an individual that is aware of the adverse of effect flood tends to prepare to reduce future occurrence, hence, reducing vulnerability, and vice-versa.

Despite the huge contributions of these studies to addressing flooding issues, the extent of its impacts is still evident and continually disastrous in the area. The understanding of households' flood risk perception as a tool in modern-day flood risk preparedness, response, and management is not yet addressed. Similarly, the factors responsible for the peoples' decisions towards residing in flood-prone areas, where they experience flooding regularly despite salvaging interventions is not yet clear from the literature. These are the gaps this current study aims to address. It, therefore, underscores the need for this study to help the relevant ministries, emergency institutions, local partners, and state and national governments in Kogi and Nigeria respectively to build safe and resilient communities through effective risk communication and contribute to the achievement of the Sustainable Development Goal (SDG) 11 and 13.

This study was a further attempt to determine the drivers of vulnerability that farming households in communities along the river banks to be prone to flooding, assess the perception of the hazard, and understand the decision-making of these farming households living in flood-prone areas in the state, and suggestions of possible implementable solutions to this seemingly intractable problem based on the outcome of the study. Hence, the study provided answers to the following research questions.

1.3. Research questions

The fundamental question that emerges from this study is: being faced with the risks of flooding, how do households in the riverine communities of Kogi State perceive flooding and make a decision regarding the disaster? From this fundamental question arise secondary questions:

- What are the factors that influence each household's vulnerability to floods and do their vulnerabilities differ across the selected communities?
- How is flood risk being perceived by households in the Kogi State?
- What are both the measures households take to reduce the flood impact and the factors influencing their decision to remain in or leave flood-prone areas?

1.4. Aim and objectives

The overall aim of this study is to contribute to the improvement of knowledge on households' flood risk vulnerability and decision-making to flood disasters in Kogi State, Nigeria. Three specific objectives follow from the aim. These are to:

- Determine farming households' flood vulnerability across the selected communities;
- Assess households' perception of flood disasters in the study area; and
- Analyses households' adaptation strategies as well as the factors influencing their decision-making to remain in flood-prone areas.

1.5. Research hypotheses

The improvement of the knowledge on the vulnerability of households' flood risk contributes to a better utter understanding of their perception and decision-making to flood disasters in Kogi State, Nigeria which the population's socioeconomic and livelihood activities depend. From the main hypothesis, the secondary hypotheses are presented as follows:

- Households' level of vulnerability to flooding in this study area varies considerably (from "very low" to "very high") and is influenced by both environmental and socioeconomic factors.
- Flood risk is being perceived differently by the households in the study area based on the social and economic characteristics
- Households employ an array of adaptation strategies, including engineering solutions and local/indigenous knowledge, while the decision to move away or remain in flood-prone areas is influenced by their socioeconomic and personal characteristics.

1.6. The interest of the study

The findings of this study will contribute to the scientific knowledge in the field of climate change and disaster risk management. First, the adopted methodology in assessing households' flood vulnerability was presented unambiguously and can be adopted by the researcher in another clime to expand knowledge in the field. It will uncover critical areas in assessing household vulnerability to flooding that many researchers were not able to explore in the study in particular. Thus, contributes to the expansion of scientific knowledge in general. With respect to application, the results from the study will be useful for individuals, groups, non-governmental organisations (NGOs) and government, and all other policymakers in the field of environmental sustainability and disaster risk management. In particular, the highlighted contributions of indicators, and the vulnerability maps present local shreds of evidence of the issues that need to be addressed to develop and design contingency plans to enable swift community policy engagement and actions to effectively reduce people's vulnerability to flooding in Kogi State and Nigeria at large.

1.7. Scope of the study

This study addresses flood disaster risk, household flood vulnerability, and their perception of floods, as it relates to their decision-making. As a result, this study was limited in geographical scope to farm families living in areas that had been identified as flood-prone communities due to their high proximity to the banks of Rivers Niger and Benue where farming is their major activity and source of livelihood.

1.8. Limitation of the study

Some limitations were recorded in this study prior to the formulation of the research perspective and recommendation which were generally related to the approach used.

Firstly, to determine farm households' level of vulnerability, the method was limited to the use of a widely used and accepted methodology, the index-based approach. Bearing in mind that selection of indicator is location specific, which makes it a bit challenging. Therefore, the selected indicators used for this study to define the components of flood vulnerability (exposure, susceptibility, and lack of resilience) was based on secondary data collection, extensive literature review, empirical field observation, and expert opinion with respect to data availability in the communities under study. These was validated by employing the MOVE (Methods for the Improvement of Vulnerability Assessment in Europe) vulnerability assessment framework (Birkmann et. al., 2013).

Secondly, due to time limitation, the study do not put into consideration the use of temperature and rainfall data. It is believed that these two factors play role in vulnerability risk assessment and could provide better results in the investigation.

Finally, the study do not take into account the economics aspects of the nexus that exist between the engineering solution-based flood control and the perception of the population in terms of the cost and benefit of their use of the flood prone areas.

In summary, Table 3 presents the research questions, objectives, hypotheses and methodology adopted and the objectives, the hypotheses and the methodology adopted and the plan of presentation in the of this research.

Table 3: Initial synoptic table of the research

Research question	Research objective	Hypotheses	Methodology			Results	Plan
Principal question	General objective	Main hypothesis	Methods used	Data/Data Collection Tools	Data analyses/technique		
Being faced with the risks of flooding, how do households in the riverine communities of Kogi State perceive flooding and make a decision regarding the disaster?	To contribute to the improvement of knowledge on households' flood risk vulnerability and decision-making to flood disasters in Kogi State, Nigeria	The improvement of the knowledge on the vulnerability of households' flood risk contributes to a better utter understanding of their perception and decision-making to flood disasters in Kogi State, Nigeria which the population's socioeconomic and livelihood activities depend.				Contribution to the body of knowledge on vulnerability, perception and decision-making of household to flood disaster risk was made	
Secondary questions	Specific objectives	Subsidiary hypotheses					
What are the factors that influence each household's vulnerability to floods, and how do their vulnerabilities differ across the selected communities?	Determine farming households' flood vulnerability across the selected communities.	Households' level of vulnerability to flooding in this study area varies considerably and is influenced by both environmental and socioeconomic factors.	-Documentary research -Quantitative research -Qualitative research	-Literature review -Indicator development -Flood historical data -Household survey -Development of indicator	-GIS analysis using QGIS -Descriptive stat -Excel -Epi-data -PAST4Porject	Chapter 4: Household flood vulnerability level across the study area determined	Part 2: Results and discussion
How is flood risk being perceived by households in the Kogi State?	Assess households' perception of flood disasters in the study area.	Flood risk is being perceived differently by the households in the study area based on the social and economic characteristics	-Documentary research -Quantitative research -Qualitative research	-Literature review -Household survey -FGD -interview guide	-ANOVA -Excel -Epi-data -PAST4Porject -Descriptive stat	Chapter 4: Household perception of flood risk assessed	
What are both the measures households take to reduce the flood impact and the factors influencing their decision to remain in or leave flood-prone areas?	Analyses households' adaptation strategies as well as the factors influencing their decision-making to remain in flood-prone areas.	Households employ an array of adaptation strategies, including engineering solutions and local/indigenous knowledge, while the decision to move away or remain in flood-prone areas is influenced by their socioeconomic and personal characteristics.	-Documentary research -Quantitative research -Qualitative research	-Literature review -Household -Interview guide survey -FGD	-Multi-nominal logistic model -Excel -Epi-data -PAST4Porject -Descriptive stat	Chapter 4: Household adaptation strategies and decision to either remain or quit flood-prone areas analysed	

Source: Peter B. Oyedele, 2022

Conclusion

In summary, this chapter presents the problem statements, research questions, objectives, and hypotheses of the study. This is important present the context of the study, understand the gap that the study intends to fill, and contribute to the urgently needed adequate understanding of the impacts of flooding and the drivers of vulnerabilities in the study area. Furthermore, the research questions, objectives, and hypotheses of the study were clearly stated.

CHAPTER TWO

CLARIFICATION OF CONCEPTS, THEORETICAL FRAMEWORK, AND LITERATURE REVIEW

Introduction

All scientific research is always linked to a context of meaning. To clearly define the research problem and put it into perspective, it was essential to clarify the concepts related to the research theme. The conceptual and theoretical frameworks aim to identify this context, i.e. the concepts, theories, activity data, etc. Thus, this conceptual framework was developed around the identified problem of the study. Similarly, a detailed review of the literature was done to tie issues to the research problem. The approach adopted to achieve this review began with a literature search and analyses of the said literature. By and large, definitions of concepts relating to disasters, hazards, and floods. The adopted framework for the study, flood vulnerability, perception of households to risk of flooding, and causes of flooding were also discussed in this Chapter.

2.1. Clarification of concepts and theoretical framework

Many of the definitions and terminologies considered in this review were those generally used in the context of climate change by the Intergovernmental Panel on Climate Change (IPCC), the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Office for Disaster Risk Reduction (UNDRR) and the United Nations International Strategy for Disaster Reduction Secretariat (UNISDR). These concepts were basic, accepted definitions and terms. These were considered to keep the character of conventional standards of the vocabularies for scientifically reliable purposes and also to promote a common understanding of the subject for use by the public, authorities, and practitioners.

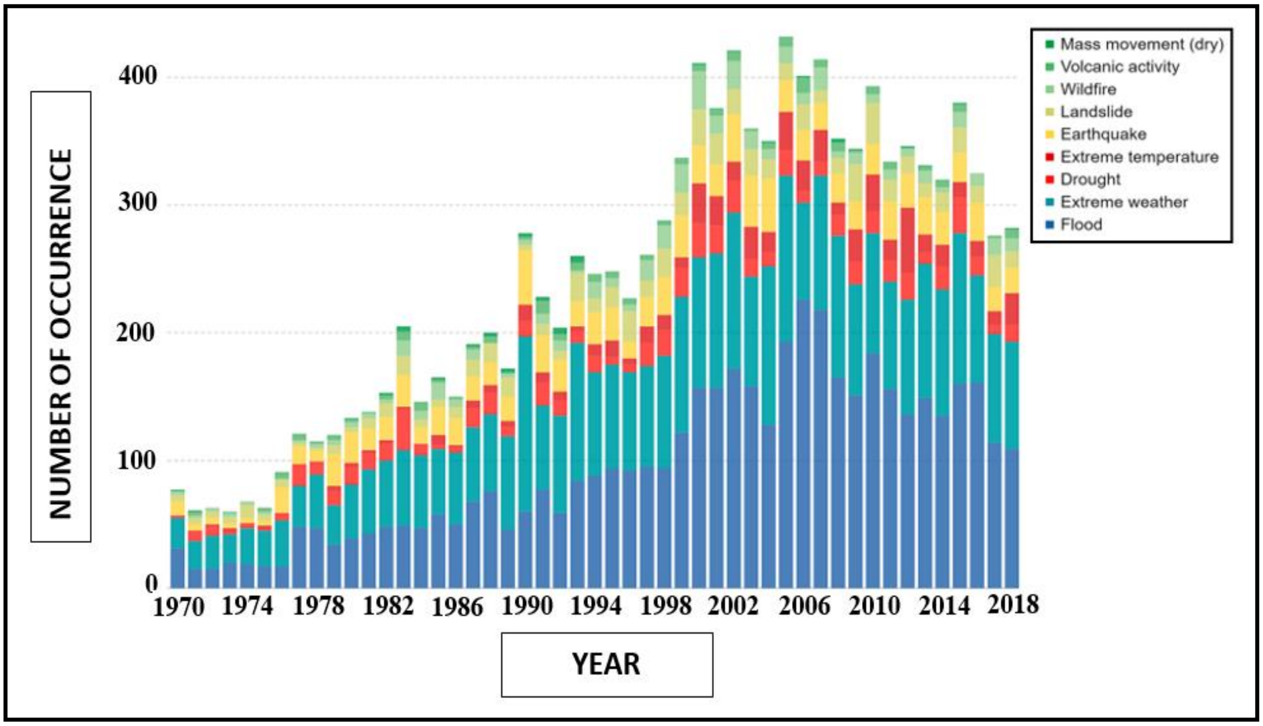
2.1.1. The concept of disaster

According to the International Federation of Red Cross and Red Crescent Societies (IFRC, 2009) is a serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its resources. The effect of the disaster can be immediate and localized, but is often widespread and could last for a long period. The effect may test or exceed the capacity of a community or society to cope using its resources and therefore may require assistance from external sources, which could include neighboring jurisdictions, or those at the national or international levels (UNISDR, 2015b). Disasters can be caused by natural, man-made, and technological hazards, as well as various factors that influence the exposure and vulnerability of a community (IFRC, 2009).

The United Nations Office for Disaster Risk Reduction [UNDRR] (2019) defines disaster as a "serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. The effect of the disaster can be immediate and localized, but is often widespread and could last for a long period of time. The effect may test or exceed the capacity of a community or society to cope using its own resources, and therefore may require assistance from external sources, which could include neighboring jurisdictions, or those at the national or international levels".

Globally, disasters have one of the most disastrous effects on economic development, livelihoods, agriculture, and health, social and human life as noted by Birkmann et al. (2013). For example, flooding represents a source of disaster that can cause a halt to different human activities on the basis of their different socio-economic and physical conditions. Figure 5 shows the global reported natural disaster by type.

Figure 5: Global reported natural disasters by type



Source: Ritchie & Roser, 2019

Figure 6 shows a wide range of datasets from around the world that were kept since the beginning of the 20th century indicating that the number of disasters has significantly increased over the past five decades as noted by Ritchie and Roser (2019). These disaster has inflicted hardship and pain on people around the globe. Typical examples are death, displacement, disease, loss of crops, damage to physical and service infrastructure, depletion of natural and social capitals, injury to people, damage of properties, disruption of economic activities, loss of livelihood and/or environmental, ecological degradation, institutional weakening and a general disruption of economic and social activity.

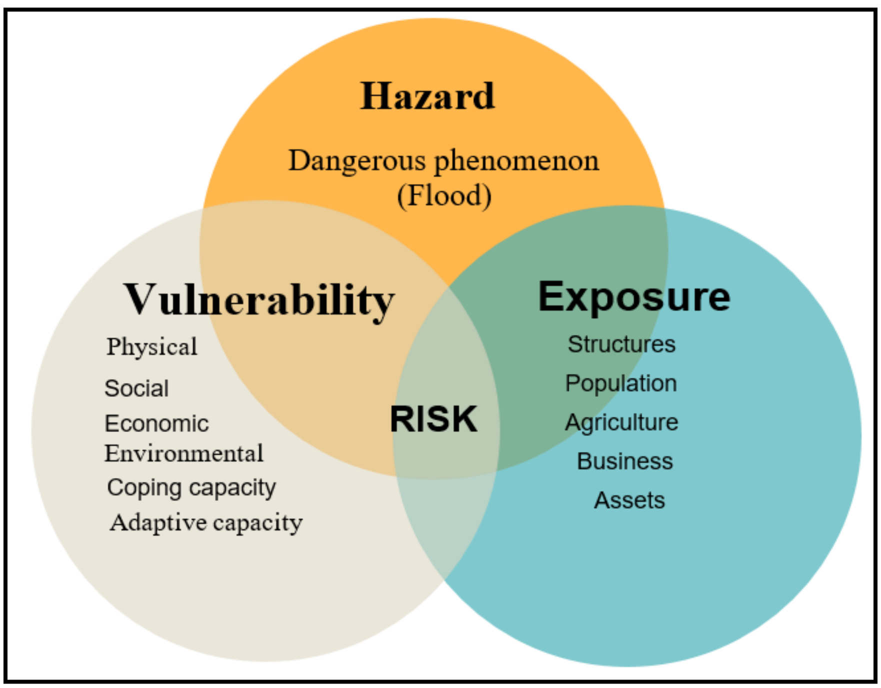
According to sociologists, "…disaster may highlight the fundamental beliefs and social systems that give communities and the societies they make up their identity. Hence, social elements that promote both stability and change can be identified. The study of disaster may therefore shed light on both fundamental behavioral patterns and the social forces that limit them." (Drabek, 2007, p. 3). In other words, linking disaster to sociology can help us to gain inference and understands how human perceives, behave or relate to a potential disaster event that is capable of causing setbacks.

2.1.2. Disaster risk

According to the United Nations International Strategy for Disaster Reduction (UNISDR), the term disaster risk is defined as the potential disaster losses, in lives, health status, livelihoods, assets, and services, which could occur to a particular community or a society over some specified time. The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least (UNISDR, 2009).

It was referred to as the combination of the probability of an event and its negative consequences (UNISDR, 2009, 2013). Earlier researchers have put forward that hazardous occurrences do not result in disaster and that for actual assessment of the disaster situations and losses, various elements such as vulnerability and exposures have to be included (Birkmann et al., 2013; Olorunfemi, 2011). This has become the basic method used today in disaster risk analysis. Risk has been defined as a function of the hazard, exposure, and vulnerability of a system (Figure 6).

Figure 6: Conceptual framework for disaster risk assessment



Source: de Brito et al. (2017, p. 4)

From the framework, disaster risk was found to be the product of the combination of three elements: vulnerability (V), exposure (E), and Hazard (H). Hazard is the probability of occurrence of a dangerous phenomenon, in this case, flood, while exposure consists of the presence of people, property, and assets in hazardous areas (UNISDR, 2015b). Compared with the coping or adaptive capacity (C) of the community, structure, or system, (R = H × V/C) (UNISDR, 2009). Mathematically, risk can be considered a risk as the product of hazard, exposure, and vulnerability (Figure 2.2) (White et al., 2004).

Mathematically represented as:

Disaster (R) = [Vulnerability (V) x Hazard (H)] / Capacity (C)

This equation above is widely used by many researchers to analyze flood disaster risk and potential impacts on the people and community. The first hand of risk at any level and community is the possibility of the occurrence of flood hazards; this however does not result in some negative consequences until the level of vulnerability and exposures of the people are known (Olorunfemi, 2009). For clarity, the study pinned down the idea of hazard to be flooding, which is the focus of the study.

2.1.3. Hazards

Hazard as defined by the United Nations office of disaster risk reduction (UNISDR, 2015b) is a dangerous phenomenon, substance, human activity, or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods, social and economic disruption, or environmental damage. In simple terms, a hazard is a dangerous situation or event that carries threats to humans. This clearly shows that to classify anything as a hazard, it must have the potential to be dangerous and harmful to humans. Hazards will be considered disasters once they affect humans, but if they occur in an unpopulated area, they will remain hazards. A good example of this is flood hazards, that to affect human's live and livelihoods[7]. From the foregoing, flood can then be classified as a hazard because it poses threat to life, health, environment, or property.

[7] According to EM-DAT: International Disaster Database on Nigeria disaster, in 2012 alone, about 7,000, 867 lives were affected by the widely spread flood while 363 and $500,000 deaths and economic damages respectively were recorded (Guha-Sapir et al., 2012)

According to the (UNDRR, 2019), hazard may be natural (natural process and phenomena), anthropogenic (induced by human activities) or socio-natural in origin (both natural and human). Different types of hazards include biological, environmental, geological, hydrometeorological and technological processes and phenomena (Wicaksana, 2015). For example, climate related hazards such as floods, can be defined as naturals hazard constitute by climate events or phenomenon which could threaten or provoke human (injury, loss of life), physical (destruction of houses, road infrastructure, etc.), social (reduction or loss of income, interruption of income-generating activities, displacement, etc.), psychological (fear, etc.) and environmental (destruction or degradation of vegetation cover, soil, etc.) damage.

Sociologists use the word hazard and disaster interchangeably as noted by Drabek. It argued that a disaster is "…an event in which a community undergoes severe such losses to persons and/or property that the resources available within the community are severely taxed. In contrast, a hazard is a condition with the potential for harm to the community or environment." (Drabek, 2007, p. 4).

2.1.4. Vulnerability

The word 'vulnerability' is usually associated with natural hazards like floods, droughts, and social hazards like poverty, etc. Vulnerability is the characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard (UNISDR, 2009). Defining vulnerability can help us understand the best ways to reduce it (Balica et al., 2009). The vulnerability also have connection with the geographical location of a system. In this regards, (Okayo et al. (2015) argued that vulnerability help to determines how people will be affected and where they are spatially located. It has an important role in flood risk assessment, as hazards only become disasters if there are vulnerable people or infrastructure located in hazard-exposed areas (Kobiyama et al., 2018). According White et al. (2004), vulnerability describes the potential to be harmed physically and/or psychologically.

The degree to which a system, or a part of a system, may react negatively during the occurrence of a hazardous event has been defined by Proag (2014) as a notion that indicates some risk paired with the level of social and economic liability, and the ability to cope with the resultant event.

Table 4 defines shows the types of vulnerability and the definition of elements that make a population more vulnerable to a potential hazard.

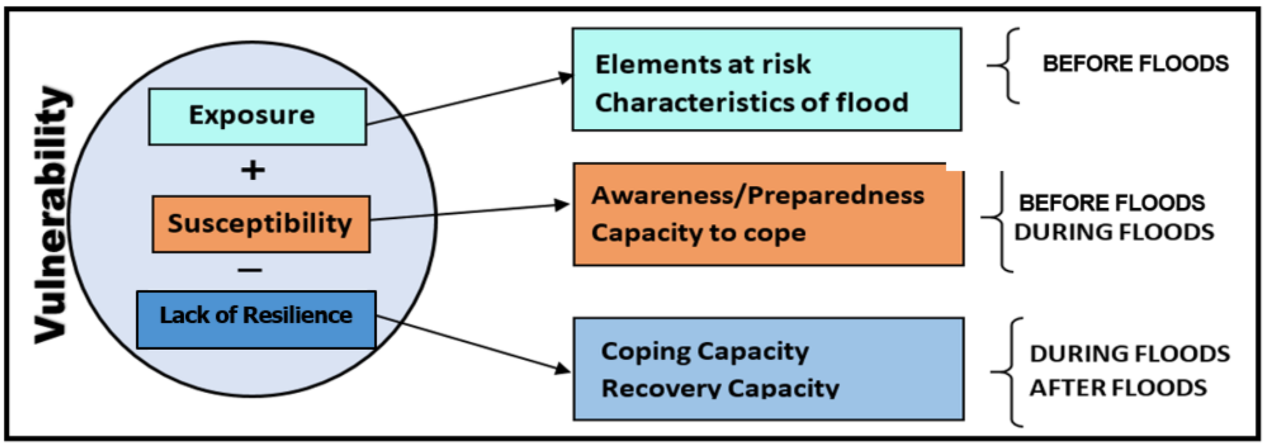
Table 4: Types of vulnerability

Vulnerability	**Description**
Physical	Physical vulnerability relates to buildings, infrastructure and agriculture. Although the focus is on physical assets, it also includes the potential loss of crops and other infrastructure necessary to livelihood.
Social	Vulnerability analysis should examine the risk faced by critical facilities, which are vital to the functioning of societies in disaster situations, such as hospitals and dispensaries, emergency services, transport, communication systems, essential services, etc. Vulnerable groups for instance include women, mentally and physically handicapped persons, children, and elderly persons, the poor people, refugees, and livestock. It is composed also composed by rapid population growth, poverty and hunger, poor health, low levels of education, gender inequality, fragile and hazardous location, and lack of access to resources and services, including knowledge and technological means, disintegration of social patterns.
Economic	Economic vulnerability assesses the risk of hazard-causing losses to economic assets and processes. These fall into two groups: Direct. Damage to or destruction of physical and social infrastructure and its repair or replacement cost, as well as crop damage Indirect. Loss to production, employment, vital services, income disparities. This is based on the following factors: trade and foreign-exchange earnings, aid and investments, international prices of commodities and inputs, production and consumption patterns.
Political	Lack of access to information and knowledge, lack of public awareness, limited access to political power and representation.
Environmental	Environmental vulnerability concerns land degradation. Earthquake, flood, hurricane, drought, storms, water scarcity, deforestation and the other threats to biodiversity

Source: Proag (2014)

In the case of flood disaster management, vulnerability has an important role in flood risk assessment, as hazards only become disasters if there are vulnerable people or infrastructure located in hazard-exposed areas (Kobiyama et al., 2018). The main objective to assess vulnerability is to inform decision-makers or specific stakeholders about options for adapting to the impact of flooding hazards (Douben, 2006). Flood impacts strongly depend on the vulnerability of the exposed system or community (de Brito et al., 2018). Thus, the knowledge of vulnerability is fundamental for assessing flood risk, as it allows computing the susceptibility of the exposed elements (Karagiorgos et al., 2016) by considering multiple dimensions (Birkmann et al., 2013). This framework (Figure 7) was adapted for this study in assessing the vulnerability of households in the selected communities of Kogi State, Nigeria.

Figure 7: Framework for defining vulnerability



Source: Adapted from Balica (2007, p. 37)

Figure 7 shows the vulnerability framework postulated by Balica (2007), which is a function of three factors of vulnerability namely: exposure; susceptibility; and lack of resilience. This framework was adopted in this study for the working definition of vulnerability.

From the vulnerability framework, exposure refers majorly to elements that risk as the features of the hazard, in the case of floods. Susceptibility on the hand refers to the awareness, preparedness, and capacity of a system to cope with the disturbance of a hazardous condition. While lack of resilience as used in this study refers to the lack or inadequate coping capacity and the inability of a system to be able to recover from the change. In addition, the assessment allows for the identification of flood vulnerability hotspot areas and the main drivers that contribute to them (e.g., social, economic, physical, cultural, environmental, and institutional) (Rufat et al., 2015).

2.1.5. Exposure

Exposures on the other hand are the people, property, or elements within the hazard zones that are prone to potential damages or losses (the element at risk) (UNISDR, 2015b). Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest. It is stated in the UNDRR glossary, that "measures of exposure can include the number of people or types of assets in an area. It represents the location or presence of attributes, and value of assets that are important to communities and that could be affected by a hazard (UNDRR, 2017).

2.1.6. Susceptibility

Susceptibility relates to system characteristics, including the social context of flood damage formation. Especially the awareness and preparedness of affected people regarding the risk they live with (before the flood), the institutions that are involved in mitigating and reducing the effects of the hazards, and the existence of possible measures, like evacuation routes to be used during the floods (Berezi et al., 2019; UNESCO-IHE, 2013).

2.1.7. Resilience

The United Nations Office for Disaster Risk Reduction (UNDRR, 2015) defines resilience as the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. Resilience means the ability to "resilience from" or "spring back from" a shock without any external support but leaning on its own resources. The resilience of a community concerning potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both before and during times of need (UNISDR, 2009). In this study resilience is defined as the capacity of a system to endure any perturbation, like floods, maintaining significant levels of efficiency in its social, economic, environmental, and physical components.

2.1.8. Capacity

The combination of all the strengths, attributes, and resources available within an organization, community, or society to manage and reduce disaster risks and strengthen resilience (UNISDR, 2009; 2015b). Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership, and management.

- **Coping capacity** is the ability of people, organizations, and systems, using available skills and resources, to manage adverse conditions, risks, or disasters. The capacity to cope requires continuing awareness, resources, and good management, both in normal times as well as during disasters or adverse conditions. Coping capacities contribute to the reduction of disaster risks (UNISDR, 2015b).

- **Capacity assessment** is the process by which the capacity of a group, organization, or society is reviewed against desired goals, where existing capacities are identified for maintenance or strengthening and capacity gaps are identified for further action (UNISDR, 2015b).

- **Capacity development** is the process by which people, organizations, and society systematically stimulate and develop their capacities over time to achieve social and economic goals (UNISDR, 2015b). It involves learning and various types of training, but also continuous efforts to develop institutions, political awareness, financial resources, technology systems, and the wider enabling environment.

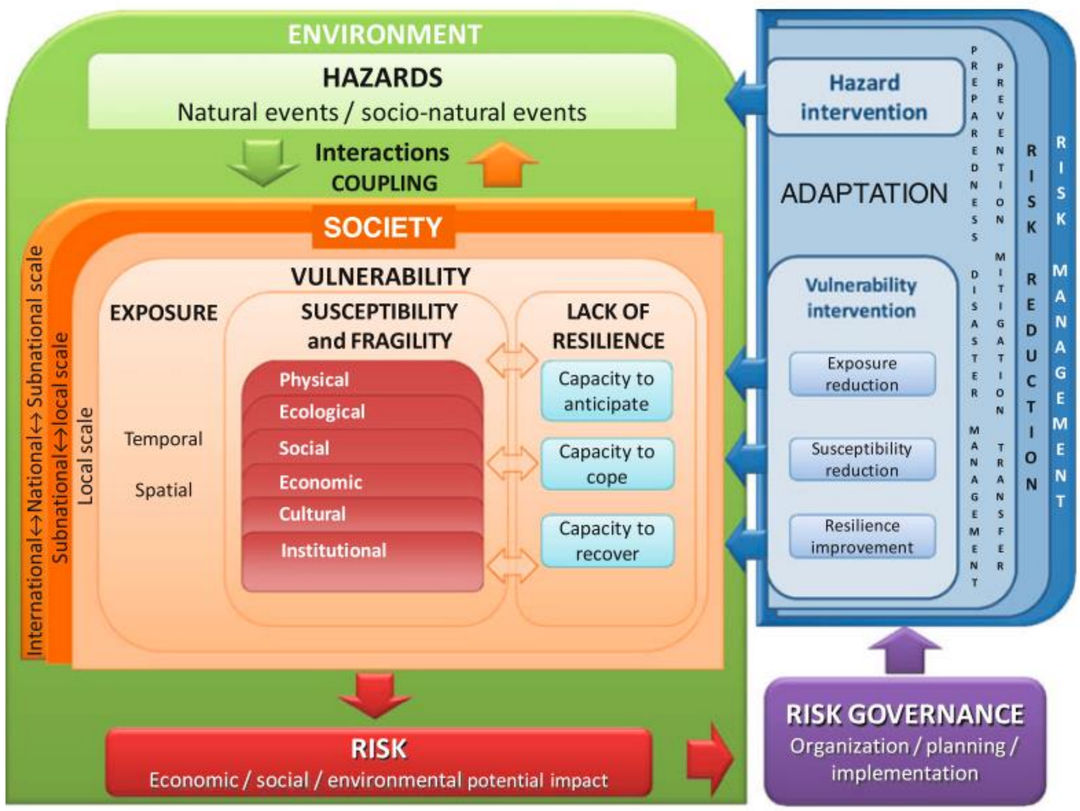
2.1.9. Flood

The Intergovernmental Panel on Climate Change's (IPCC, 2012b) Glossary of terms, considered "flood refers to the overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods".

2.1.10. The MOVE framework

This study adopted the deductive reasoning for the selection of the preliminary set of indicators by employing the MOVE (Methods for the Improvement of Vulnerability Assessment in Europe) vulnerability assessment framework postulated by Birkmann et al. (2013) as shown in Figure 8.

Figure 8: The MOVE framework adopted for the study



Source: Birkmann et al. (2013, p. 199)

The MOVE framework was developed to improve vulnerability assessment in Europe. It is a thinking tool to guide systematic assessments of vulnerability and to provide a basis for comparative indicators and criteria developed to assess key factors and various dimensions of vulnerability (Birkmann et al., 2010). Firstly, it conceptualized (flood) vulnerability as a product of three key factors of vulnerability factors including exposure, susceptibility, and lack of resilience. Secondly, it specifies the different dimensions of vulnerability as physical, ecological, social, economic, cultural, and institutional. Thirdly, it specifies that the dynamic nature of vulnerability could be expressed through spatial and temporal exposures. It differentiates coping from adaptation and incorporates the concept of adaptation into disaster risk management thereby bridging the concept and approach gaps between disaster risk management (DRM) and climate change adaptation (CCA) communities as it fulfills a need for standards and guidance in estimating vulnerability as the critical component of risk (Birkmann et al., 2013).

Within the MOVE framework, vulnerability is defined as a degree of susceptibility or fragility of elements, systems, or communities, including their capacity to cope under hazardous conditions. Vulnerability is tied to natural and built environmental degradation at the urban level and to gradual climate change. Unplanned urbanization often exposes the inhabitants to urban floods. This fact is therefore seen as a lack of resilience. Birkmann et al. (2013) define the three vulnerability factors, such that exposure as "the extent to which an area that is subject to an assessment falls within the geographical range of a hazard event". Similarly, susceptibility means "the predisposition of elements at risk (social and ecological) to suffering harm resulting from the levels of the fragility of settlements, disadvantageous conditions, and relative weaknesses". While lack of resilience/capacity is the "limitations in access to and mobilization of the resources of the human settlements and their institutions and the incapacity to adapt and respond in absorbing the socio-ecological and economic impact. Resilience includes the capacity to anticipate, cope and recover". All the concepts were discussed above.

2.1.11. Theory of risk society

The theory of risk society was postulated by a German sociologist called Ulrich Beck in 1992. Defining risk, Ulrich says industrial society has created many new dangers of risks unknown in previous ages. The risks associated with global warming are one example. In the present era of industrialization, the nature of risk has undergone tremendous change. Earlier, there was no absence of risk. But these risks were natural dangers or hazards such as earthquake, epidemic for instance the most recent global pandemic – COVID-19. He argues that the risk which is inherent in modern society would contribute towards the formation of a global risk society. In a modern society, there are several changes such as technological change that have an adverse effect on the society at large. This technology of course produces new forms of risks and we are constantly required to respond and adjust to these changes.

The risk society, according to Ulrich, is not limited to environmental and health risks alone, it includes a whole series of interrelated changes within contemporary social life such as shifting employment patterns, heightened job insecurity, declining influence of tradition and custom, erosion of traditional family patterns and democratization of personal relations. In addition to this explanation, part of the risks experienced in our society today is flood risk that has caused series of damages to critical infrastructures, buildings, farmlands and farm produce (FGN, 2013). Flood risk has caused the death of both human beings and animals in thousands. The history of risk distribution shows that, like wealth, risks adhere to the class pattern, only inversely; wealth accumulates at the top, risk at the bottom. To that extent, risks seem to strengthen, not to abolish, class society. Poverty attracts an unfortunate abundance of risks. By contrast, the wealthy (in income, power, or education) can purchase safety and freedom from risk. This explains why the poverty is one of the major factors that exposes the people to several environmental hazard such as flood risks thereby making them to be highly vulnerable to flood disasters in the area.

2.1.12. Decision-making theory

When discussing disaster risk management, one of the most commonly considered theory is the decision-making theory. This theory was postulated by one of the greatest economist called Herbert A. Simon in his renowned book, Administrative Behavior (1947). From the review of his book by Alijoyo and Fisabilillah (2021), the decision-making theory is a theory of how rational individuals should behave under risk and uncertainty. The theory suggests that decision-making means the adoption and application of rational choice for the management of a private, business, or governmental organization in an efficient manner. This connotes that the rationality of an individual, or household to make choice in relation to flood disaster as it affects their lives and source of livelihood. The theorist suggested that decisions were critical because if they weren’t taken on time, it will negatively impact an organization’s objective. The theorist according to Alijoyo and Fisabilillah (2021) argued that making a decision is choosing between alternative courses of action. It can even mean choosing between action and non-action. The concept can be divided into two parts: the decision that someone arrives at and the process or actions taken. In other words, implementing a decision is as important as making that decision. From this perspective, ERM will help the organization conduct their risk-based decision-making, which implicitly considers the process of actions taken upon such a decision at its earliest (Alijoyo and

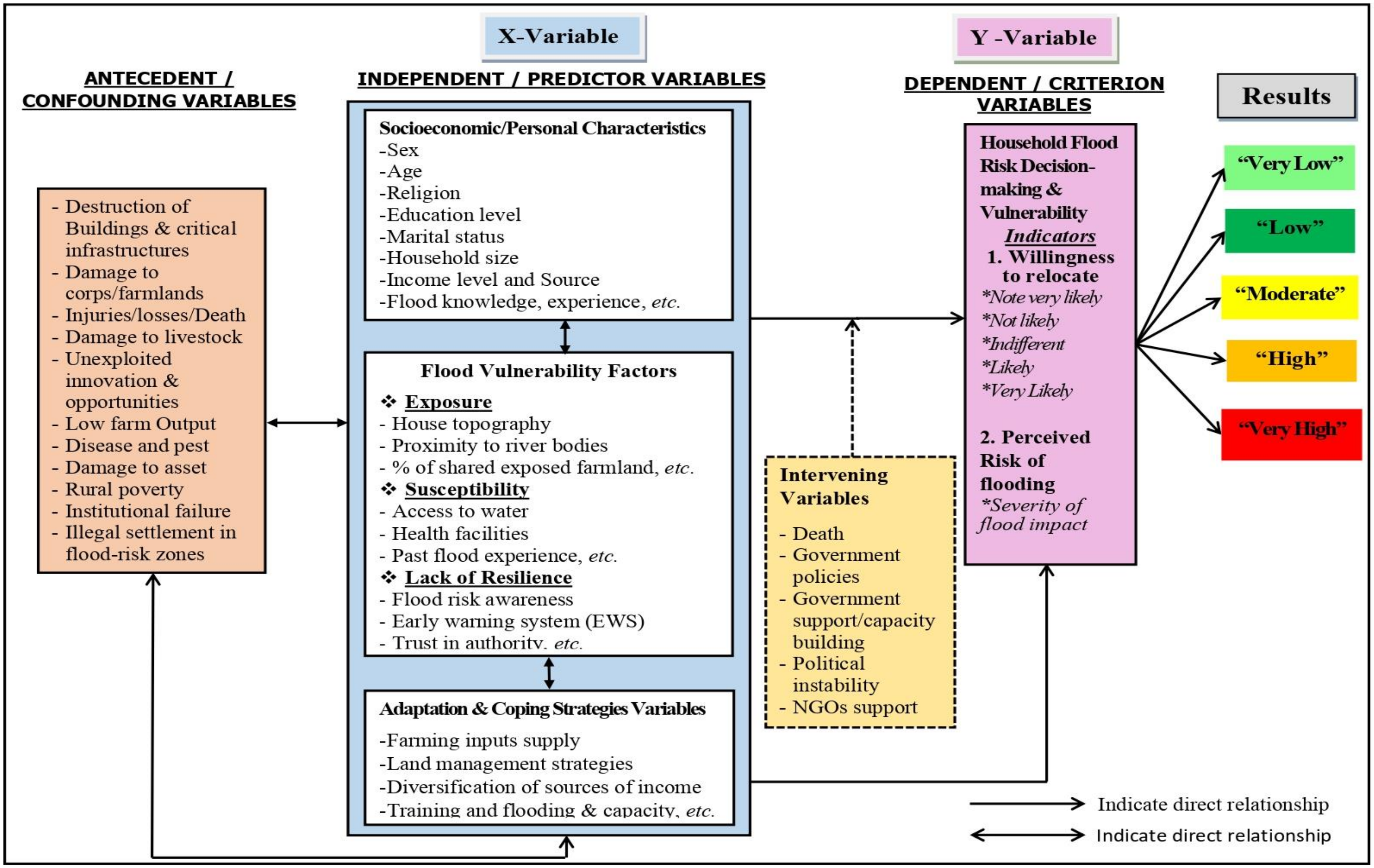
Fisabilillah, 2021).

With respect to flood risk and farming household to flood disaster, which is the major concern of this study. This theory implies that human being are considered to be rational in making decision to escape the impact of flood disaster. Specifically, people reside along a river course for reasons best known to them. For instance, individuals in households, businesses, and local governments decide how to use flood-prone areas. These uses may include farmlands and farm settlements, the building of houses, companies, or recreational centers. According to Kousky and Shabman (2015), these decisions made are the outcome of multiple interacting influences, with one being the consideration of flood risk and disaster. It is clear that household that are residing in flood-prone areas make the decision to settle down in such areas despite the challenges being faced as a result of flooding owing to their high exposure and vulnerability nature to hazardous, floods. With the yearly occurrence of damages from flooding in Kogi state, this study which to investigate and understand what and how household makes decision in the management of flood disaster. This is because, implementing a decision is as important as making that decision (Alijoyo and Fisabilillah, 2021).

2.1.13. Theoretical/hypothetical model for household flood vulnerability in Kogi State

The theoretical and hypothetical model for this study describes the factors that directly or indirectly affect household flood vulnerability and their decisions to risk flooding. Badjie et al. (2019) reported that rural household livelihoods are built within a diverse range of activities which include dependency upon both natural resources and non-natural resources, through which rural households meet their necessities. However, these livelihood activities can be constrained by factors either within the system or environment where the livelihood activity is carried out or external conditions and factors. Factors like environment, floods, political, social, economic, climate change and variability, demographic, and policy settings. In light of the above, this research work focuses only on assessing the perception, vulnerability to flooding, and decision-making of farm households in selected communities of Kogi State, Nigeria. Figure 9 presents the hypothetical model used in this study.

Figure 9: Theoretical-hypothetical model for the assessment of household flood vulnerability and decision-making in Kogi State, Nigeria



Source: Peter B. Oyedele, 2022

2.2. Literature review

2.2.1. Flood risk

Floods represent one of the most frequent and damaging natural disasters in the world (United Nations Office for Disaster Risk Reduction (UNISDR, 2017). In developing countries, the majority of people are at risk and the rate is growing each year due the high levels of poverty making them more vulnerable to disasters (UNISDR, 2004 as cited in Munyai et al., 2019). Therefore, in Africa, the floods hazards are likely to exacerbate due to the rapid growth in population and the Intergovernmental Panel on Climate Change (IPCC) has opined that "Sub-Saharan Africa has experienced more frequent and intense climate extremes in previous decades as a result of climate change, a trend that is likely to continue as the impacts of climate change intensify" (EM-DAT, 2019). Various climate projections over West Africa indicated an exacerbating occurrence of flood events in the future (Adegoke et al., 2019).

In Nigeria, floods are the most common and recurring disaster (FGN, 2013). In the 2012 Floods Post-Disaster Needs Assessment (PDNA) report, jointly prepared by the Government of Nigeria and its key ministries under the coordination of the National Emergency Management Agency (NEMA), it was reported that the frequency, severity, and spread of these floods are increasing (FGN, 2013). Beginning in July 2012, heavy rains struck the entire country. The impact of the 2012 flood was very high in terms of human, material, and production loss, with 363 people killed, 5,851 injured, 3,891,314 affected, and 3,871,53 displaced in several states, including Kogi state (FGN, 2013, p. 5). Earlier, Kolawole et al. (2011), noted that flash flooding destroys agricultural activities and products such as crops, rice paddy, fruit trees, and vegetables thereby posing the risk of hunger to those engaged in subsistence farming and a great loss to those engaged at a commercial scale. The impacts of flooding in Nigeria will continue to trigger concerns for food security and as well the vulnerability of the general public (Nkwunonwo et al., 2016).

2.2.2. Flood disaster and development

Flood disasters constitute major setbacks for the development of the world because of their destructive impacts on gains of development. Development achievements of many years can be lost to a single disaster within one day. However, disaster can also be a catalyst for change

(Birkmann et al., 2010). (Driessen et al., 2018) opined that flooding remains the most common of all-natural disasters. Surprisingly, many countries are today facing the challenge of recognizing the magnitude of risk posed by flooding and the lackluster attitude of the government and other critical stakeholders to make the investments required to reduce flood risk (Tullos, 2018). The magnitude of the disaster, according to Raheem et al. (2013), is usually described in terms of the adverse effects that a disaster has had on lives, property, and infrastructure; environmental damage; and the costs attached to post-disaster recovery and rehabilitation.

2.2.3. Flooding and its impact in Kogi State

Within the last decade, flood disasters in Kogi State have become a yearly and recurring phenomenon. Aderogba (2012) gave a comprehensive account of this, with 102,567 people displaced; over 96 people killed, an estimated loss of 1.2 billion naira, and about 24,476 houses submerged (Photo 2).

Photo 2: Images of houses submerged under floodwater during the 2019 flood in Kogi State

Source: Kogi State Ministry of Environment and Natural Resources (KSMENR, 2021)

The photo shows houses being submerged in flood water in one of the communities affected by the 2019 flood event in Kogi State. Aside from houses being submerged, it was equally reported that several farmlands and agricultural products were destroyed by floods. This revealed that the negative impacts of this overwhelming event in Kogi remain a critical obstacle to agriculture, human security, and development due to the loss of lives, livelihoods, infrastructure damages incurred, and agricultural lands being washed away. The two major Rivers (Niger and Benue) that divide Nigeria into three unequal geographical regions are flowing through Kogi state and make communities around this span of the rivers one of the areas frequently affected by floods (Oluwaseun et al., 2013).

In 2010 and 2012 several communities in Lokoja, Ibaji, and Kogi Local Government Areas (LGAs) were devastated by flooding (Ndukson Buba et al., 2021). Ahuchaogu et al. (2021) also reported that some communities in Kogi state are regularly under the influence of flash floods due to their location in the valley of the confluence of River Niger and Benue. In their study on understanding flood vulnerability among local communities in Kogi State, Oyedele et al. (2022) found that the majority of the sampled communities from eight local government areas in the state were highly vulnerable to flooding and prone to observed annual flooding in the state with gross negative impacts. Okpala-Okaka et al. (2013) observed that 344 communities in the State were affected by the 2012 floods with many farmlands submerged. Aside from the loss of lives and properties, floods equally prevent the optimal exploitation of the land and proper management and control of water resources (Ojigi et al., 2013). Photo 3 shows a rice farm that was destroyed by a flood in Kogi State.

Photo 3: A rice farm being destroyed by flood in Kogi State

Source: Kogi State Ministry of Environment and Natural Resources (KSMENR, 2021)

The photo was from the flood event of 2019 when farmers suffered colossal losses on their rice farmlands due to flooding as reported by the Kogi State Ministry of Environment and Natural Resources (KSMENR). Aside from rice farms, other crops destroyed by floods in the area are cassava, yam, okra field, maize farm, etc.

2.2.4. Causes of floods in Kogi State

A flood happens when soil and vegetation cannot absorb water from downpours. Also, a flood occurs when a river body outburst its banks and the water spill onto the floodplain. The causes of flooding in Kogi state have been attributed to excessive rainfall, river overflow as well as dam management. Ojigi et al. (2013) attributed the causes to an increase in urbanization. In their work, it was emphasized that the increasing rate of urbanization aggravates flooding extensively by restricting floodwater pathways, thereby causing the river to overflow its banks. Hirpa et al. (2019) opined that apart from overflows of the rivers, floods may be caused by the failure of some hydraulic structures such as dams, or the sudden release of a huge amount of water as in the case of 2012 that hits Lokoja in Kogi State which was majorly attributed to the release of water from Lagdo Dam in Cameroon (NEMA, 2022). It caused enormous damage to lives and property in many states bordering the river Niger-Benue basin and was considered the worst event in the study area and the entire of Nigeria for over half a century.

Ismail and Saanyol, (2013) attributed the cause of flooding to households' lack of preparedness for the hazard. They concluded that this level of effective preparedness can only be achieved with adequate knowledge of the disaster risk. Similarly, Oyedele et al. (2022) noted that the high vulnerability of most communities in Kogi is driven by high exposure, high susceptibility as well as lack of resilience. Several factors such as poor building structures, lack of evacuation and flood management measures, over-dependence of households on agriculture, lack of diversification of economic activities, and weak household economic capacities were identified as the causes of the high exposure level, susceptibility, and the lack of resilience among households (Oyedele et al., 2022). The consequences as noted by NEMA (2013) are that the inhabitants of the area and even people from distant places who depend on farming and other activities are in danger of losing their means of livelihood. As such, the annual flood is deepening poverty in the region.

In 2018, the Kogi State Ministry of Environment and Natural Resources (KSMENR) reported that there are serious ecological problems especially devastating floods confronting the Kogi State of Nigeria almost every year. The situation was acute along the riverine Local Government Areas of the State such as Ajaokuta, Kogi, Lokoja, Idah, Ofu, Igalamela, Ibaji, Omala, and Bassa LGAs which made the Federal Government declare a State of Emergency in Kogi State during the 2018 flood disaster. This according to the report, led to the destruction of key infrastructural facilities in the state e.g. roads, potable water sources, and electricity infrastructure aside from the loss of lives and properties. Equally, the flood was a major threat to socioeconomic activities in the affected areas of the State (NEMA, 2018).

2.2.5. Flood Events in Kogi State (2004 – 2020)

Historically, Kogi State has incessantly been devastated by floods from 2004 – 2020 (KSMENR, 2021; NEMA, 2018). As such flooding in Kogi State is fast becoming an annual event given the trend i.e (2004, 2010, 2012, 2017 and 2018, 2019, and 2020). Table 5 shows the historical flood incidence in Kogi State between 2004 and 2020.

Table 5: Historical Flood Events in Kogi State (2004 – 2020)

Flood Year (Month of occurrence)	Notable Events	Sources of information
2004	• Devastated floods • Some graves and dead bodies were swept off	KSMENR, 2021
2010	• Several houses and farmland were inundated	KSMENR, 2021
2012 (September)	• Floodwater covers major high ways causing many travelers to be stranded in Lokoja, for several days • 6 deaths were recorded	Aderoju et al., 2014; FGN, 2013; KSMENR, 2021; NEMA, 2013
2017 (September)	Over 10,000 people were displaced due to heavy rainfall that last for more than 2 weeks in the river catchment.	FloodList, 2020; KSMENR, 2021
2018 (September)	• About 200 communities were submerged • About 200,000 households were affected • 5 deaths recorded • 87 people were injured • 1.8 billion naira worth of properties	FloodList, 2020; NEMA, 2018
2019 (September)	• No fewer than 150 communities across 9 LGAs were submerged in floodwater • Ibaji LGA was submerged according to the report	Adaoyichie, 2019
2020 (September)	• 66 communities were affected • Over 50,000 people were displaced and forced to evacuate their homes in Kogi State due to days of flooding from the overflowing of Rivers Niger and Benue.	FloodList, 2020

Source: Compiled by Author -Peter B. Oyedele, 2022

At the onset of the rainy season every year, the citizens become apprehensive about the likelihood of a flood. The apprehension is worse because flood event in the State does not necessarily depend on rainfall amount or intensity since the causes of these flooding are sometimes also external to the area. For example, heavy rainfall in countries around Nigeria or in places upstream could result in a flood in Kogi State.

Table 6: Flood Historical data from Kogi State Flood incidence in 2018

S/N	LGA	Number of affected communities	Number of displaced persons	Households	Male	Female	Children (<18 years old)	Pregnant Women	Lactating Mothers	People living with disability	Injured	Dead
1	Ibaji	17	56,775	9,463	17,982	17,144	16,910	801	2,997	69	46	36
2	Koto-Karfe	22	15,260	2,543	5,249	4,801	7,147	177	384	7	4	1
3	Lokoja	18	16,083	2,681	8,069	6,923	10,137	272	359	20	7	-
4	Igalamela	25	7,360	1,227	3,790	3,570	4,830	256	163	-	-	-
5	Bassa	36	30,594	5,099	13,983	12,671	16,888	508	712	28	16	1
6	Omala	6	7,090	1,182	3,581	3,509	5,290	210	139	9	15	6
7	Idah	23	10,265	1,711	5,480	4,785	7,818	394	59	9	4	1
8	Ofu	58	11,573	1,929	3,721	3,601	4,319	17	12	-	-	-
9	Ajaokuta	9	15,425	2,571	6,283	6,383	9,540	192	208	3	1	-
Total		**211**	**170,425**	**28,404**	**68,138**	**63,387**	**82,879**	**2,827**	**5,033**	**145**	**93**	**45**

Source: Kogi State Ministry of Environment and Natural Resources (KSMENR, 2021)

Table 6 further gave a detailed account of the 2018 flood event as it revealed the number of affected local government areas, the total number of affected persons, affected children, and the number of injured individuals as well as the total number of deaths recorded.

2.2.6. Vulnerability of Rural Farmers to Flooding in Nigeria

The huge reliance of agriculture in Nigeria on rainfall as noted by Obalola and Tanko, (2016) alone is becoming even more precarious due to climate change. Serious damages from flooding incidences and the vulnerability of rural smallholder farmers due to low capital have perpetually impacted negatively on their welfare and their ability to employ diverse adaptation techniques hence mitigating subsequent shock events is usually left to the government (Ajibade et al., 2013; Oyedele, 2018). In the event of floods, the socioeconomic life and livelihood of the affected people are distorted. In most, cases farmlands and livestock the major sources of people's livelihood are submerged.

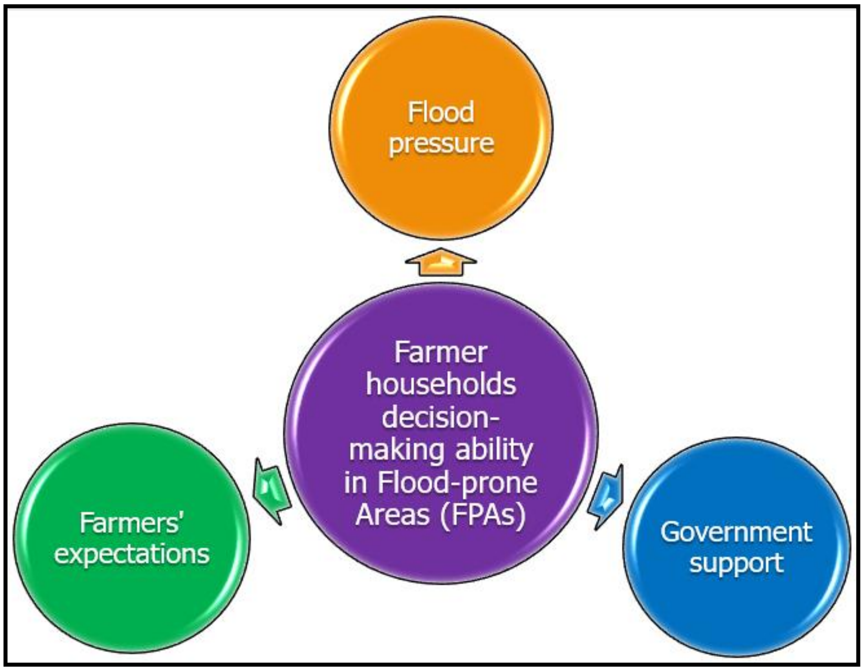
Property worth millions of dollars is lost in the event of a flood and most cases the people are displaced for several weeks, only to return home to start life afresh. Flood losses are devastating as many never get recovered after the flood recedes. Vulnerable communities suffer great losses in events of the flood, especially when the flood is unprecedented. Hunger, famine, diseases, and epidemics outbreak are usually the resultant impact of the flood (Mmom & Aifesehi, 2013). A decline in food production can lead to starvation which may, in some cases, last for several months after each episode of the flood. Starvation, together with a decline in environmental quality resulting from flood-related damage, fuels the desire for migrating out of these rural areas (Armah et al., 2010).

The report also revealed that Kogi was one of the most affected states. Being a largely agrarian state, farmers in Kogi state are mostly hit whenever floods occur owing to their vulnerability. On the account of the 2012 flood, farmlands, animals, farming activities, lives, and properties were destroyed in subsistence farming and a great loss to those engaged at a commercial scale (Kolawole et al., 2011).

2.2.7. Decision-making of household to flood disaster

Decision-making is crucial in our everyday life. People decide on an event based on the cause and effect of such events. Given that several negative consequences come with flood disasters, to mitigate the impacts, a set of flood reduction measures need to be taken as noted by de Brito and Evers, (2016). Gaillard, (2010) described an individual's decision-making towards a hazardous situation as their understanding and interpretation of the risk and how it will affect them, their family, and the wider environment. For instance, people tend to settle in areas regarded as flood-prone regardless of the consequences. In addition, the decision to move or not to move in is dependent on the gains and benefits of the household to a new area as opined by (Wang et al., 2018). In their study on the decision of farmers to move or not to move from flood-prone areas, Wang et al. (2020) adopted the decision-making model of Brown and Moore. The decision-making ability of farmer household living in flood-prone areas (FPAs) towards flood disaster management (i.e. action before, during, and after) hinged on three factors, namely: flood pressure; government support; and the farmers' expectation (Figure 10).

Figure 10: Factors for determining household decision-making in flood-prone areas (FPAs)



Source: Adapted from Wang et al. (2020, p. 3)

According to the model, as shown in Figure 10, flood pressure refers to the probability of utilization of the FPAs; it was assumed that if the FPAs have a high probability of utilization, the flood pressure will be high; otherwise, the flood pressure will be low. This was considered the push factor associated with the original residence (Wang et al., 2020). However, when negative environmental pressure exceeds the pressure threshold (different individuals have different pressure thresholds), people will take measures to migrate.

The second factor which is government support according to the framework refers to the government's promotion of a smooth relocation process through rational planning of the resettlement population carrying capacity and the potential for economic development, provision of investment funds for infrastructure construction, issuance of resettlement grants, and implementation of measures and preferential policies to encourage farmers to relocate in case of any disasters. Finally, based on a complete understanding of the resettlement policy and resettlement conditions, farmers form expectations of the living and production environment of the resettlement site (Wang et al., 2020).

2.2.8. Perception of households towards flood disaster

To study and reduce the negative impact of flood disasters on society and the economy, researchers began to pay attention to flood risk assessment and flood risk management. Many researchers studied the objective flood risk (Kellens et al., 2011; Wang et al., 2018), such as flood occurrence probability, flood inundations, and economic loss based on risk perspective. Another researcher believes that the subjective factors of an individual can influence the judgment of the objective of flood disaster risk. According to Kellens et al. (2011), one of the important factors, and that has become an important topic to policymakers that are concerned with flood risk management is the individual's flood risk perception. Individuals' flood risk perception, as revealed by Wang et al. (2018) has become an important topic for policymakers that are concerned with flood risk management. Kellens et al. (2011) reported that understanding people's risk perception is a necessary tool in modern-day flood risk management and mitigation strategies. To understand individual decision-making around natural hazards, it is important to understand the perception of risk (Gaillard, 2010). Because the perception of risk is personal, it makes it difficult to understand an entire community's perspective. A person's perception is built by many factors including the interpretation of facts, the personal potential for loss, external influences such as media, and personality traits.

Samuels et al. (2009) described risk perception as a 'pre-scientific' process, mostly influenced by attitudes, intuition, expectations, information about and experiences with hazards. Risk perception is important in understanding and anticipating public responses to hazards, setting priorities, effectively channeling resources, and effectively communicating risk information on the side of laypersons and experts (Samuels & Gouldby, 2009; Wang et al., 2018). The role of risk perception is needed to reduce disaster risks and improve hazard mitigations (Bradford et al., 2012). How people perceive the risks of climatic hazards is currently a major research thrust in the field of risk perception (Harlan et al., 2019).

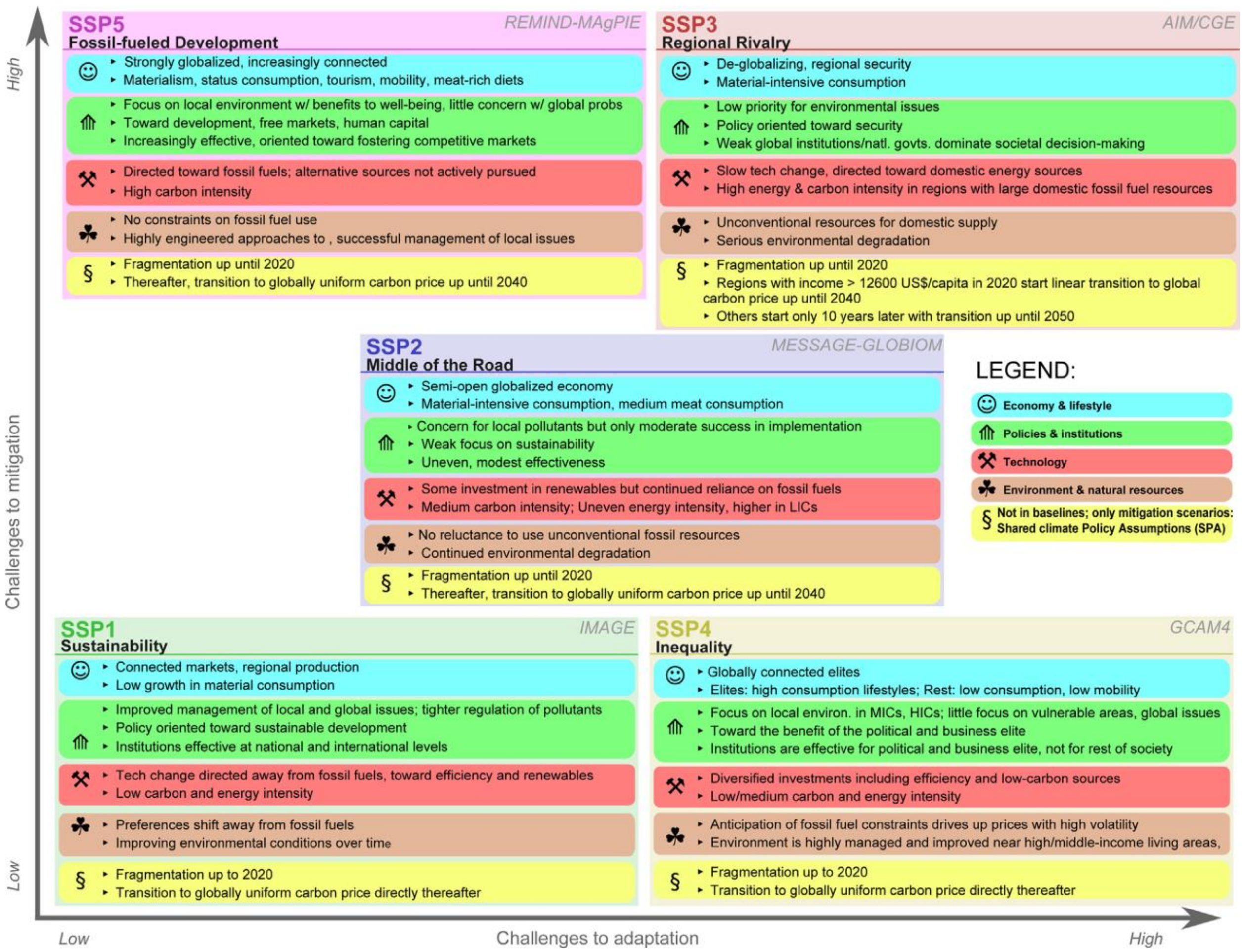
In their work on flood risk perception in flood-affected communities in Lagos, Nigeria, Adelekan & Asiyanbi (2016) emphasized that risk perception of the public in response to flooding remains a holistic approach to managing flood risk as it considers their social information, and aids the understanding of the factors underlying exposure to flood hazard. Understanding risk perception is not only a useful tool to get more insight into the risk-reducing processes but also it helps to improve the level of preparedness and ultimately reduce flood losses (Becker et al., 2014). In addition, Wang et al. (2018) itemized the import of studying risk perception among vulnerable communities as follows:

1. People's behavior is influenced by their risk attitudes toward the event;
2. People with different characteristics have a different attitudes towards the same kind of event, and this difference can be useful for improving flood risk control and management;
3. Existing flood control engineering measures can reduce the real flood risk, but human behavior is rational, and their understanding of things is not sufficient, which can easily lead to behavioral deviation. It is difficult to achieve the desired results by only using technical means to reduce the risk of flooding;
4. Residents are both victims of disasters and executors of flood disaster prevention and mitigation policies. Studying their flood risk perception is helpful to understand their attitude toward policies and possible behaviours.

2.2.8. The scenario framework for future climate projection in Kogi State

Changes in the pattern of precipitation, temperature and potential evaporation (as a result of climate change) drive modification in the global water cycle in general, and more specifically in rivers' runoff, ground water, and the availability of water (Bates et al, 2008). Climate change has substantial impact on rivers, lakes, flood and/or drought in West Africa (IPCC, 2007). The new scenario framework (van Vuuren et al., 2012) which encompasses Representation Concentration Pathways (RCPs) and Shared Socio-economic Pathway (SSP) (Figure 11) indicating future climatic and economics scenarios respectively developed by the Intergovernmental Panel on Climate Change (IPCC) could be an appropriate datasets to achieve the climate-economic demand projection assessment. The RCPs comprises four different 21st-century pathways of greenhouse gas (GHG) emissions and atmospheric concentrations, air pollutant emissions and land use (IPCC, 2014).

Figure 11: The shared socioeconomic pathways (SSPs) narratives



Source: Bauer et al., 2017

The Shared Socioeconomic Pathways (SSPs) first was which introduced by (O'Neill et al., 2014) and are being used in the upcoming 6th IPCC Assessment Report. SSPs are based on five narratives describing broad socioeconomic trends that could shape future society (Pachauri, 2014), to facilitate the integrated analysis of future climate impacts, vulnerabilities, adaptation, and mitigation (Riahi et al., 2017). The narratives show future socio-economic pathway without climate change consideration and there are five. The description of each SSPs narratives is presented in the chart below. SSPs provides projections for some socio-economic variables such as: population, education, urbanization, and economic development. In the past, the IPCC reports have been focusing more on the concentration pathways, with respect to what will be the amount of CO_2 in the air, this is like more focusing on the emission, and future trajectory of the economy will also have an impact. So this mean that if we go for a greener economy, it means that we have to expect more transformation. This means that we would expect less emission in the future. So if the economy is going towards strong emission economy using coal, natural gas and the like, it means that this will result in much more emission of CO_2. So how that translate into more emission and how it will affect the climate system is of greatest importance. So we have two major drivers, economy driver (population, income, etc.) and the climate. This is the advantage of the new framework introduced in the recent IPCC report.

Conclusion

This chapter has made it possible to specify the conceptual field in which this research falls. A conceptual framework based on the definition of the problem, the clarification of concepts, and the review of the literature. Indeed, the analysis of this literature review clearly shows that flood disaster is a sensitive issue to which many authors have not remained indifferent as they put efforts into investigating the subject and proffering suggestions and outcomes of their investigation. Through their research, the various authors have clearly shown the variable nature of flooding both in space and in time. This flood disaster has greater impacts on the farmers, their environment as well as their livelihoods. Additionally, to avoid possible confusion in the global and detailed presentation of this methodology, it is useful to present the methods used for this research. This is what the next chapter tends to achieve.

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODOLOGY

Introduction

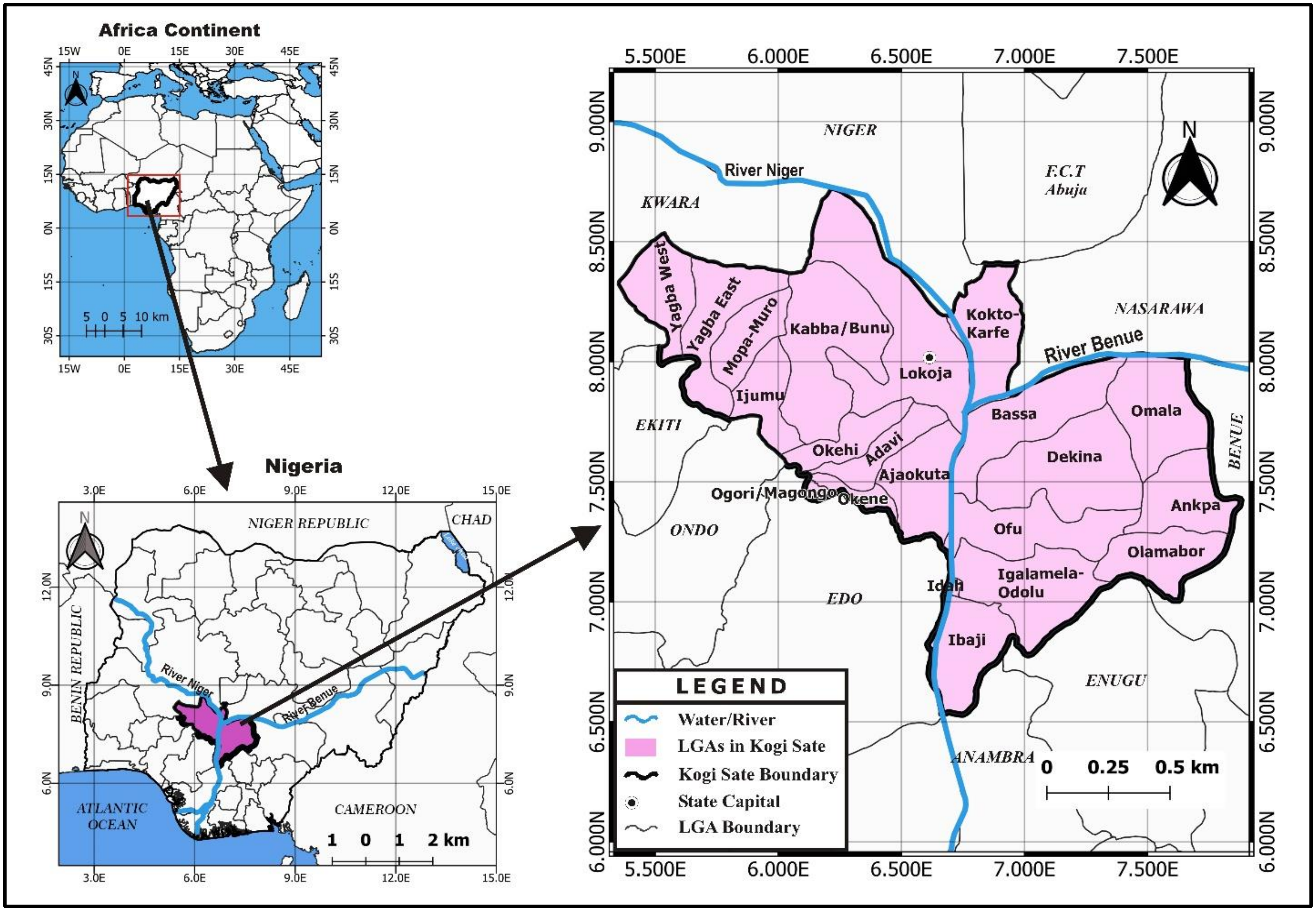
Scientific approaches are used in tandem with the study's goals and objectives to address the identified research gap. As a result, a key component of the thesis in this case is the research methodology. The research methodological approach in this study is presented in three phases; description of the study area in terms of both the biophysical characteristics (study location, the climatic, soil textures analysis, vegetation cover) and the socio-economic characteristics (population, and economic activities); Methods adopted (sampling procedure, data required, as well as the sources of the data; Data collection and analysis (data collection procedures, and data processing). These were presented in this chapter so that readers may comprehend the methods and approaches adopted to achieve the stated research objectives.

3.1. Study area description

3.1.1. Location

The study was carried out in Kogi, Nigeria, located between latitudes 7^{o}301N to 7^{o}521N and longitudes 6^{o}381E to 6^{o}421E. The State was created out of Kwara and Benue States along with eight other states on the 27th of August 1991. It is divided into three senatorial districts namely: Kogi East, Kogi Central, and Kogi West. It is one of the States in the North-Central geo-political zones of Nigeria with a total land area of 29,833 km^2 and a population of 3,314,043 in 2006, with a projected population of 4,473,500 in 2021 (kogistate.gov.ng, 2021). Kogi State is made up of twenty-one (21) local government areas (LGAs), with its headquarters in Lokoja (see Map 3).

Map 3: Kogi State map showing all the 21 local government areas (LGAs)



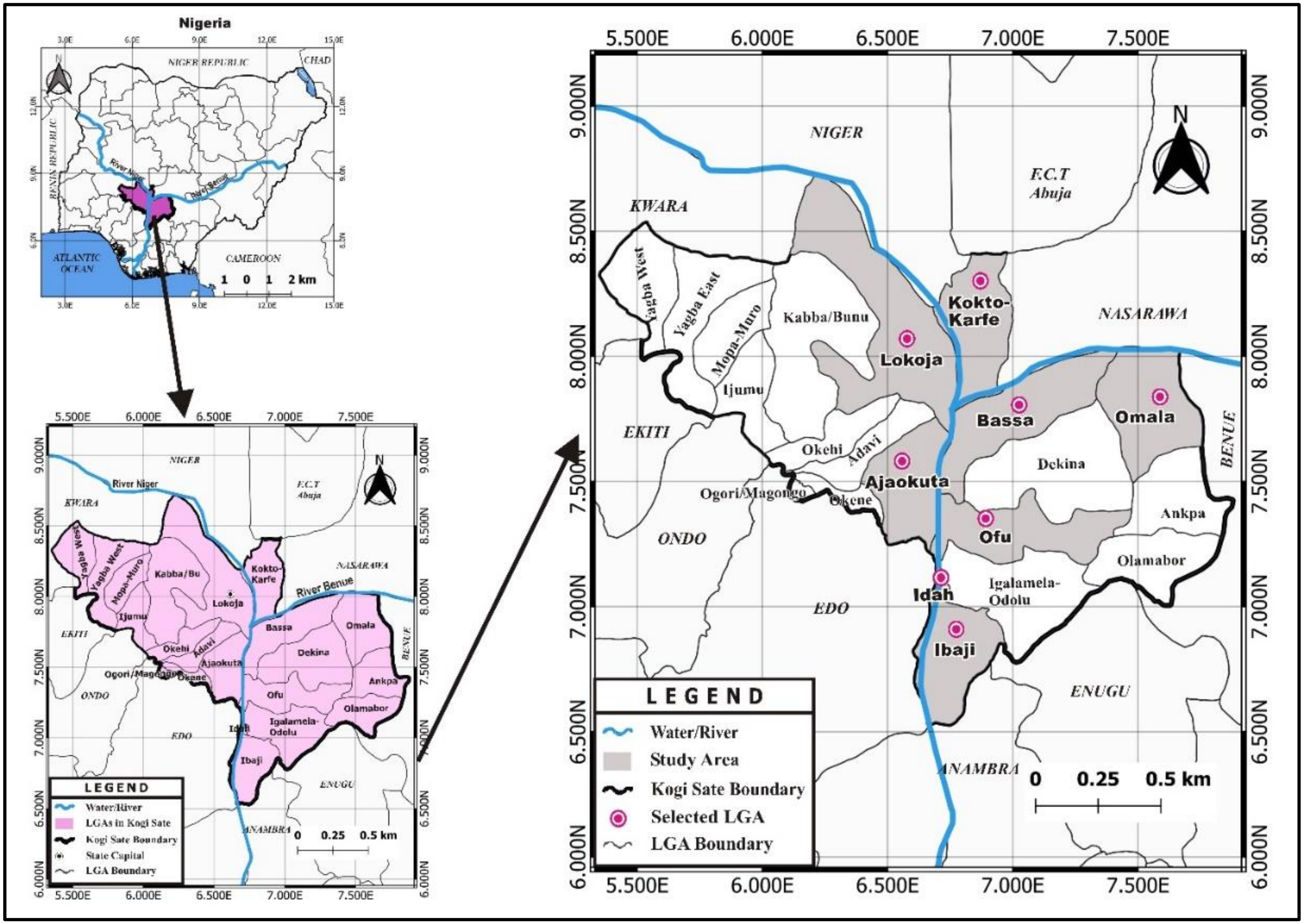
Source: Author's (Peter B. Oyedele) analysis of data from USGS SRTM and Diva-GIS, 2021

The two major rivers in Nigeria, the Niger, and the Benue are also shown on the map as they pass through the State. The Niger River forms a confluence with the Benue River at Lokoja the State capital. Hence, popularly referred to as the “Confluence State”. Kogi is drained by these rivers and their tributaries. This justifies why many of the communities around this span of the rivers are the areas frequently affected by floods (Oluwaseun et al., 2013). Historically, several communities in nine of the total LGAs have been prone to flood disasters.

Households living in communities from these LGAs, Ibaji, Ofu, Ajaokuta, Idah, Bassa, Omala, Lokoja, and Koto-Karfe as shown in the map, were selected on purpose for this study. According to a report from Adaoyichie (2019), more than 150 communities from these LGAs were submerged under floodwater during the 2019 flood disaster incidence in Kogi State.

Due to a recent flood event in 2019, eight LGAs (Map 4) whose communities were reported to be flooded by overflowing rivers were purposively selected for this study (Adaoyichie, 2019; NEMA, 2018).

Map 4: Study area map, showing the selected local government areas (LGAs)



Source: Author's (Peter B. Oyedele) analysis of data from USGS SRTM, Diva-GIS and Field survey (coordinates of communities), 2021

3.1.2. Physical characteristics of the study area

The characteristics of the study are presented including, elevation model, hillshade, soil type, climate, hydrography and vegetation so as to establish the direct and indirect link with the study context -flooding were documented.

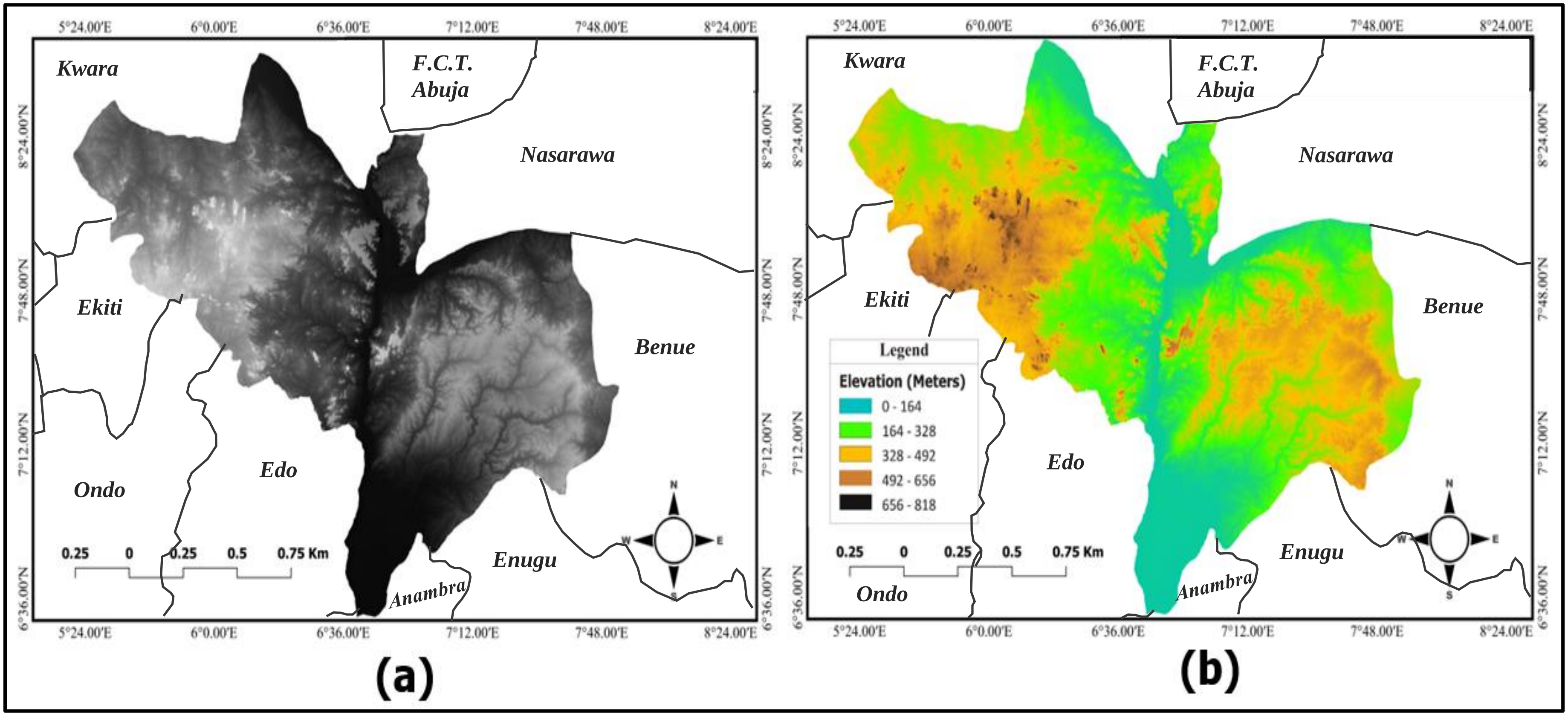
3.1.2.1. Topographical features of the area

A topographical map is one that shows the physical features of the land. Topography plays an essential role in flood intensity, and for determining a flood-prone area, topographic elements directly affect runoff velocity and flow size (Kia et al., 2012). Physical measurements of topographical elements like slope, aspect, elevation, contour, and hill shading qualities can be used to determine the causes of probable flood-related issues (Anis-Athirah et al., 2021).

- **Elevation map of the area**

According to Garrote (2022), a basic terrain analysis of a digital elevation model (DEM) are very useful for flooding analysis (Garrote, 2022; Ntajal et al., 2017). Elevation controls the water discharge rate; therefore, communities in low- elevation areas are highly susceptible to flood events, while those in high-elevated areas are safe from the torrent amid flooding noted Das et al. (2019). In their work, De Risi et al. (2018) alluded to the importance of DEM analysis, that, it support and gives a basic information for the inundation simulations of any area. Similarly, using DEM along with empirical field data on floods is one of the most reliable methods of assessing flood risk in developing countries (Garrote, 2022). It was based on this understanding that the DEM analysis of the study area was considered and in this study so as to know have a knowledge of its linkage with respect to flooding in Kogi State. A 30 meters resolution DEM obtained from the United State National Aeronautics and Space (NASA) Shuttle Rada Topography Mission (SRTM) project website (http://gdex.cr.usgs.gov/gdex/). The analysis was carried out with the spatial analyst tool and management analyst tool on the QGIS toolbox to provide models on the elevation of the selected areas under study. The elevation of the entire Kogi State was estimated and was further zoomed into the study using the different functions (rasterization, clipping, and conversion) in the QGIS environment. For the study, elevation and the hillshade were derived from the SRTM DEM of the study area. Map 5 shows the generated elevation map.

Map 5: Digital elevation model (DEM) SRTM map of Kogi State



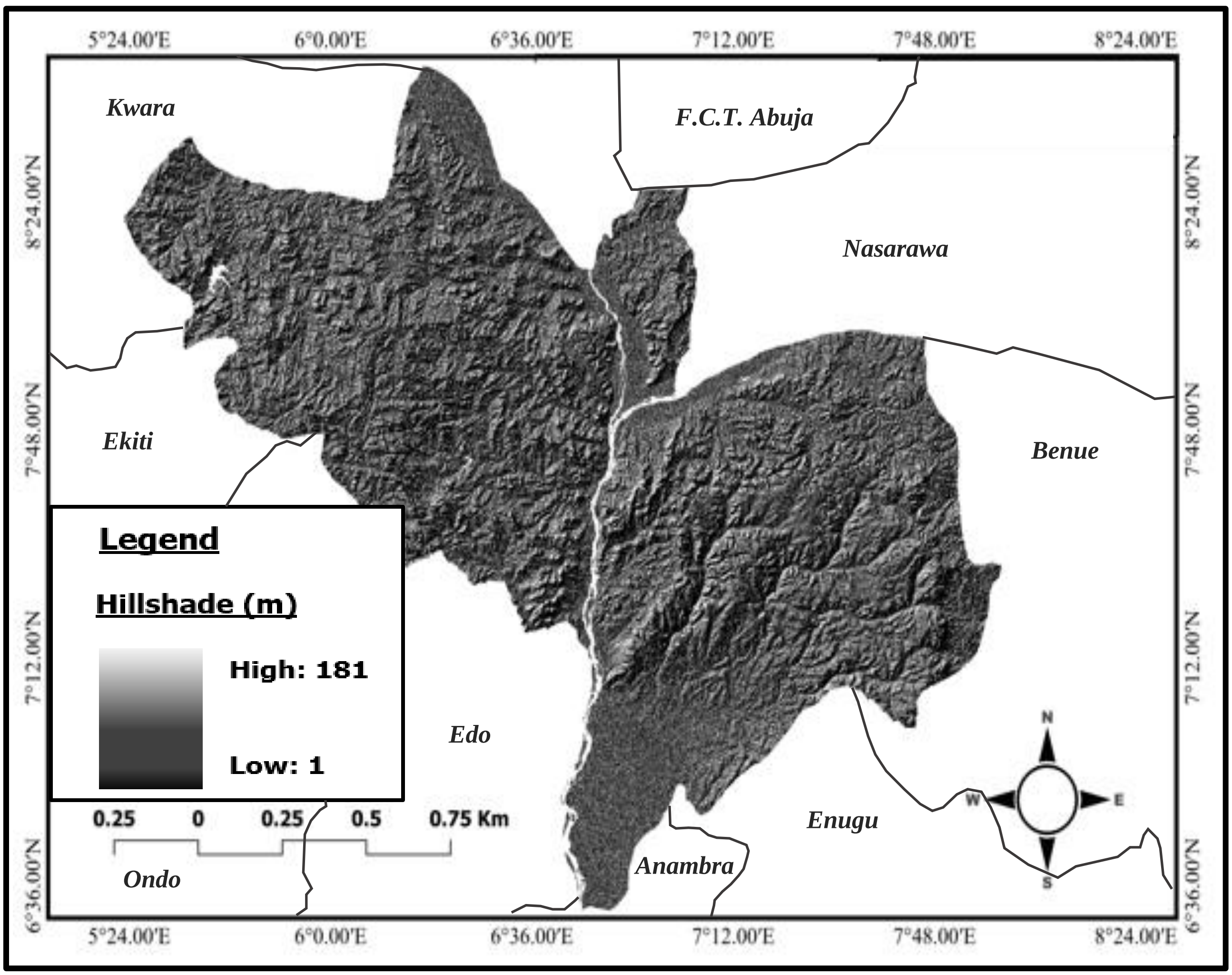
Source: Author's (Peter B. Oyedele) analysis of Topographical data from USGS SRTM and Diva-GIS, 2021

Maps 5 “a” and “b” show the DEM SRTM and the elevation map of Kogi State. It shows that the elevation values of Kogi State ranged between 0 meter and 818 meter.

- **Hillshade and the enhanced elevation map of Kogi State**

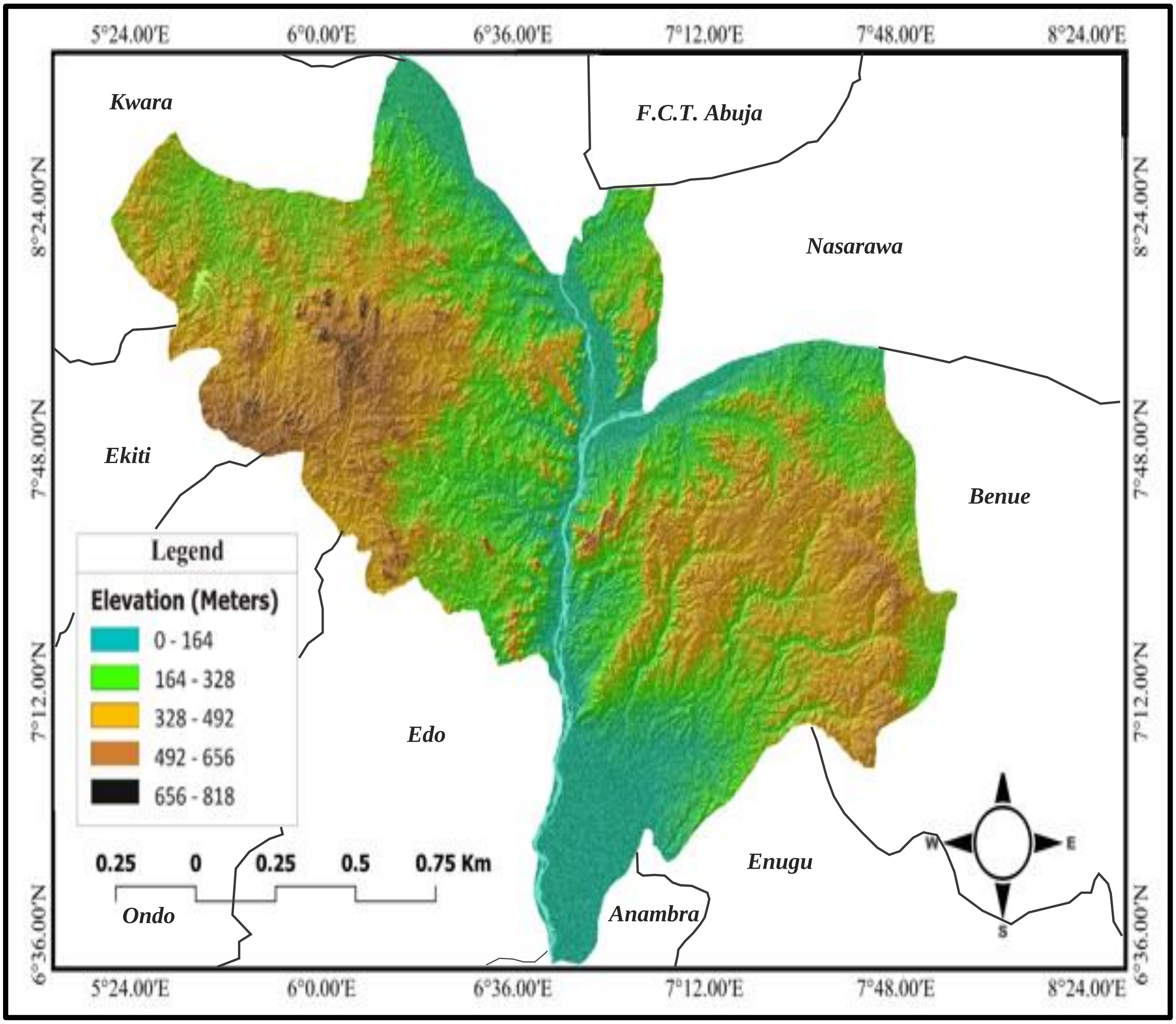
The hillshade was also extracted in a 3-dimensional representation of the terrain surface. It is a technique for visualizing a terrain determined by the combination of a light source which can enhance the elevation of a given area (Anis-Athirah et al., 2021). Map 6 and 7 below show the hillshade and the enhanced map of the entire Kogi State.

Map 6: Hillshade map of Kogi State



Source: Author’s (Peter B. Oyedele) analysis of Topographical data from USGS SRTM and Diva-GIS, 2021

Map 7: Enhanced map of Kogi State



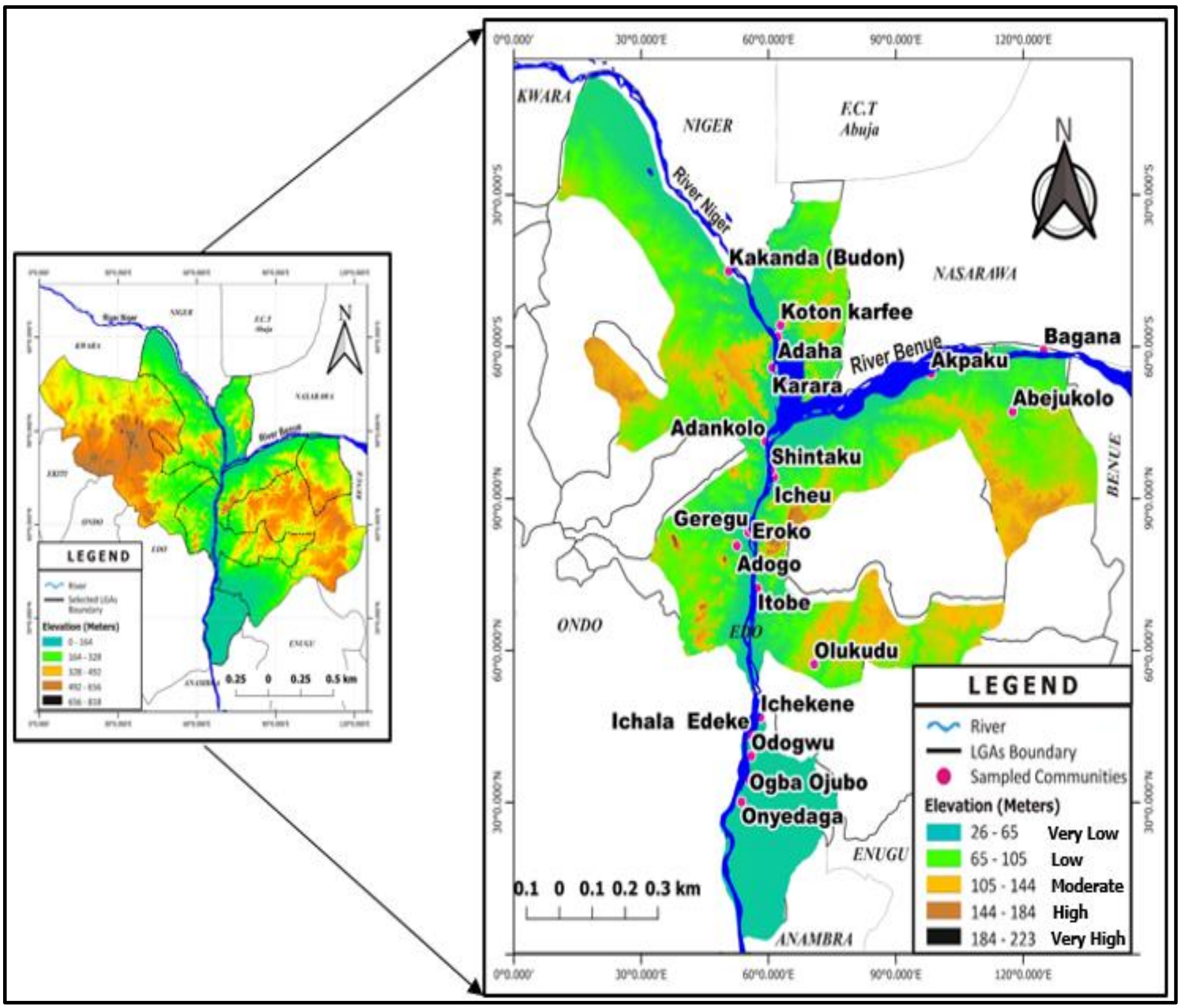
Source: Author's (Peter B. Oyedele) analysis of Topographical data from USGS SRTM and Diva-GIS, 2021

The hillshade map is presented in Map 6. By overlapping the topographic factors of hillshade and the DEM SRTM, it produces the enhanced elevation map of Kogi State (Map 7). A critical look at the map, shows that elevation of Kogi State, in which the study communities falls is characterized by relative elevation. This, on the map is designated from blue to black colours. The blue colour shows areas that are of lower elevation while the black are those of higher elevations.

- **Elevation of the sampled communities**

The elevation map of the sampled communities was extracted from the Kogi State SRTM DEM man. It shows that the elevation vales in the area ranged between 26 meter and 223 meter. Elevation values were classified into five, where 26 meter to 65 meter represents very low elevation, 65 meter to 105 meter, 105 meter to 144 meter, 144 meter to 184 meter, and 184 to 223 meter represent low, moderate, high and very high elevations as shown in Map 8.

Map 8: Elevation of the sampled communities



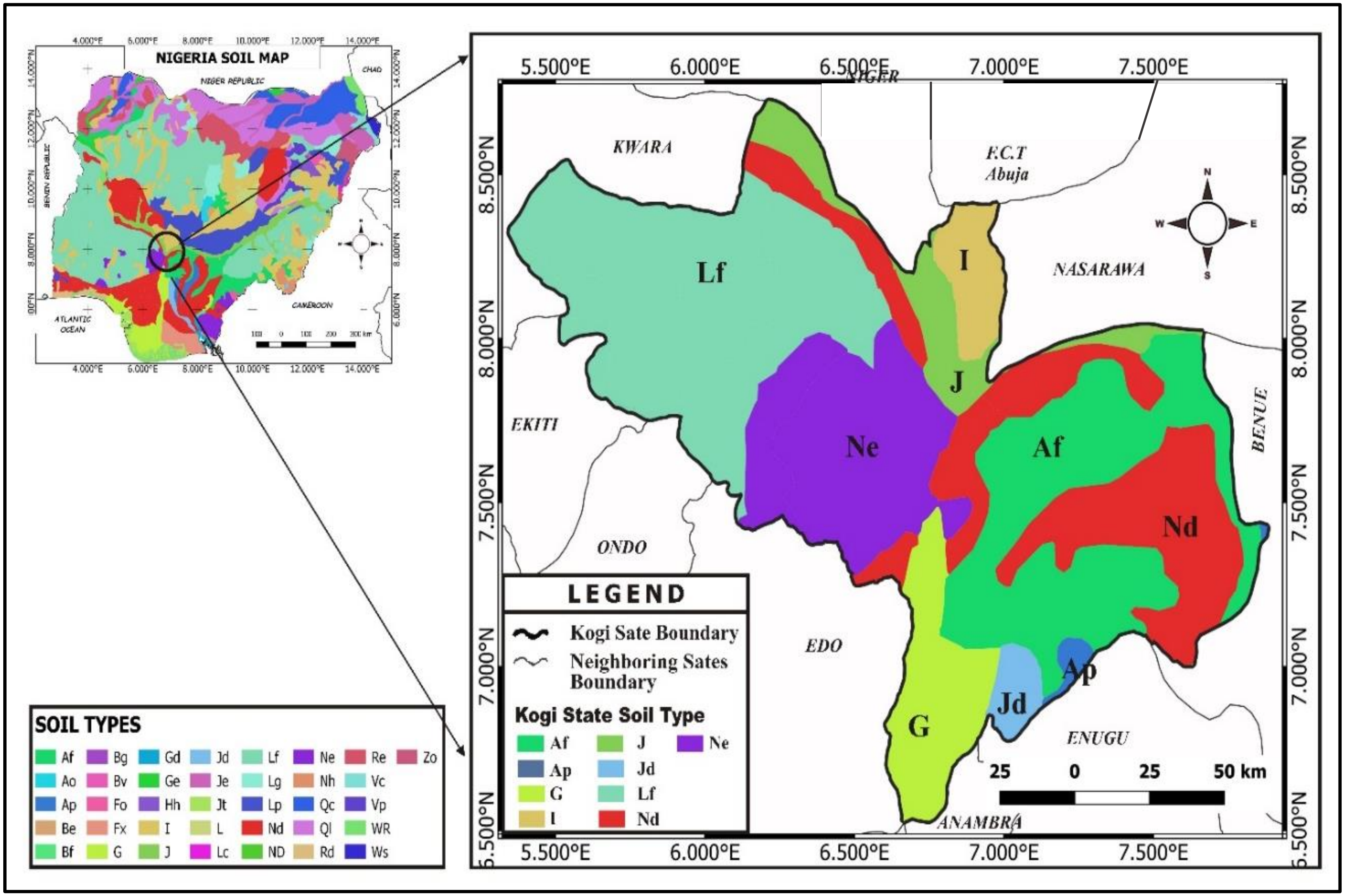
Source: Author's (Peter B. Oyedele) analysis of data from USGS SRTM, Diva-GIS and Field survey (GPS coordinates of the seleceted communities), 2021

From the map, communities such as Geregu, Eroko, Icheu, Shintaku, Odogwu, Ogba-Ojubo, Onyedega, Ichekene, Ichala Edeke, Edeha, Apaku, Kogi-Koto Karfe, Kankanda (Budon), Adankolo, Karara, and Bagana were observed to be located in areas where the elevation ranges between 26 to 65 meters above sea level and this connotes lower elevation. While Adogo, Itobe, and Abejukolo and Olukudu communities were located in areas characterised moderate to very high elevations. This analysis shows that 60% of the total area under study is covered by low to very low elevation, while 40% of the area falls in the high elevation. This connotes that these communities have the lowest elevation and can this can be used to explain why inhabitants of such communities are vulnerable to flooding. Elevation plays a major role in flood vulnerability and disaster risk mapping analysis. Müller et al. (2011) noted that the lower the elevation, the higher the flood exposure, hence, the more vulnerable will the system be. Low elevation are most prone to flooding (Anis-Athirah et al., 2021).

3.1.2.2. Soils types of the area

Soil is described as "a non-renewable dynamic natural resource that is necessary to life" by (Schoonover & Crim, 2015, p. 21). Soil is related to water flow, water quality, land usage, and vegetation productivity. Generally, soil type influence what happens to precipitation when it reaches the ground. Impermeable soils such as clay do not allow water to infiltrate, this forces water to run off reducing river lag times and increasing flood risk Getahun and Gebre (2015). Like other locations, the soil textures in Kogi State were also verified and analysed to understand how it aids infiltration and flow of water. Depending on its characteristics such as water holding capacity, rate of infiltration, soil then plays a crucial role in the absorption of water and by extension, flooding as noted by (Ifediegwu et al., 2019). These soil types were shown in Map 9.

Map 9: Soil types in Kogi State by FAO standard



Source: Author's (Peter B. Oyedele) analysis of data from USGS SRTM and Pedological data from FAO (2021)

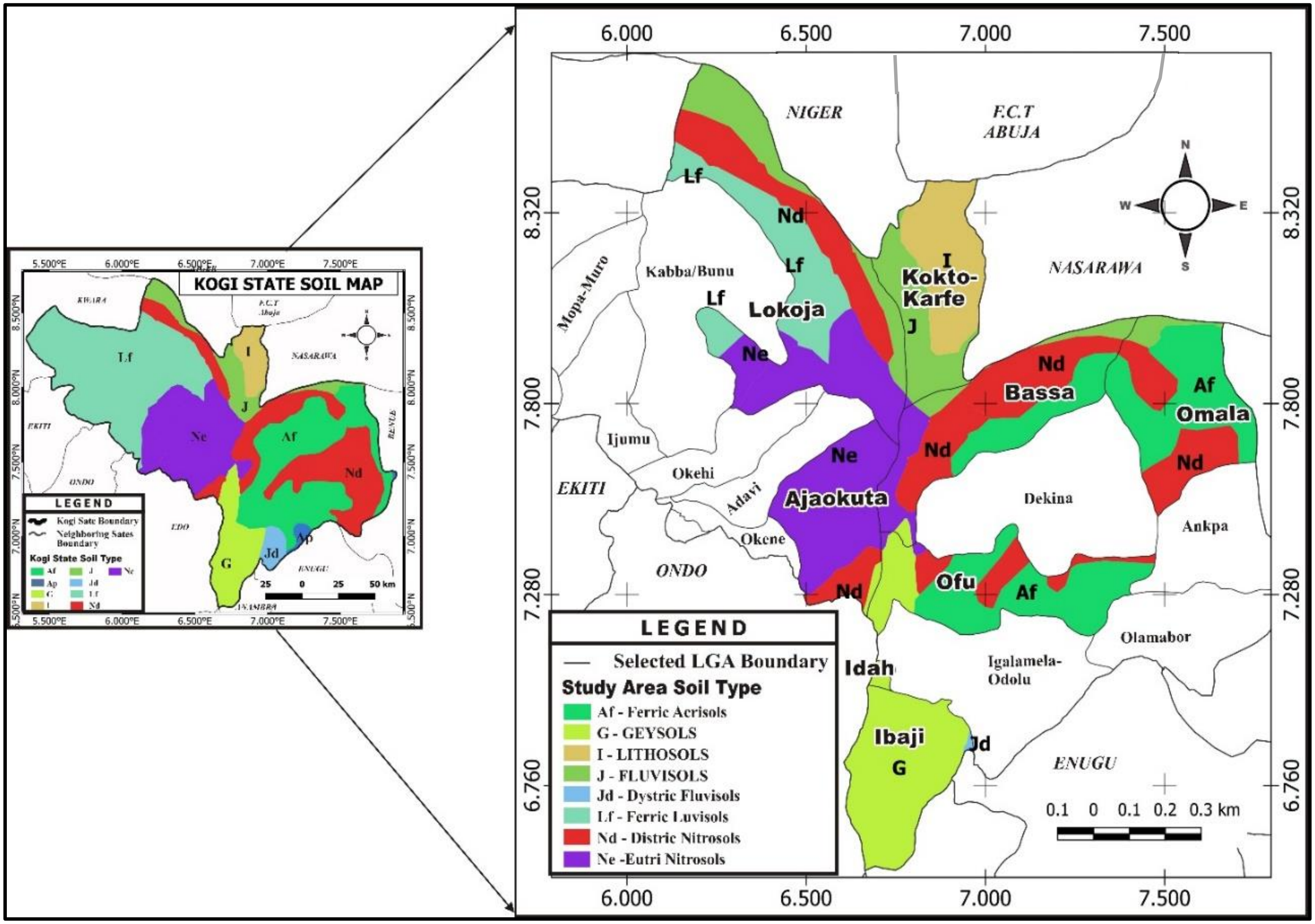
The map shows that there are different types of soil in Kogi State based on the data retrieved from the Food and Agriculture Organization (FAO, 2021) soil database the result of the soil analysis. From the map, it was seen that Kogi State consists of different soil types. According to FAO (2021), these soil types have different water retention capacities and permeability, as such, they can be considered in understanding the causes of flood disasters. Karmakar et al. (2010) earlier opined that the effects of soil type (permeability) and land use/land cover on flood severity are also taken into account when assessing flood exposures. In clear terms, overly saturated soil in such plain areas will no longer be able to absorb the water and will cause flooding of water (Aldardasawi & Eren, 2021). Finally, to determine flood risk at various locations in a watershed, values for the probability of flood occurrence, vulnerability to flooding, exposures of land use, and soil type to flood are utilised (Karmakar et al., 2010).

- **Dominant Soil-types in the Selected LGAs**

To further understand the soil type in the selected study locations, the Kogi State was zoomed in to achieve this purpose. The analysis of the soil types in the selected LGA is presented in Map 10.

Lokoja LGA for example has a combination of four types of soil namely: Distric Nitrosols (Nd), Fluvisols (J), Eutric Nitrosols (Ne), and Ferric Luvisols (Lf) in almost equal proportion. Ajaokuta, on the other hand, comprises three types of soil, the Distric Nitrosols (Nd) dominated followed by Eutric Nitrosols (Ne) and a very negligible portion of the Gleysols (G). Lithosols (I) and Fluvisols (J) were the two types of soils found in Koto-Karfe. In addition, Bassa LGA was characterized by a combination of five different soil types in fractional portions. These include Lithosols (I), Distric Nitrosols (Nd), Ferric Acrisols (Af), Fluvisols (J), and Eutric Nitrosols (Ne). The dominant soil type was found to be the Distric Nitrosols (Jd). In Omala, three types of soil were found there. They are Distric Nitrosols (Nd), Fluvisols (J), and Ferric Acrisols (Af). Furthermore, Ofu LGA also has a combination of four types of soil: Gleysols (G), Distric Nitrosols (Nd), Ferric Acrisols (Af), and Eutric Nitrosols (Ne).

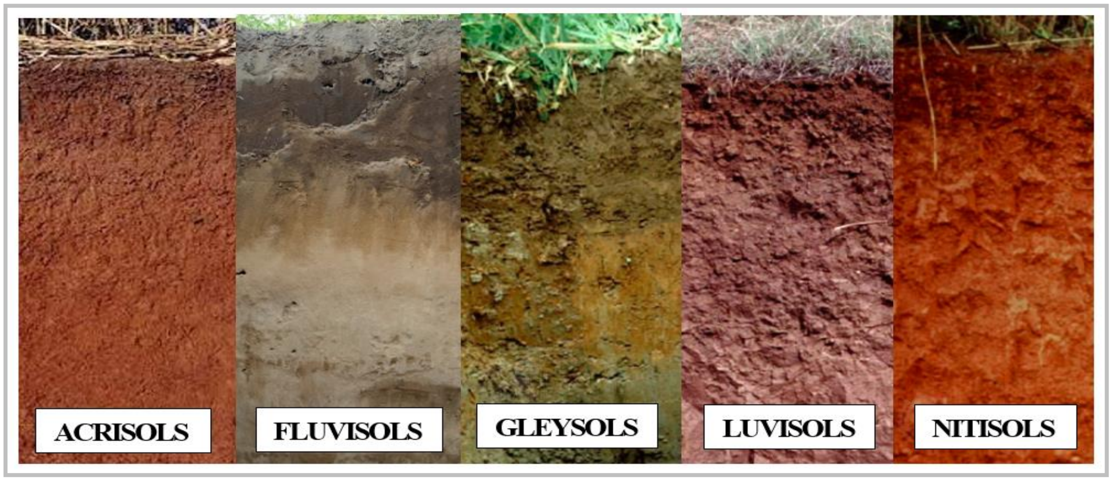
Map 10: Soil types in the selected study location



Source: Author's (Peter B. Oyedele) analysis of data from USGS SRTM and Pedological data from FAO (2021)

Finally, the result of the soil mapping revealed that the Gleysols covered Idah and Ibaji LGAs. From the foregoing, five major soil-type were identified in the study area and these are Acrisols, Fluvisols, Gleysols, Luvisols, and Nitisols (Photo 4).

Photo 4: Dominant Soil-type in the study location



Source: Author's (Peter B. Oyedele) Fieldwork, 2021

Photo 4 shows the observable soil types during the fieldwork. These soils are common across many of the sampled communities. According to Nachtergaele et al. (2012, pp. 23–30), Acrisols are soil with a subsurface accumulation of low-activity clays and low base saturation, while Fluvisols are young soils in alluvial deposits. Also, Gleysols are soils with permanent or temporary wetness near the surface, Luvisols are soil with a subsurface accumulation of high activity clays and high base saturation and Nitisols are deep, dark red, brown, or yellow soils having a pronounced shiny nut-shaped structure. Schoonover and Crim (2015) further defined Gleysols and FLuvisols as those formed under waterlogged conditions produced by rising groundwater found typically on level topography that is flooded periodically by surface waters or rising groundwater, as in river floodplains respectively.

These soil types are dominated by the montomorillonite clay mineral. Typically, they are used for dryland crops or rice cultivation or, after flooding, for field crops and for grazing in the dry season. This is the case in Idah and Ibaji where rice cultivation is the major crop in the area due to the nature of their soil. This clay mineral expands when there is a wet condition and shrinks when there is a dry condition, causing cracks at the surface in the dry season. This is linked to the fact that places with lower elevations stand a higher exposure to flooding with a given clay soil (Photo 5) and land cover type (Tingsanchali & Promping, 2022).

Photo 5: Observed Clay soil type in Olukudu community

Source: Author's (Peter B. Oyedele) Fieldwork, 2021

3.1.2.3. Climate and hydrography of the area

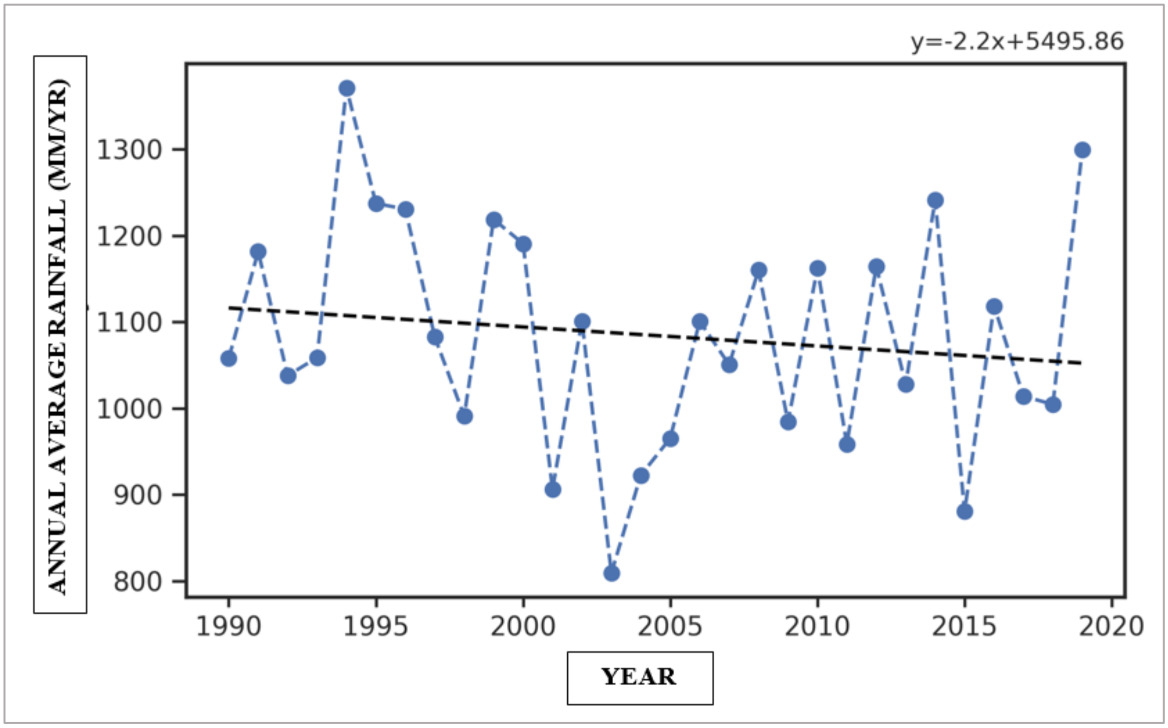
- **Climate**

The climatic cover of Kogi State is tropical, which is characterized by two major seasons; dry season and wet season (Climate-Data.org, 2022) . The wet season begins towards the end of March and ends towards the end of October. In every wet season, rainfall starts as late as April in some parts of the State. The area enjoys both wet and dry seasons with the total annual rainfall ranging between 804.5mm – 1767.1mm (Audu, 2012).

- **Precipitation**

Historically, precipitation is the lowest in January, with an average of 1 mm. In August, the precipitation reaches its peak, with an average of 1081 mm. The dry season begins in November and lasts until late February. According to Audu (2012), the Harmattan wind is experienced during the dry season for about two months (December and January). The Figure 12 shows the annual precipitation variation in Kogi State from 1990 to 2020.

Figure 12: Annual precipitation variation in Kogi State from 1990 to 2020



Source: Author's analysis of CHIRPS data from Climate Hazards Center https://data.chc.ucsb.edu/products/CHIRPS-2.0/

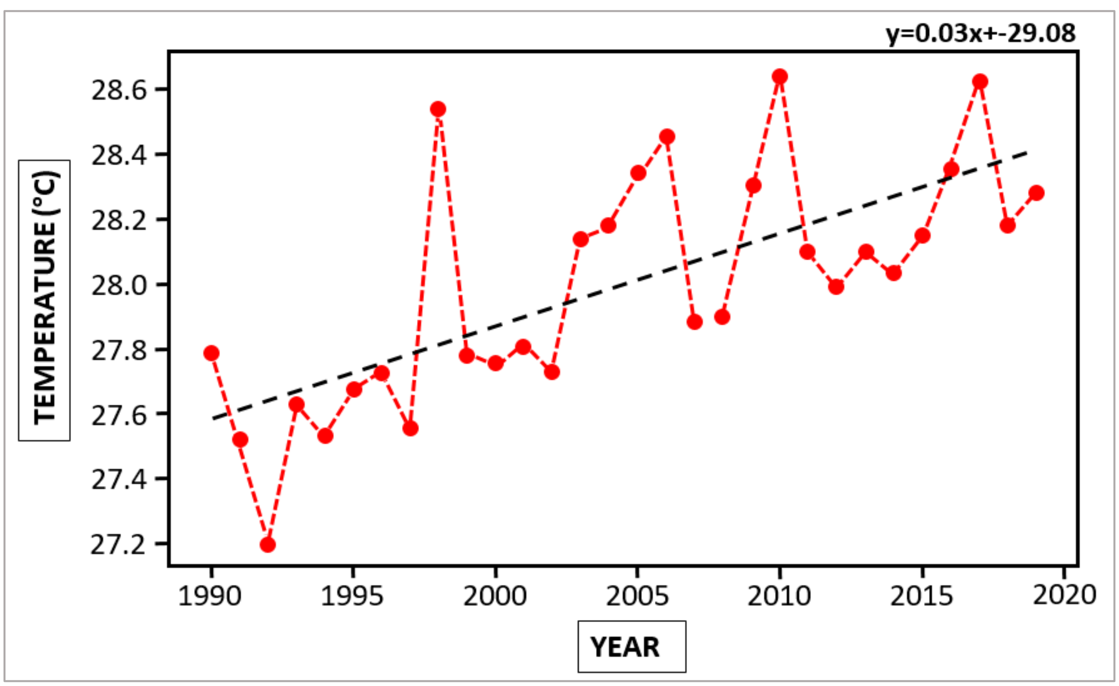
From the figure, it can be noticed that the precipitation have changed over the last 30 years across the study area. The Figure show both the minimum and maximum precipitation. The maximum annual rainfall was observed to be far above 1300 mm observed around 1994, while the minimum precipitation amount within this time range was 800mm observed between 2003 and 2004. The average rainfall amount within the past 30 years in the study area is 1084mm/year. The trend line in the Figure clearly shows that the precipitation pattern is decreasing over the last 30 years. This shows that there are strong variability in the area. These variation was also recorded for each of the selected area (see Appendix 3 and 4).

In particular, a look at the last decade from 2010 to 2020, an obvious shift in the rainfall pattern was observed. Also, from year 2000 to around 2013, it was equally observed that the precipitation amount was less than 2000mm/year. This is means that there was a decrease in the rainfall amount in the area. Specifically, in 2019, there was a regain in the precipitation amount that increase in rainfall pattern. Based on the analysed data, on the average, precipitation is decreasing in the study areas. The decreasing pattern of rainfall amount may be due to the increase in the observed global change. This had made the region to have experienced an extreme rainfall event that had led to flooding within the past decades. And this had had a very negative impact and significant on the farming activities of the rural communities in the area whose agricultural activities is rain-fed. The noticeable variation in the rainfall regime in the area may caught the community dwellers unaware in the periods when there will be higher volume of rains that eventually leads to flooding. Also, the community are most likely used to these observable changes in the precipitation patterns.

Temperature

The Figure 13 shows the annual temperature variation in Kogi State from 1990 to 2020. Based on the analysed chirp's data, it observed that there has been variation in the temperature of the study area over the past 30 years. The maximum and minimum annual temperature are 28.8^{o}C and 27.2^{o}C respectively. The average temperature is 28.0^{o}C. The trend line in the Figure clearly shows that the temperature pattern is increasing over the last 30 years. This shows that there are strong variability in the area. These variation was also recorded for each of the selected area (see charts in the Appendix).

Figure 13: Annual temperature variation in Kogi State from 1990 to 2020



Source: Author's analysis of CHIRPS data from Climate Hazards Center

https://data.chc.ucsb.edu/products/CHIRPS-2.0/

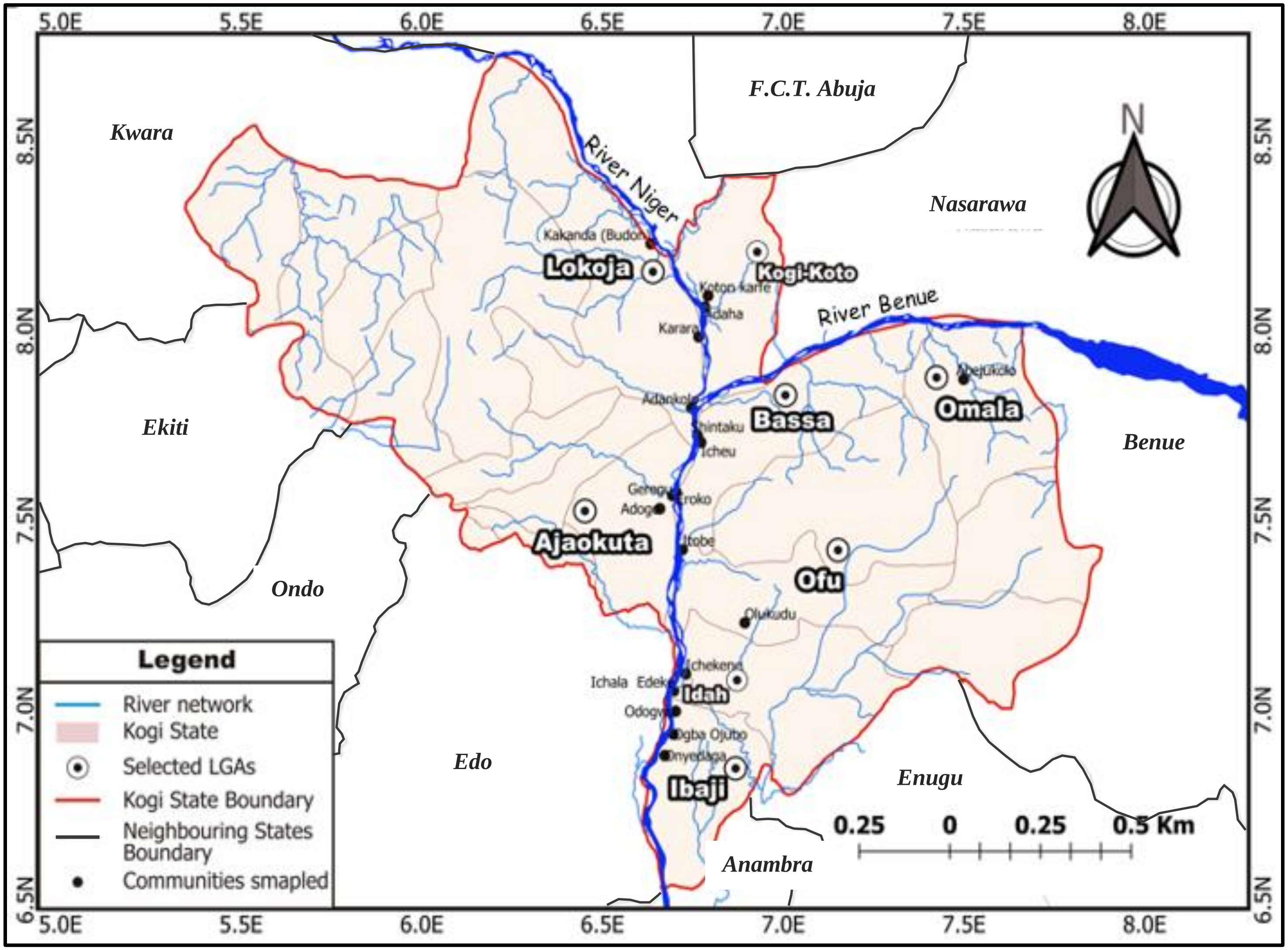
In addition, the relative humidity of 30% in the dry season and 70% in the wet season (Alabi, 2009; Ibitoye, 2012). The average daily wind speed is 89.9 km/hr. The average daily vapour pressure is 26 Hpa (Audu, 2012).

- **Hydrography**

The most important hydrogeological feature is the River Niger and the confluence of Rivers Niger and Benue (Audu, 2012). Within the state, there are many rivers, streams and lakes. The Niger-Benue River constitutes the major surface water that drains almost all part of Nigeria (Map 11). The Niger River with an elevation of about 900 m in the Republic of Guinea, is an international river running through such countries as Guinea, Mali, Niger Republic and Nigeria for a total distance of some 4,200 km. It flows northeast, traversing the inland Delta in Mali down to the Niger Delta in the gulf of Guinea. The Benue is also an international river originated from the Mandara Mountains in Cameroun is the major tributary of the Niger River (it empties its water into the Niger at Lokoja where confluence is formed). The major tributaries of the Benue River in Nigeria are Katsina-Ala, Donga, Taraba, Gongola and Pai (Nkeki et al., 2013, p.125). The river Benue forms a confluence with the Niger River at Lokoja, the capital city of Kogi State.

Within the last decades, researchers (Aderoju et al., 2014; Nkeki et al., 2013; Ojigi et al., 2013) have reported the incidence of flooding along the rivers Niger and Benue. In particular, Nkeki et al. (2013) noted that river flooding is a function of rainfall and runoff volume within the river. According to a report from Adaoyichie (2019), more than 150 communities from these LGAs were submerged under floodwater during the 2019 flood disaster incidence along the two rivers. Considering the numerous settlements along the river, it is therefore important to understand the flow of the river in relation to the study so as to effectively demonstrate the contribution to flood mitigation and adaption with the area.

Map 11: Hydrographic network of the river Niger and Benue in Kogi State

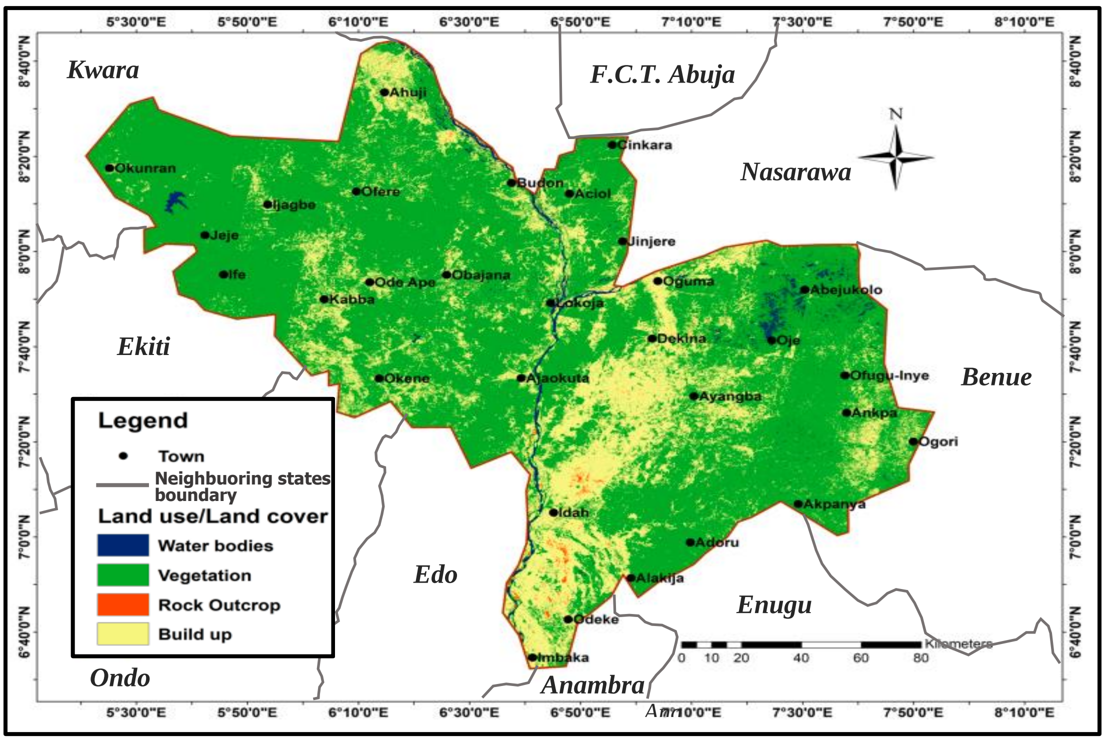


Source: Author's (Peter B. Oyedele) analysis of data from USGS SRTM and Hydrological data from Diva-GIS, 2021

3.1.2.4. Land use and land cover (LULC) of the study area

According to Ifediegwu et al. (2019, p. 11), the land cover map of Kogi State is made up of vast vegetation , water-logged, settlements and rock-outcrop. The vegetation and water bodies accounted for 22,305 km/km2 (74.21%). The dominance vegetal cover could be attributed to widespread of agricultural practice in the study area. Vegetation and waterlogged areas are good for groundwater infiltration, and therefore important in the understanding of flooding and its consequences (Map 12).

Map 12: Land use land cover map of the area

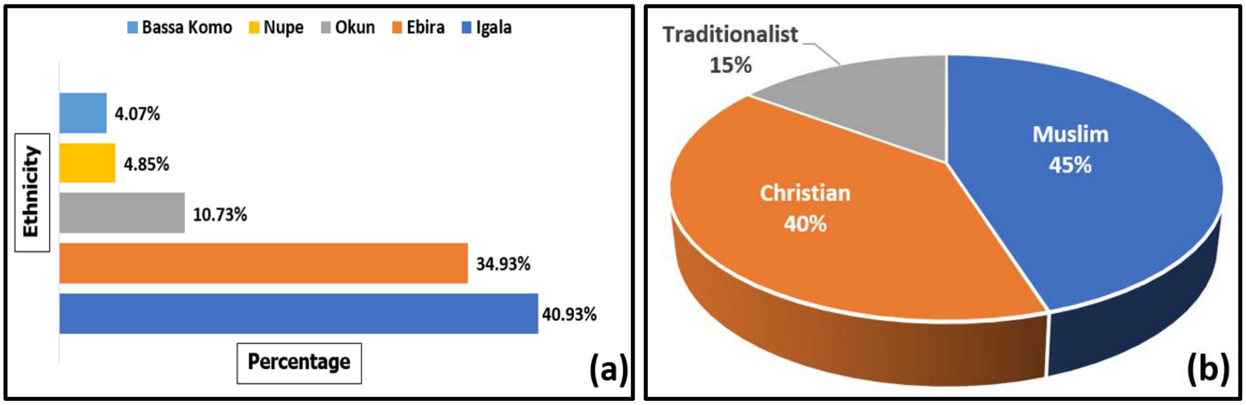


Source: Author -Oyedele P.B, modified from Ifediegwu et al. (2019, p. 11)

3.1.3. Human characteristics

The population is made up of various ethnic groups, which include; Igala, Ebira, Okun of Yoruba extraction, Nupe, and Bassa Komo speaking people (Ibitoye, 2012). The most predominates ethnic groups ethnics are the Igala, Ebira, and Okun. Other minor groups as noted by (House et al., 2012) include Bassa Nge, Kupa, Kankanda, Bassa Komo, and the Oworo (a Yoruba group). Figure 14 shows the percentage composition of the religion and ethnicity of the population.

Figure 14: Ethnicity and religion of the population



Source: Ibitoye, 2012

These shows that the communities are heterogeneous in terms of culture, ethnicity, and religion. All these religion and ethnic groups have had their share of the persistent flood disaster in the area either directly or indirectly. Based on people's believe, their vulnerability may not be uniform within and across the religion and ethnic affiliation.

3.1.4. Economic activities

The population of the state is mostly rural, as in most Nigerian rural communities, and the economy of the area is largely agrarian. Farming is the predominant occupation of the people of Kogi State (Ibitoye, 2012). They are also engaged in fishing activities along the rivers Niger and Benue. Other economic activities such as weaving, blacksmithing, pottery, dyeing, etc. (Audu, 2009). The farming sector employs a vast majority of the total workforce in the state. Farm produce common in the area include coffee, cocoa, palm oil, cashews, groundnuts, maize, cassava, yam, rice, melon and they also raise cattle on the highlands (Ibitoye, 2012). Economic tree crops such as oil palm, cocoa, and cashew are commonly grown especially in the southern and eastern parts of the State. Irrigation is widely practiced along the riverine areas during the dry season, growing vegetable crops such as tomato, okra, lettuce, carrot, onions, peppers, and amaranthus in large quantities. A typical farm family may have early yam and rice plots in the Fadama, cassava, grains, and late yam in the upland (Ibitoye, 2012). It is also common practice to find each farming family keeping one form of livestock or the other such as poultry, rabbitry, sheep, and goat on a small scale (Audu, 2012; Ibitoye, 2012). All these economic activities have been found to be threatened by flood disasters.

3.2. Methods

3.2.1. Sampling procedure

A multi-stage sampling technique was used to select respondents for the study.

Step 1: Purposive selection of eight (8) LGAs on the account of the recent flooding that ravage about nine LGAs that were severely hit in terms of affected people, and economic loss by the 2019 flood event as reported by Adaoyichie (2019). These LGAs are: Lokoja, Kogi-Koto Karfe, Bassa, Ibaji, Omala, Ajaokuta, Ofu and Idah. All the steps are presented in Table 7.

Table 7: The sampled size of households in the selected communities

S/N	Local Government Area (LGA)	Selected Community	Respondents /Community	Total Respondents /LGA
1	AJAOKUTA	Geregu	20	40
		Adogu	20	
2	BASSA	Eroko	20	60
		Icheu	20	
		Shintaku	20	
3	IBAJI	Odogwu	20	60
		Ogba Ojubo	20	
		Onyedaga	20	
4	IDAH	Ichekene	20	40
		Ichala Edeke	20	
5	KOGI-KOTO KARFE	Edeha	20	60
		Apaku	20	
		Koto-Karfe	20	
6	LOKOJA	Kakanda Budon	20	60
		Adankolo	20	
		Karara	20	
7	OFU	Itobe	20	40
		Olukudu	20	
8	OMALA	Bagana	20	40
		Abejukolo	20	
TOTAL		**20**		**400**

Source: Author's (Peter B. Oyedele) analysis, 2021

Step 2: Based on reports and guidance from the Kogi State Emergency Management Agency (KSEMA) and the Flood Disaster Management/Rescue team at the Department of Climate Change, Kogi State Ministry of Environment and Natural Resources. According to their reports, these communities were severely submerged with lots of damage to farmland, livelihoods were recorded. On the account of the degree of damage and recommendation from these institutions, three communities were randomly selected from Lokoja, Kogi-Koto Karfe, Bassa, and Ibaji LGAs while two communities were selected from Omala, Ajaokuta, Ofu, and Idah LGAs. This brings the total number of communities selected to twenty.

Step 3: Due to constraints in mobility, lack of availability of data, accessibility, and availability of respondents (as there was an account of the unstable movement of people in and out of the communities due to the impact of flooding on them), only 20 respondents were conveniently selected from each community.

Step 4: For the final survey, data were collected from 400 farming households (which included either the father, mother, or children above the age of 18 years) between March and June 2021. A semi-structured questionnaire was developed for the household survey with questions on the relevant study indicators. Thereafter, a pilot survey was conducted among random households to streamline and enhance the questionnaire.

3.2.2. Research Instrument and Data Collection

Research instruments are tools that are used to collect, measure, and analyse data that are related to research objectives. In this study, a combination of quantitative and qualitative data collection techniques was used to collect both primary and secondary data.

3.2.2.1. Primary data and instrument used

Primary data collected for the study were socioeconomics characteristics of households, household flood experience, knowledge, and response, household's perception of floods, vulnerability of household to flood: exposure, susceptibility and lack of resilience, flood impacts on household and their livelihoods through structured questionnaire administration. The primary data used in this study include respondents' geographical location coordinates, and socioeconomic characteristics (age, gender, farm enterprises/crop grown, other occupation than farming, size of household, years of education, income level, land ownership/tenancy, etc.). In addition, to assessing and understanding the vulnerability of households to flooding, the following data we collected:

- *Flood Exposure:* type of flood, frequency (return period), distance of farmland to the river, and time of impact, etc.

- *Susceptibility:* soil type, drinking water source, waste management, right of women to inherit the land, and contact with agricultural extension service.

- *Capacity to Anticipate:* local early warning systems, anticipatory time allowance, flood education, etc.

- *Coping/Adaptation capacities:* construction of drainage channels at the edge of farms, flood-tolerant crops and planting in other locations, etc.

- *Capacity to Recover:* Other economic activities, Savings and Cooperation and insurance policies, etc.

The following were the research instrument employed in obtaining the needed primary data:

- **Reconnaissance Visit and Stakeholder Consultation**

The first step was a reconnaissance visit. This constituted the first stage of the visit to the study area and included several activities including stakeholders' engagements (Photo 6 "A" and "B").

Photo 6: Reconnaissance visit and stakeholder engagements in the study areas

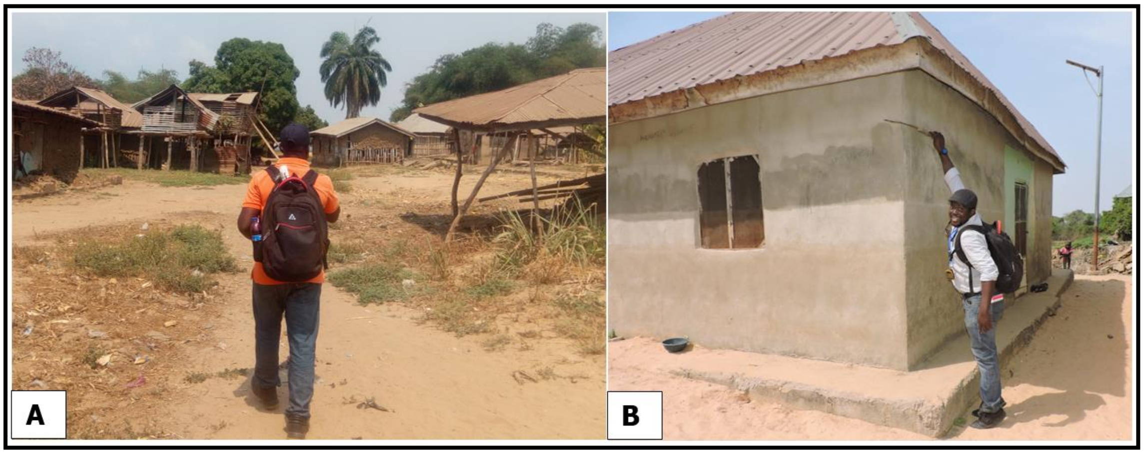
Source: Author's (Peter B. Oyedele) Fieldwork, 2021

The reconnaissance visit as shown in the photo was done to collect information that assisted in the proper design of the fieldwork. Opinion leaders, community heads, heads of ministries, and departments of different agencies were met during the exercise[8]. It was carried out in November 2020. This initial step provided an overview of the flood situation and context, key stakeholders/persons and organizations were identified, the nature and importance of the relationships inside the community, and policies among other things shall be well understood.

- **Field Observation -Transect Walks**

Photo 7 shows some of the transect walks (TW) that were carried out in the sampled communities in the selected LGAs to get the general landscape pattern and acquire a detailed understanding of the land use/land cover status.

Photo 7: Transect Walks conducted in the study area



Source: Author's (Peter B. Oyedele) Fieldwork, 2021

The transect walks[9] were carried out to the respondents' homes, relaxation joints as well as farms which is a major focus of this study. The exercise helped to gain adequate information relating to the farmers' farmland, the soil type, and disaster history of the study area, and validation of the research problem. Photographs and Geographic Positioning System (GPS) point to the important elements at risk and the area is taken. The boundaries of residential areas of each village were mapped from the field using a GPS device. All those data were then analysed with the use of GIS. In addition, the nature of building and housing conditions (location of houses, level of the house's

[8] (A) With the Kogi State Honurable Commissioner for Agriculture (Middle) and the Director of Agricultural Services (left) at the Kogi State Ministry of Agriculture, (B) courtesy visit to the Emir (head of the community) in his palace in Budon, the headquarters of Kakanda community in Lokoja LGA, Kogi State.

[9] (A). Ichala Edeke community in Idah LGA and (B). Budon community in Lokoja LGA, Kogi State

plinth, house type) of public buildings were all observed and surveyed to identify the building that could potentially be used as safe shelters in case of severe floods, and measurements of floodwater level.

- **Interview - Questionnaire Administration**

A combination of both structured and semi-structured questionnaires was designed to investigate household flood risk perception and vulnerability. This questionnaire was administered face-to-face rather than posting, this was because comparing postal and other types of survey, face-to-face interview survey had better response rates (Bowling, 2005; Kola & Abotchi, 2012). The questionnaire was originally constructed in English Language and translated into respondents' most convenient languages (Pidgin, Igala, Kakanda, etc.) to answer the questions appropriately (Figure 3.11).

- **Focus Group Discussions (FGDs)**

Among a group of respondents in the study area, focus group discussions (FGD) were held. Only four FGDs were conducted in four separate areas due to time constraints. Photo 8 shows one of the FGD sessions in one of the communities.

Photo 8: Focus Group Discussion (FGDs) at Onyendega Community in Ibaji LGA, Kogi State

Source: Author's (Peter B. Oyedele) Fieldwork, 2021

Both men and women participate in each FGD session. They were able to talk about their experiences with flooding as well as their ideas and opinions during the discussion. These viewpoints were carefully taken into account as part of the fieldwork findings and were documented for a thorough grasp of the topic of floods in the study area.

During this session, a group of selected participants was asked about their opinion or perceptions concerning the flooding in the area, its causes, impact, and their means of coping. The essence of this exercise was to better gain in-depth knowledge for bringing out, understanding, and learning the point of view of the respondents regarding their perception of flood risks and flood disaster issues in the area.

3.2.2.2. Secondary data and sources

Secondary data were equally used in achieving the research objectives. The various secondary data, their description, and the sources used are presented in Table 8.

Table 8: Secondary data and sources used for the study

Data Type	Description	Data Source
Soil data	Digitized map	FAO Soil portal http://www.fao.org/soils-portal/data-hub/soil-maps-and-databases/other-global-soil-maps-and-databases/en/
Waterbody / River Map	Maps	NASRDA
SRTM-Digital Elevation Model (DEM)	Resolution (30 meters)	CGIAR-CSI (http://srtm.csi.cgiar.org) http://dds.cr.usgs.gov/srtm/
Topographical map	2013 (scale 1:50,000)	- Kogi State Ministry of land and housing - DIVA GIS
Flood profile data (Flood historical data)	Flood impact and distribution including past images	- National Emergency Management Agency (NEMA) - State Emergency Management Agency (SEMA), Kogi State - EM-DAT - Kogi State Red Cross
Rainfall Data - (Monthly and annual rainfall data) - Daily minimum and maximum rainfall	1990 -2020 (Historical data) 2020-2100 (Future projection data)	High resolution Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) data *Source: Climate Hazards Center* (CHC) https://data.chc.ucsb.edu/products/CHIRPS-2.0/

Data on past flood inventory and environmental, permanent, and triggering factors were collected. In addition, and administrative data (political and jurisdictional boundaries), infrastructures data (road network, buildings), demographic and socioeconomic data were obtained from institutions and organizations. Pictures and documentaries on past flood events were also obtained via satellite.

In addition, several centers and institutions were visited. These include the libraries of the Nigerian Institute of Social and Economic Research (NISER) in Ibadan, Oyo State, the Kogi State Library Board in Lokoja, and the Stella Obasanjo Library center also in Lokoja. The department of climate change unit at the Kogi State Ministry of Environment and Natural Resources, the Food and Agriculture Organization of the United Nations (FAO). Other places visited are Laboratoire de Recherche sur la Dynamique des Milieux et des Sociétés (LARDYMES) Université de Lomé, the UNFCCC, Kogi State Ministry of Agriculture, Nigerian Meteorological Agency (NiMet), Department of physical planning schemes and development control in the Kogi State Town Planning and Development Board, Kogi State Emergency Management Agency (SEMA); The computer and information unit of the National Centre for Technology Management (NACETEM), Obafemi Awolowo University, Ile-Ife and National Inland Waterways Authority (NIWA) Headquarters, Kogi State were all consulted for a better understanding of the research and to better put the topic of interest into distinct and right perspectives[10].

Photo 9: During secondary data collection at NIWA Headquarters in Kogi State

[10] (A) during a visit to the institution, and (B) at one of the Stakeholder meetings on flood response & management

Source: Author's (Peter B. Oyedele) Fieldwork, 2021

Climate Hazards Center InfraRed Precipitation with Station data (CHIRPS)

The Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a quasi-global rainfall data set. The CHIRPS data set uses the higher spatial resolution of CHIRPS and the advanced forecasting ability of GEFS to provide weather forecasts, updated daily at a spatial resolution of 5 km across the globe (de Sousa et al., 2020). As its title suggests it combines data from real-time observing meteorological stations with infra-red data to estimate precipitation. For this study, both temperature and precipitation data 2019-2020 (historical) and 2020-2100 (future projection) were used. The data were download from the *Climate Hazards Center* (CHC) (https://data.chc.ucsb.edu/products/CHIRPS-2.0/) at high resolution satellite imagery with in-situ station data (Table 9) to create gridded rainfall and temperature time series for trend analysis.

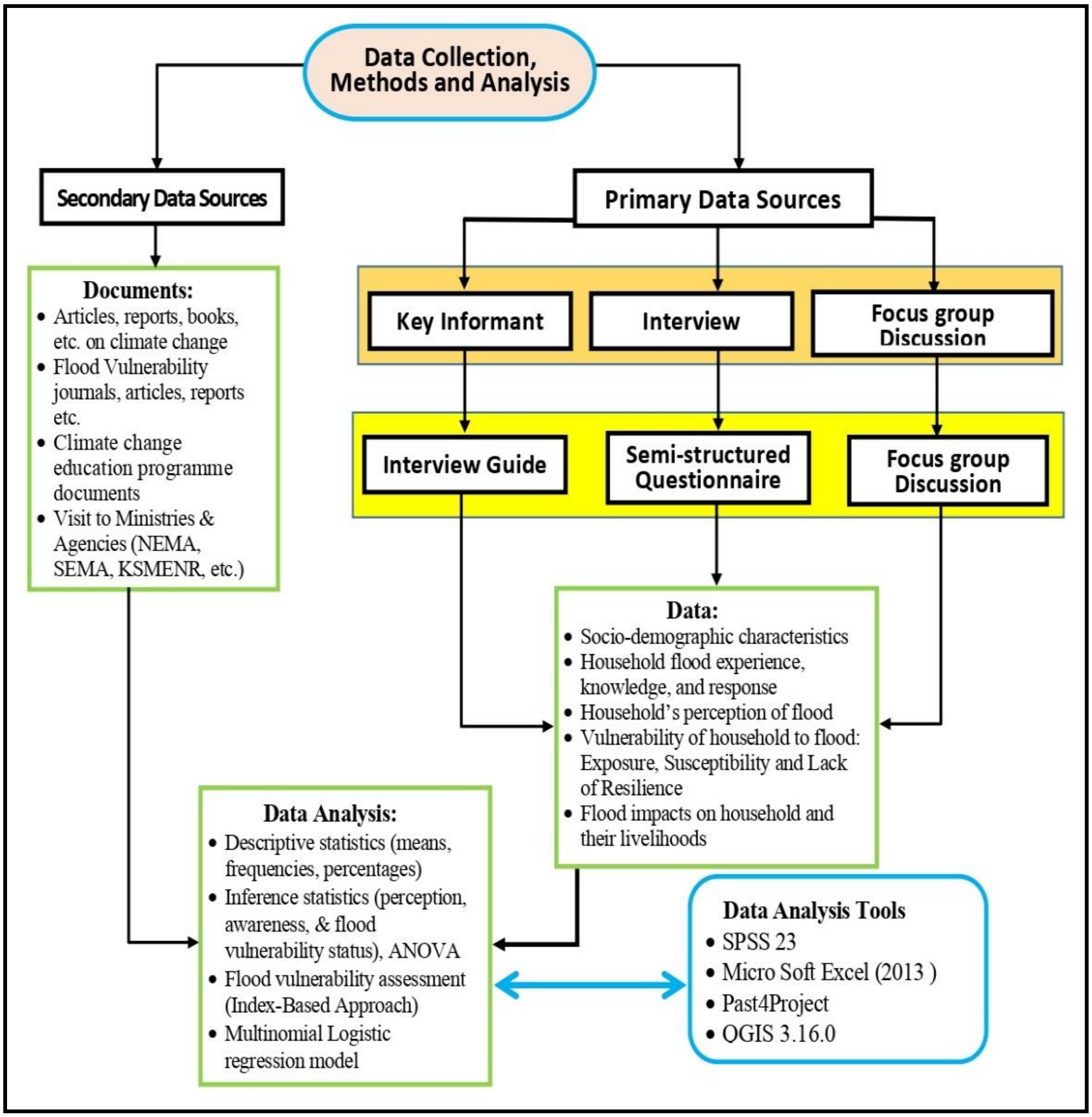
Table 9: Gridded rainfall and temperature time series for trend analysis

Selected communities	**Lokoja**	**Ajaokuta**	**Koto-Karfe**	**Bassa**	**Omala**	**Ofu**	**Idah**	**Ibaji**
Longitude	6.73	6.462	6.908	7.219	7.654	6.915	6.732	6.738
Latitude	7.78	8.254	8.076	7.905	7.825	7.243	6.941	6.618
Grid	8	3	6	9	10	15	17	18

3. 3. Methodological framework

Figure 15 shows the methodological framework of the research. It shows the data to be the research instrument, types of analysis, required data, and sources. Here, a combination of quantitative and qualitative data collection techniques was used to collect both primary and secondary data.

Figure 15: Methodological Framework



Source: Peter B. Oyedele, 2021

3.4. Validation of research instrument

Two techniques were employed to validate the research instrument.

- **Content validity:** The research instrument such as the questionnaire design, interview guide, indicator selected, etc. were given to experts in the field of flood risk and disaster management as well as the team of project supervisors to critically examine and review viz-a-viz the objectives of the study. Their comments and suggestions were harmonized and utilized in improving and standardizing the research instrument, which was used in collecting data for the study.
- **Construct validity:** The instrument was compared with the variables in the conceptual framework on which the study was based to ensure that the interview schedule did not deviate from its conceptual background.

3.5. Reliability of research instrument

Test-retest reliability was conducted on the research instrument to determine the degree of consistency to which it measures the variable it was designed to measure. The reliability test was carried out to ensure the appropriateness and standardization of the research instrument to give a consistent result. To this end, the instrument was tested in Lokoja Local Government Area (LGA). This exercise of pretest helped to determine the effectiveness of the survey questionnaire instrument designed for the study, it was quite necessary to determine the strengths and weaknesses of your survey concerning question format, wording, and order of the instrument before using it was used. The interview schedule was administered to twenty farmers across three villages in Budon, communities situated in the Lokoja LGA at two weeks intervals to determine the degrees to which the questions contain therein (research instrument) were understood by the respondents before it was finally used for real data collection. The two test scores were correlated using spearman rank order correlation and the pretest shows a reliability coefficient of 0.94 and was significant at a 0.01 probability level. According to Mohajan (2017), a reliability coefficient of 0.8 and above implies a satisfactory and acceptable level of internal reliability.

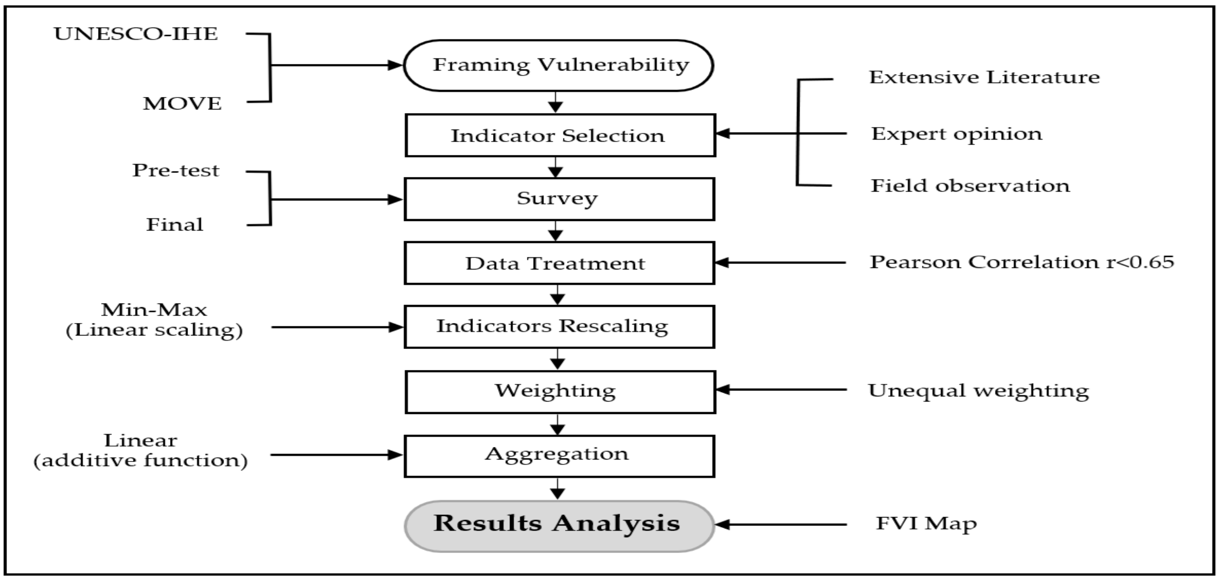
3.6. Data analysis

Data analysis is the process employed in inspecting, cleaning, transforming, and modeling the collected data from the field to discover useful information, informing useful conclusions concerning the research objectives. Therefore, this section presents the method applied in the analysis of the research objectives. It consists of three sub-sections, detailing the methods used in analysing the three different objectives of the study.

3.6.1. Data analysis for specific objective one (SO1): Construction of flood vulnerability indicators

The construction of flood vulnerability indicators as used in this study was built on several studies (Hagenlocher et al., 2013, 2016; Nazeer & Bork, 2021) that developed flood vulnerability composite indices (Figure 16).

Figure 16: Flood vulnerability indicator development workflow



Source: Adapted from (Nazeer & Bork, 2021).

The workflow shows a multi-step workflow by Nazeer & Bork (2021) adapted for this study. It includes (1) indicator derivation, (2) normalization of indicators, (3) weighting of normalized indicators, (4) aggregation of indicators, and (5) flood vulnerability mapping.

3.6.1.1. Framing and description of vulnerability indicators

To frame and describe vulnerability indicators, deductive reasoning for the preliminary set of indicators' selection as used in Methods for the Improvement of Vulnerability Assessment in Europe (MOVE) by Birkmann et al. (2013) was adopted for this study. Vulnerability was defined as the combination of exposure, and susceptibility, and maintains the negative definition of vulnerability and alludes to "lack of resilience" rather than just "resilience."

- ***Exposure (E):*** This explains the degree to which a region that is the focus of an assessment falls within the scope of a hazardous event (Birkmann et al., 2013). It refers to the possibility that flooding will affect individuals, as well as possible tangible items (properties, buildings, cultural heritage, and agricultural land) because of their position (Balica & Wright, 2010).
- ***Susceptibility (S):*** defines the propensity of elements at risk (social and ecological) to suffer harm as a result of the level of settlement volatility, unfavourable conditions, and relative weaknesses (Birkmann et al., 2013; Kablan et al., 2017).
- ***Lack of resilience (LoR):*** This means the inability to anticipate, cope with, and recover from the effect of a natural hazard. It comprises pre-event risk reduction, in-time coping, and post-event response actions (Birkmann et al., 2013). Similar to this, it highlights the socio-ecological system's restrictions to resource access and mobilization, as well as its inability to respond by absorbing the damage (Depietri et al., 2013).

3.6.1.2. Indicators derivation

From the literature, most vulnerability analysis is based on indicator selection and analysis (Kumar, D., & Bhattacharjya, 2020; Nazeer & Bork, 2021). Adger & Vincent (2005) advocated for the usefulness, appropriateness, data availability, and ease of recollection of indicators in vulnerability assessment. The indicators were presented before a team of experts on the appropriateness, some indicators were retained, while others were deleted. Finally, a list of non-exhaustive eighteen (18) indicators derived from the literature and empirical field observation used were presented in Table 10.

3.6.1.3. Data treatment

According to Damm (2010), a high degree of the linear relationship between indicators may distort the vulnerability index and mislead the end users. Therefore, to avoid the loss of important information, the redundancy of indicators, and a misleading vulnerability index in the end, the data obtained were subjected to treatment before data rescaling, weighting, and aggregation. The study adopted the approach of Damm, (2010) to determine the relationship among the indicators using the Pearson correlation. In the analysis, two or more highly correlated indicators with more than a 65% ($r > 0.65$) relationship were analysed to consider the removal of one of them.

Table 10: Flood vulnerability indicators of flood-prone communities of Kogi State and their functional relationship

Vulnerability Components	Indicators (Units)	Abbr.	Justification/Explanations	Functional Relationship (+/−)	References
Exposure (E)	Average elevation (m)	AE	Flood exposure increases with decreasing elevation, hence the higher the vulnerability	(+)	Kissi et al., 2015; Ntajal et al., 2017; Tingsanchali & Promping, 2022
	The closeness of farmlands to river bodies (m)	CRB	The closer the farmlands are to active water channels, the higher the vulnerability	(+)	Balica, 2007; Ntajal et al., 2017; Tingsanchali & Promping, 2022
	Floodwater duration (days)	FD	The longer the floodwater persists, the higher the vulnerability	(+)	Balica, 2007; Ntajal et al., 2017
	Share of exposed farmland (%)	SEF	The higher the % of farmland, the higher the potential for flood exposure and the higher the vulnerability	(+)	Bowen & Riley, 2003
Susceptibility (S)	Household size (avg.)	HS	The higher the avg. number of household sizes, the more the dependency rate, the higher the people's susceptibility, and the greater the vulnerability	(+)	Cutter et al., 2003; Müller et al., 2011
	House conditions: number of houses with poor material (Avg.)	HCs	The more the number of houses with poor building materials, the higher the susceptibility, hence the more vulnerable, the higher the vulnerability	(+)	Balica, 2007; Cutter et al., 2003; Müller et al., 2011
	Past flood experience (%)	PFE	The less flood experience people have, the more they are susceptible to becoming affected and the higher the vulnerability	(+)	Balica, 2007
	Household's dependency on agricultural production (%)	HDAP	The more the % of household dependency on agricultural production, the higher the susceptibility of affected people to be affected by flooding and the higher the vulnerability	(+)	Nazeer & Bork, 2019; Žurovec et al., 2017
	Lack of access to improved drinking water (%)	LAIW	The higher the % of people with a lack of access to improved drinking water, the higher the susceptibility of the affected people and the higher the vulnerability	(+)	Nazeer & Bork, 2019

Table 7. Cont's.

Vulnerability Components	Indicators (Units)	Abbr.	Justification/Explanations	Functional Relationship (+/−)	References
Lack of Resilience (LoR)	Literacy rate: percentage of the population with higher education (%)	LR	The higher the literacy rate, the more their capacity to anticipate, hence the lower people's vulnerability	(-)	Kablan et al., 2017; Nazeer & Bork, 2019; Žurovec et al., 2017
	Access to Flood warning system/facilities/information (%)	AFWS	The higher the %, the higher the capacity to anticipate, hence the lower people's vulnerability	(-)	Balica, 2007, 2012; Veenstra, 2013
	Flood education (training) access rate (%)	FEAR	The higher the access rate to training on floods, the higher the people's capacity to anticipate flooding and the lower the vulnerability	(-)	Cardona et al., 2012; Müller et al., 2011)
	Means of evacuation facilities (%)	MEF	The higher the % of households that can evacuate when a flood disaster strikes, the more their capacity to cope and the lower the vulnerability	(-)	Balica, 2012; Birkmann et al., 2013; Cardona et al., 2012; Müller et al., 2011
	Long-term residents at least 10 years + (%)	LTR	The higher the %, the longer the household settled in flood-prone areas, the more experienced they are, the higher their ability to cope, and the lower the vulnerability	(-)	Kissi et al., 2015
	Access to healthcare and social services (%)	AHS	The higher the %, the more the ability of the affected population to cope and the lower the vulnerability	(-)	Nazeer & Bork, 2019
	Access to financial aid to face flood disasters (%)	AFA	The higher the % of households with access to financial and social assistance, the higher the capacity to cope and the lower the vulnerability	(-)	Ntajal et al., 2017

Source: Peter B. Oyedele, 2021

3.6.1.4. Normalization of indicator

The indicators obtained come with different units and scales. To have a comparable set of indicators, the study adopted the Min–Max normalization to convert the values to a linear scale (such as 0 to 1). There are two distinct forms of functional relationships to take into consideration: Vulnerability (V) increases as the absolute value of the indicator also increases. In this case, where the functional relationship between the indicator and vulnerability is positive, the normalized indicator is derived using the following equation:

$$X_i = \frac{X_a - X_{Min}}{X_{Max} - X_{Min}} \qquad \textbf{\textit{(1)}}$$

(b) Vulnerability (V) decreases with an increasing absolute value of the indicator. Here, when the relationship between vulnerability and the indicator is found to be negative, the data are rescaled by applying the equation below:

$$X_i = \frac{X_{Max} - X_a}{X_{Max} - X_{Min}} \qquad \textbf{\textit{(2)}}$$

where:
X_i = normalized value;
X_a = actual value;
X_{Max} = maximum value;
X_{Min} = minimum value for an indicator i (1,2,3…,n) across the selected communities.

3.6.1.5. Weighting of indicator

No weight was assigned to the indicators. The reason was that most responses during the stakeholders' engagement were contradictory and highly conflicting. Therefore, to avoid an index value that will mislead the end users, the normalized indicator was aggregated into its respective sub-indices for the final flood vulnerability index (Nazeer & Bork, 2021).

3.6.1.6. Aggregation of indicator

The additive arithmetic function was employed in the aggregation of the indicator into its respective sub-indices (exposure, susceptibility, and lack of resilience) using Equation (3) (Kissi et al., 2015; Nazeer & Bork, 2019, 2021):

$$SI = \frac{\sum_{i=1}^{n} X_i}{n} \quad \textbf{\textit{(3)}}$$

The overall flood value of the vulnerability index was computed with Equation (4), an additive function (Lee & Choi, 2018; Nazeer & Bork, 2019):

$$FVI = \frac{1}{3}\,(SIE + SIS + SLoR) \quad \textbf{\textit{(4)}}$$

Where: SI means sub-indices exposure *(SIE),* susceptibility *(SIS),* and lack of resilience *(SILoR)* for "n" numbers of indicators in each component of vulnerability.

3.6.1.7. Statistical calculation of flood vulnerability index

For statistical analysis, the questionnaire survey data collected were subjected to several statistical analyses: First, a data code sheet was developed and used to uniformly code the data for entry purposes using EpiData version 3.1. Applying *equations (1)–(4)*, the calculated vulnerability index value ranges from 0 to 1, with 1 denoting the highest vulnerability and 0 signifying no vulnerability at all (Table 11).

Table 11: Flood vulnerability index ranking for selected flood-prone communities

Index Value	Description	Designated Colour	Colour shades
0.32–0.40	Very low vulnerability	Light Green	
0.40–0.48	Low vulnerability	Dark Green	
0.48–0. 57	Moderate vulnerability	Yellow	
0.57–0.65	High vulnerability	Orange	
0.65–0.74	Very high vulnerability	Red	

Source: Adapted from (Balica, 2007).

In Table 10, using an equal-interval method, the obtained FVI values were grouped into five classes following Kablan et al. (2017). This was used to determine the flood vulnerability based on the computed flood vulnerability index and the colour match.

3.6.2. Data Analysis for specific objective two (SO2): Farm households' perception flood risk

To understand the perception of farm households to flood risk, the quantitative data from the interview schedule was processed using statistical package for social sciences (SPSS) software and analysed.

3.6.2.1. Descriptive statistics

To compare the results either in percentage or in frequencies, descriptive statistics was first applied to the dataset to quantitatively describe and summarize the features of the respondents' socio-demographic characteristics as well as the other factors. This involves the use of mean, frequency distribution, percentages, and standard deviation. Pictorial diagrams were appropriately used.

Table 12: Measurement and influencing factors of households' perception of flood risk

Section	Details	Variables
Socioeconomic characteristics	Socio-demographic Characteristics of respondents	- Local government areas (LGAs) - Gender - Age - Education level - Occupation - Income per month - Length of stay in the community
Other important factors	Households' flood experience	- The frequency
	Households' flood knowledge education	- The extent of local flood knowledge education on present and future flood risk
	Flood management (sole responsibility of government)	- The responsibility of flood protection
	Willingness to relocate	- Respondent's readiness to move away from the flood zone
Flood risk perception	Households' perceived flood risk	- The impact of flood disaster (severity of flood impact)

Source: Author's (Peter B. Oyedele) Fieldwork, 2021

Table 12 defined the measurement and factors of households' perception of flood risk. The variables were used to further investigate the perception of households' flood risk within and among the different age groups, gender, income, and educational level. The flood experience and willingness of respondents were equally considered in this measurement.

3.6.2.2. Inferential statistics

- ***One-way Analysis Of Variance (ANOVA):*** To determine whether there was any relationship between the factors and household perception of flood risk. This involves the use of one-way ANOVA (Analysis Of Variance) was performed using the equality null hypothesis to investigate the mean ranks of two or more independent variables. This was considered appropriate for use because the available dataset satisfied the following test assumptions: A metric-dependent variable (i.e. measure using an interval or ratio scale; and one or more non-metric (categorical) independent variables (also called factors).

- ***Post Hoc Tests***: using Tukey procedure was adopted to determine and compare the differences in how each set of respondents perceived the risk of flooding. It further determined whether the association was positive or negative.

- ***Independent-Sample T-test:*** was used to determine the mean difference in the case of gender. Given that there are just two groups for this variable (gender), this statistical method was deemed adequate (male and female).

3.6.2.3. Model specification for data analysis

The general model specification for data analysis is expressed mathematically as:

$$Yij=\mu+\tau i+\epsilon ij \qquad (5)$$

Where:

Yij = Household perception of flood risk;

μ = General means (constant);

τi = Treatments here refer to all the respondents' socio-demographic characteristics as well as the other factors (respondents' flood experience, flood knowledge, responsibility for flood management, and willingness to relocate from flood risk zones) that could Farm household perception of flood risk in the study area;

ϵij = Radom error variable. ****All statistical analyses were conducted with a significant test value of 0.05***

3.6.3. Data analysis for specific objective three (SO3): Decision-making of farm household to flood risk

3.6.3.1. Descriptive statistics

The analysis of the quantitative data was done and summarized in the form of tables and graphs by using descriptive statistics. Descriptive statistics were then performed to identify the impact of the flood on households and existing adaptive strategies. The percentage of flood impact in different domains and the existing adaptive strategies were then extracted. The ranking of this percentage allowed us to identify the domain most affected by the flood as well as the most effective adaptive strategies from the point of view of households. Data were analyzed by using Excel and the Statistical Package for Social Science software version 26 package (SPSS 26).

3.6.3.2. Modelling households' decisions to flooding using multi-nominal regression model

Household making decisions were analyzed by using the willingness of households to relocate from flood risk hotspots to safe zones to guard against future and further flood impact (*the decision willingness to relocate* -*WtR*). This model was estimated by using multi-nominal or M-logit regression.

- ***Multi-nominal logistic model***

The M-logit was used to model the decision of households to relocate as a means of mitigation and adaptive strategy. The M-logit is used to estimate the probabilities for the most effective response of the households using different explanatory variables. It allows us to identify the factors which influence households to either remain or move away from flood risk zones. The M-logit is estimated by following this equation:

$$P_r(Y_{ik}) = P_r\,(Y_i = k|x_i; \beta_1, \beta_2, \dots, \beta_m) = \frac{\exp(\beta_{0k}+x_i\beta_k')}{1+\sum_{j=1}^{m}\exp(\beta_{0j}+x_i\beta_j')} \qquad \textbf{(5)}$$

To predict the probability (P) of a specific response to be chosen $(Y_{ik})x_i$ is a vector of the i-th observations of all explanatory variables, where β_j' is the row vector of regression coefficients in the j-th regression.

❖ **Definition of variables used**

The following explanatory variables were used: age, gender of households' header, household size, household education level, households header literate, household flood experience, household incomes the household as the socio-economic characteristics; the fact that households in part of disaster risk management group as institutional variables, the households 'plot and house elevation and the soil type as environmental variables.

Table 13 shows the different explanatory variables used for the M-logit models, where the decision to *WTR* is the dependent variable for the M-logit regression. The dependent variable in the binary model is represented by the households' willingness responses to relocate or not which is a dummy variable (equals: 1 when "Not very Likely"; 2 when "Not Likely"; 3 when "Indifferent"; 4 when "Likely"; and 5 when "Very Likely").

Table 13: Dependent and independent variables used for the model

Variables	**Description**	**Sources**	**Direct linked module**
Dependent variable: Household Decision to Relocate or Not			
Decision to Willingness to Relocate (Decision-WtR)	1 when "Not very Likely"; 2 when "Not Likely"; 3 when "Indifferent"; 4 when "Likely"; and 5 when "Very Likely" to relocate from flood-prone and risk zones	Field survey and observation	Households
Explanatory variables			
Variables	**Categories**	**Sources**	**Direct linked module**
Age			
LGA	Ajaokuta	Field survey	Households
	Bassa		
	Ibaji		
	Idah		
	Kogi Koto-Karfe		
	Lokoja		
	Ofu		
	Omala		
Gender	Male	Field survey	Households
	Female		
Educational status	No formal education	Field survey	Households
	Primary		
	Secondary		
	Tertiary		
	Apprenticeship		
Household size		Field survey	Households
Monthly Income	Less than ₦10,000	Field survey	Households
	₦10,000 - ₦20,000		
	₦20,001 - ₦50,000		

	₦50,001- ₦100,000		
	Above ₦100,000		
Occupation	Farming	Field survey	Households
	Fishing		
	Trading		
	Artisan		
	Formal sector (government)		
	Formal sector (private)		
	Unemployed		
Alternative livelihood	Yes	Field survey	Households
	No		
Length of Stay	≤10 years	Field survey	Households
	11 -20 years		
	21- 30 years		
	> 30 years		
Evacuation means	Yes	Field survey	Households
	No		
Health service access	Yes		
	No		
Households participating in flood training	Yes	Field survey	Households
	No		
Percentage of flood-affected farmland		GIS-based calculation	Households
Fear of future flood risk	Yes	Field survey	Households
	No		
Flood experience	≤ 10 years	Field survey	Households
	11-20 years		
	21-30 years		
	> 30 years		
Financial recovery	Financial recovery (Less than 5 months)	Field survey	Households
	Financial recovery (6 to 11 months)		
	Financial recovery (1 to 2 years)		
	Financial recovery (2 years)		
Flood water level	Water level value from 2010	Field survey	Households
	Less than one meter		
	More than one meter		
Flood water duration	≤ 15 days	Field survey	Households
	16 - 30 days		
	31-45 days		
	> 45 days		

3.6.4. Analysis of flood historical data

The historical analysis of past flood disaster events was done by examining the spatial distribution; temporal and seasonal distribution of flood events and the associated causalities and by detecting the possible presence of any trends or patterns in the occurrence of flooding events in time and space. The spatial distribution of flood events was examined primarily and analysed based on state units and expressed as the number of events per unit. The data obtained were analysed in Microsoft Excel 2013) and presented in form of a table.

3.6.5. GIS mapping and analysis flood risk hotspots

The physical development map of the study area was digitized using QGIS 3.16.0. Features on the digitized map (boundary, roads, villages, and location of rivers) were vectorized. The vectorized features were combined with GPS coordinates to produce the Roads Networks and Villages Maps of the Local Government Areas under study. To identify the flood plains of Kogi State from the selected Local Government Areas (LGAs), Shuttle Radar Topographic Mission (SRTM) data was colour-ramped and used to produce the Digital Elevation Model (DEM) of the LGA by converting it to Triangulated Irregular Network (TIN). Using overlay and manipulative functions available in QGIS 3.16.0, the vectorized villages, roads, and location coordinates of streams and rivers were added to the SRTM and the DEM to produce the location maps of the Major Rivers and the flood-prone villages.

Conclusion

The research has been appropriately placed in perspective in this chapter with regard to the methodological approaches employed to accomplish the study's stated objectives. The choice of the study area and its justification were first described in detail. Also, the population makeup of the area and the existing ethnic and religious groupings that made up this population, which was discovered to be heterogeneous due to mixed ethnicity, were documented. The most common agricultural activities as a source of income for the inhabitants were found to be farming and fishing. To better comprehend the impact of flooding on the people and their livelihoods, the climate, vegetation, elevation, soil types, and textures of the area were all analysed. This chapter also highlighted the necessary data, the techniques for gathering the data, and the processing and analysis of the data. The methodological framework was then presented, primarily to help readers understand the techniques and strategies adopted to achieve the research's objectives.

CONCLUSION TO PART ONE

Part one of the thesis focused on the conceptual and methodological framework. It began with the conceptualization of the subject matter –flood vulnerability, and decision-making of framing households in Kogi State, Nigeria. This was put into context by first understanding the problem of floods globally, regionally, and locally. In many parts of the world, flooding was regarded as a major problem. According to a reliable source, in the period from 1970 to 2012, floods and other hazards like storms caused over a million deaths globally. Similarly, with the high vulnerability of West Africa to natural hazards and disasters like floods, which cause loss of life, destruction of infrastructures, and damage to our ecological systems, climate change is expected to exacerbate the impacts of these problems.

Nigeria has experienced devastating floods which affected millions of people and resulted in financial losses amounting to billions of US dollars. In specific terms, flooding in Kogi state is becoming a yearly event due to its frequency and was found to be quite devastating. The understanding of the problem was achieved through details and a comprehensive literature review to know what has been done and how they were done to know what has not yet been done – the gap. The determined gap gave rise to a stated set of questions to guide this current study. To fill the gap, several thought-provoking on which the objectives of the study were formulated were posed. Furthermore, several concepts relating to the identified problem and research theme such as disaster, hazards, vulnerability, resilience, capacity, adaptation, and the like were clarified to guard against ambiguity and redundancy as the case may be. These were defined and put into context in relation to the current research problem.

For the research and its findings to be more scientific, the methodological approaches used in the study were clearly defined. This was presented in three phases. First, it began with the description of the study area, its climatic condition, economic values, population, and vegetation were all described. Secondly, both the primary and secondary data used, the method of collecting these data, and the mode of presentation were documented. Lastly, it described the method of data analysis. These were considered important to make the research to be science-based in the sense that, it could reproducible and easily be adopted in another clime.

PART TWO: RESULTS AND DISCUSSION

INTRODUCTION TO PART TWO

This part is titled "Results and Discussion". The section is made up of three chapters (4, 5, and 6). As in every other standard scientific-based research, the results on one hand simply and objectively report what was found out from the field of the research. In order words, it contains a description of the main findings concerning all the stated objectives of the study. On the other hand, the discussion aspect centers on the interpretation of the results giving meaning to them and putting them into context. More so, in the discussion aspect, as done in this thesis, the results were compared to other similar studies with an object to corroborate or refute their stands. Worthy of note is that each chapter making up this part addresses each of the research objectives of the study.

Chapter 4 presents the findings relating to the first objective of the study. Understanding the level to which households in the study area are vulnerable to flooding. The index-based approach is used to provide precise descriptions of flood risk in terms of hotspot communities' exposure, susceptibility, and lack of resilience. The explanation of the numerous drivers of vulnerability that keep driving individuals toward increased flood risk was then presented in this chapter.

Chapter 5 presents households' perceptions of flood risk. Given that the understanding of flood risk perception is not only a useful tool to get more insight into the risk-reducing processes but also helps to improve the level of preparedness and ultimately reduce flood losses. It begins with the presentation of the socio-economic characteristics of the household, the distribution of the respondents regarding flood experience, flood impacts, and their willingness to relocate, followed by details information about the peoples' understanding of flood risks.

Chapter 6 documented the findings and discussion on how households are adjusting or better still adapting to the negative effects of flooding in the study area. With the understanding that flooding in the area is reoccurring almost on yearly basis, respondents were asked whether or not they will relocate from the flood zones. The decision of households to remain in flood-prone areas or otherwise by recognizing the various influence factors of such decisions amid reoccurring flood events was investigated and analyzed and documented. The chapter ended by highlighting the roles of institutions and community members in managing flood disaster risk with aim of reducing the adverse effect on households and their livelihoods.

CHAPTER FOUR

VULNERABILITY OF FARM HOUSEHOLDS IN KOGI COMMUNITIES TO FLOODING

This results of this chapter have been published in Water Journal, MDPI[11]

Introduction

Flooding causes considerable frustration to the affected population as it threatens their lives, properties, and livelihood. It has claimed thousands of deaths, displaced millions of households, destroyed properties, and degradation of contiguous farmlands of households in the study area. The negative impacts pose setbacks to development, and environmental sustainability, hence, exacerbating poverty among the population. Its prevention and management become a concern to both the population and decision-makers (government and other relevant agencies). The latter for instance predicted the occurrence of the flood disaster and advised the relocation of residence, but information about the extent of vulnerability of the household to flood hazard was not yet determined and made available. This chapter documents findings from the determination of households' vulnerability to flooding disasters in the study area using an index-based approach by first identifying the hotspot of flooding, and factors of vulnerability (exposure, susceptibility, and lack of resilience). Secondly, understands the drivers of household vulnerability, and thirdly, determines the contribution of the selected indicators to households' flood vulnerability.

4.1. Results

4.1.1. Identification of flood vulnerability hotspots in the study areas

With the understanding that the vulnerability of a system to flood events is an integral function of three major factors; exposure; susceptibility; and lack of resilience as used by Balica (2007).The vulnerability framework adopted from Balica hypothesised vulnerability as the summation of

[11] Citation: Oyedele, P.; Kola, E.; Olorunfemi, F.; Walz, Y. Understanding Flood Vulnerability in Local Communities of Kogi State, Nigeria, Using an Index-Based Approach. Water 2022, 14, 2746. https://doi.org/10.3390/w14172746

exposure and susceptibility minus the resilience of a system *(discussed earlier, please see Figure 8)*. Each of the components were defined by variable of a set of indicator to determine the index value (see Appendix 7). The index value for each were then aggregated, following the proposition of Balica (2007). The aggregation of all the indicators used in defining each of the vulnerability components (exposure, susceptibility, and lack of resilience) and later gives rise to the vulnerability values for each community as presented. The result is presented in Table 14. From this, it was possible to determine at a glance the community with the highest exposure, susceptibility, lack of resilience and overall flood vulnerability index.

Table 14: Flood vulnerability indices of selected communities in Kogi State

Selected Community	**Sub-Index Exposure *(SIE)***	**Sub-Index Susceptibility *(SIS)***	**Sub-Index Lack Resilience *(SILoR)***	**Flood Vulnerability Index *(FVI)***
Shintaku	0.29	0.28	0.38	0.32
Ichekene	0.17	0.73	0.56	0.48
Geregu	0.37	0.42	0.71	0.50
Abejukolo	0.33	0.65	0.63	0.54
Eroko	0.45	0.68	0.49	0.54
Bagana	0.33	0.60	0.70	0.55
Olukudu	0.59	0.60	0.51	0.57
Kakanda	0.48	0.68	0.60	0.59
Adankolo	0.46	0.75	0.60	0.60
Adogo	0.53	0.74	0.55	0.61
Adaha	0.60	0.83	0.43	0.62
Itobe	0.64	0.77	0.50	0.64
Icheu	0.55	0.79	0.58	0.64
Karara	0.72	0.72	0.51	0.65
Akpaku	0.79	0.73	0.48	0.67
Koton karfee	0.87	0.65	0.50	0.67
Ichala Edeke	0.47	1.00	0.64	0.70
Ogba Ojubo	0.61	0.73	0.82	0.72
Onyedega	0.73	0.76	0.69	0.73
Odogwu	0.68	0.74	0.82	0.74
OVERALL	**0.53**	**0.69**	**0.59**	**0.61**

Source: Author's (Peter B. Oyedele) analysis of data from fieldwork, 2022

Table 14 shows the computed values for exposure, susceptibility, lack of resilience, and the overall flood vulnerability indices (FVI) across each community. To actually determine the hotspot of vulnerability spatially, the results from the table were inputted into the GIS environment for each of the vulnerability component, exposure, susceptibility, lack of resilience as well as overall flood vulnerability.

4.1.1.1. Flood exposure in the study areas

Three indicators (average elevation; the closeness of farmlands to river bodies; floodwater duration; and the percentage of the shared exposed farmland) were used in the computation of the exposure level across the community. Table 15 shows the index value of each indicator as well as the sub-index values of exposure across the selected community.

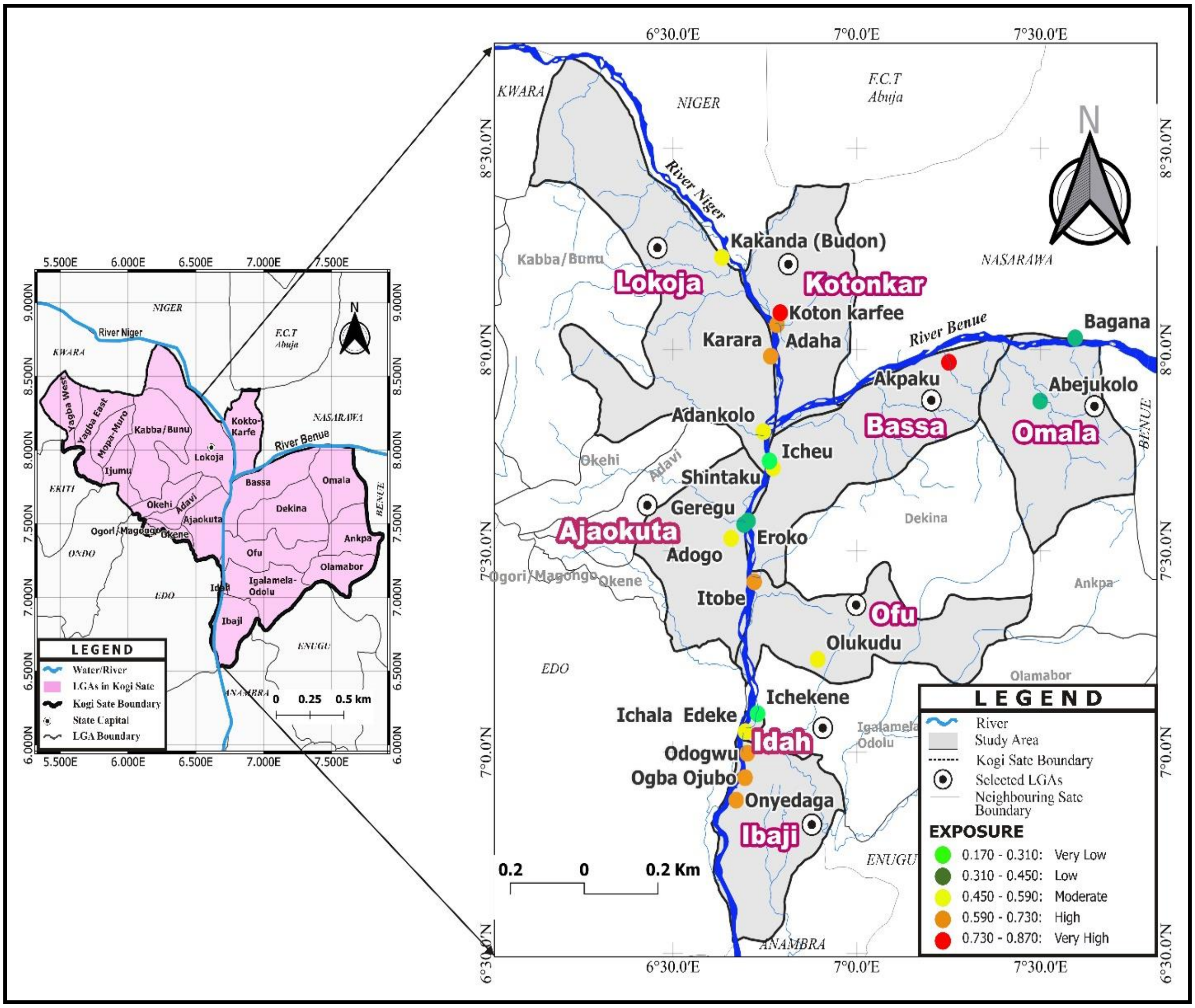
Table 15: Components of flood exposure indices of the households in the communities

Community	Closeness of farmlands to river bodies (CRB)	Floodwater duration (FD)	Shared of exposed farmland (SEF)	Sub-Index Exposure *(SIE)*
Geregu	0.26	0.43	0.43	0.37
Adogo	0.39	0.33	0.86	0.53
Eroko	0.18	0.60	0.57	0.45
Icheu	0.85	0.43	0.36	0.55
Shintaku	0.16	0.50	0.21	0.29
Odogwu	0.63	0.90	0.50	0.68
Ogba Ojubo	0.19	0.93	0.71	0.61
Onyedaga	0.34	1.00	0.86	0.73
Ichekene	0.24	0.27	0.00	0.17
Ichala Edeke	0.17	0.53	0.71	0.47
Adaha	0.36	0.50	0.93	0.60
Akpaku	0.91	0.60	0.86	0.79
Koton karfee	1.00	0.83	0.79	0.87
Kakanda	0.00	0.67	0.79	0.48
Adankolo	0.22	0.43	0.71	0.46
Karara	1.00	0.17	1.00	0.72
Itobe	0.49	0.50	0.93	0.64
Olukudu	0.38	0.62	0.79	0.59
Bagana	0.07	0.00	0.93	0.33
Abejukolo	0.03	0.18	0.79	0.33

Source: Author's (Peter B. Oyedele) analysis of data from the field, 2022

The results from the table show that the index value for each of the indicator varies from one community to the other. The sub-index value of exposure (*SIE*) varies from one community to the other. Ichekene community was found to have the lowest exposure value index (0.17) while Koto-Karfe has the highest exposure value (0.87). To know the spatial distribution and the relativity of households' exposure level to flooding across the selected community, the computed index values were overlaid into the GIS environment using a base map of Kogi State. This was used to generate the exposure map of the study are (Map 13).

Map 13: Flood exposure map of the study area



Source: Author's (Peter B. Oyedele) analysis of data from Fieldwork and Diva-GIS, 2022

The results of the exposure map shows that on one hand, 14 communities which account for 70% have between moderate to very high exposure level. While on the other hand, only 6 communities (30%) have between low to low to very low exposure level to flooding. This results shows that makjority of the sampled communities are highly exposed. As it can be seen on the map, some communities though, seems too close to the river bodies, are less exposed than those that were a bit far from river bodies due to other inherent factors such as the higher number of days in which floodwater duration in the community and the higher percentage of shared of exposed farmland in the communities based on the input data and observation made during data collection.

4.1.1.2. Susceptibility to flooding in the study areas

Indicators used in determining the level of susceptibility of households across the communities include household size, house conditions: number of houses with poor materials, past flood experience, household's dependency on agricultural production, and lack of access to improved drinking water. The result of the computed index values of these indicators are shown in Table 16.

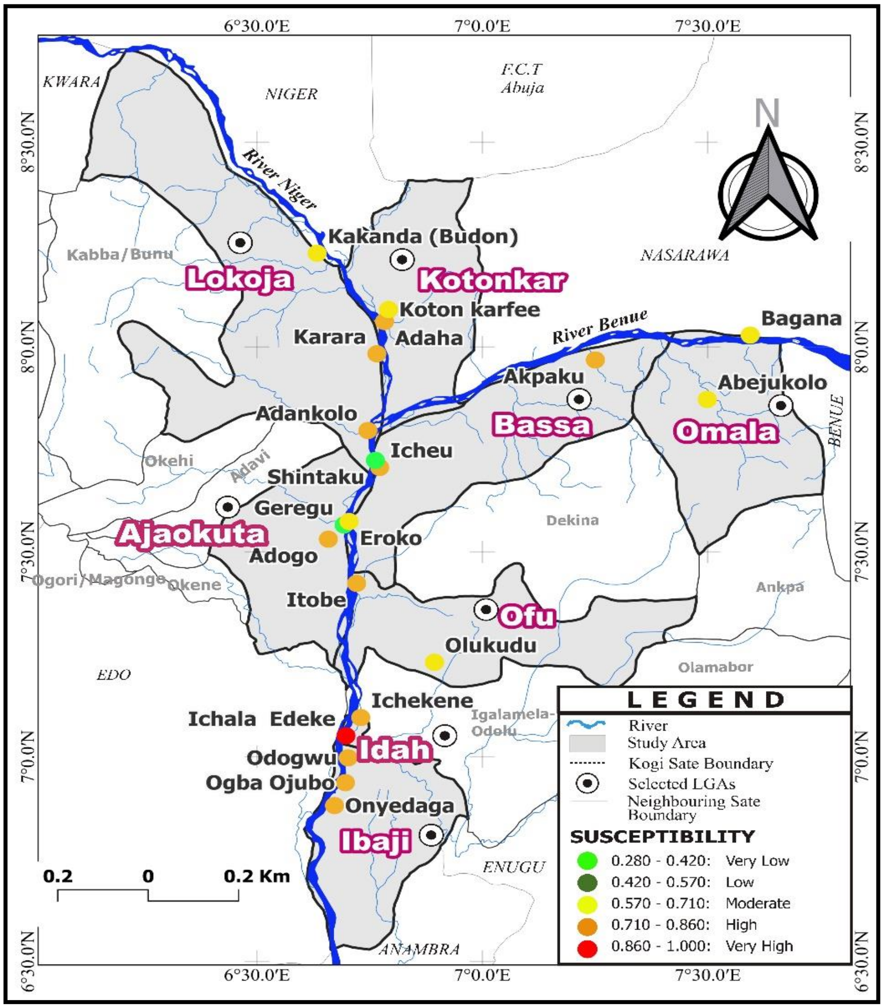
Table 16: Components of flood susceptibility of the households in the communities

Household size (HS)	**Household size (HS)**	**House conditions (HC)**	**Past flood experience (PFE)**	**Household dependency on agric. production (HDAP)**	**Lack of access to improved drinking water (LAIW)**	**Sub-Index Susceptibility *(SIS)***
Geregu	0.21	0.44	1.00	0.00	0.47	0.42
Adogo	0.00	0.89	1.00	0.90	0.93	0.74
Eroko	0.29	0.56	1.00	0.70	0.87	0.68
Icheu	0.87	0.67	1.00	0.70	0.73	0.79
Shintaku	0.14	0.00	0.80	0.10	0.33	0.28
Odogwu	0.58	0.33	1.00	1.00	0.80	0.74
Ogba Ojubo	0.36	0.44	1.00	0.90	0.93	0.73
Onyedaga	0.68	0.33	1.00	1.00	0.80	0.76
Ichekene	0.59	0.67	1.00	0.70	0.67	0.73
Ichala Edeke	1.00	1.00	1.00	1.00	1.00	1.00
Adaha	0.30	1.00	1.00	0.90	0.93	0.83
Akpaku	0.28	0.56	1.00	0.90	0.93	0.73
Koton karfee	0.30	0.56	1.00	0.90	0.47	0.64
Kakanda	0.48	0.33	1.00	0.70	0.87	0.68
Adankolo	0.41	0.78	1.00	0.90	0.67	0.75
Karara	0.48	0.78	1.00	0.90	0.47	0.72
Itobe	0.31	0.89	1.00	1.00	0.67	0.77
Olukudu	0.10	1.00	1.00	0.90	0.00	0.60
Bagana	0.59	0.78	0.00	0.70	0.93	0.60
Abejukolo	0.93	0.67	0.40	0.70	0.53	0.65

Source: Author's (Peter B. Oyedele) analysis of data from the field, 2022

From the table, it was reviewed that the susceptibility of households in the community differs. Ichala Edeke and Shintaku were found to have the highest (1.00) and lowest (0.28) sub-index susceptibility values respectively. Similarly, these indices were further analysed in the GIS environment so as to identify the spatial distribution of flood susceptibility among the households in the community. The generated susceptibility map shows that the households' susceptibility to flooding are different across the communities. In particular, this results from the maps shows that about 95% of the households from the communities have susceptibility that ranges from moderate to very high susceptibility (Map 14).

Map 14: Flood susceptibility map of the study area



Source: Author's (Peter B. Oyedele) analysis of data from Fieldwork and Diva-GIS, 2022

Spatially, the results of the susceptibility map revealed that about 90% of the community have high susceptibility to flooding. While only 10% have low susceptbility. From this, it can be inferred that majority of the sampled communities have high suceptibility to flooding.

4.1.1.3. Lack of resilience to floods in the study areas

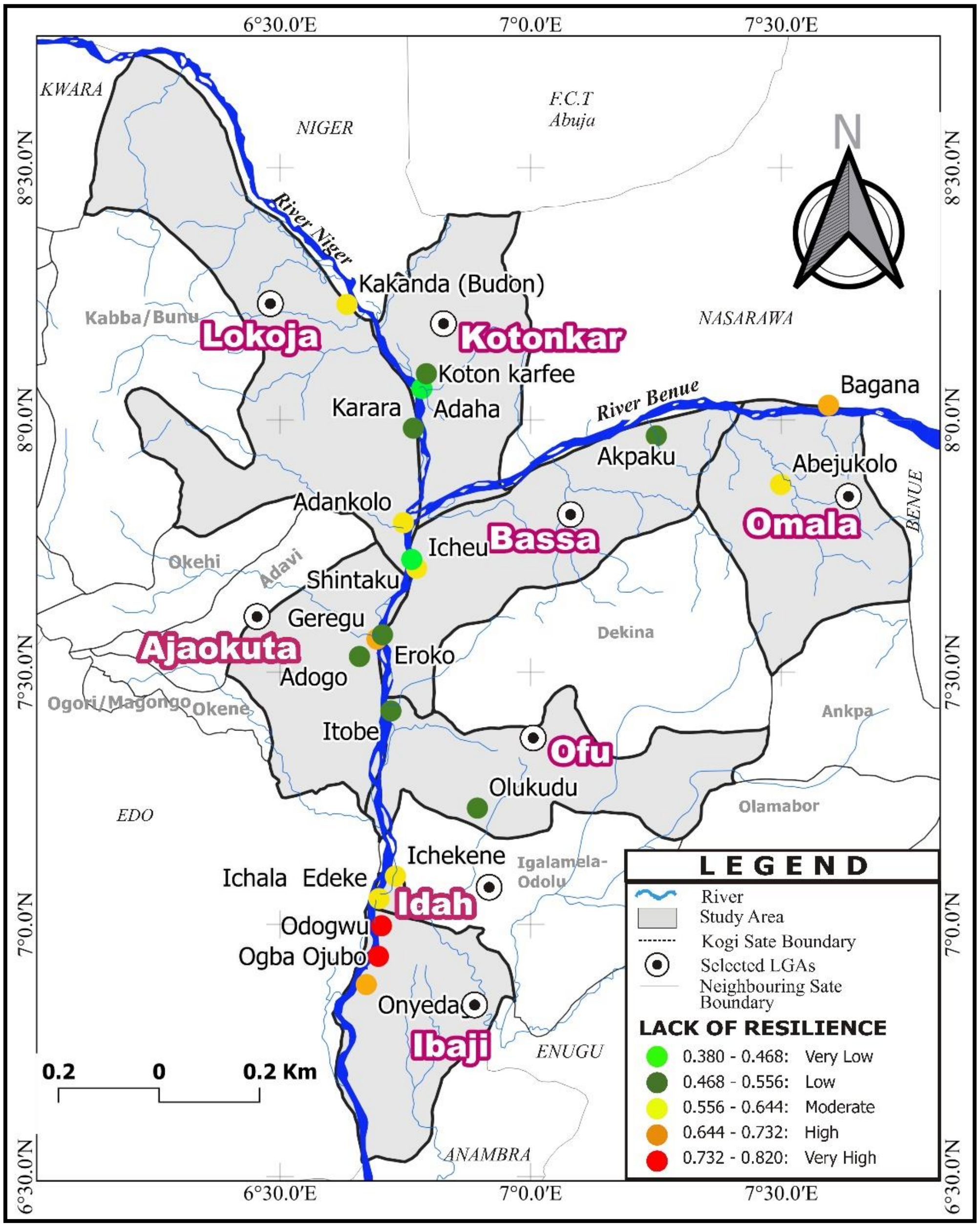
For the assessment of the lack of resilience, eight different indicators were used. These include the percentage of literacy rate, percentage of the population with higher education, respondents' access to flood warning system/facilities/information, their flood education (training) access rate, availably of the means of evacuation facilities, long-term residency in the area (at least 10 years), household access to healthcare and social services, and access to financial aid to face flood disasters. The indices values for these indicators are presented in Table 17.

Table 17: Components of lack of resilience to flooding among the households in the community

Community	% Literacy rate of population with higher education (LR)	Access to Flood warning system/facilities/information (AFWS)	Flood Education (training) Access Rate (FEAR)	Evacuation means and facilities (EMF)	Long term residents at least 10 years + (LTR)	Access to healthcare and social services (AHS)	Access to financial aid to face flood disasters (AFA)	Access to flood management measures (AFMM)	**Sub-Index Lack Resilience *(SILoR)***
Geregu	0.22	0.74	0.94	0.85	0.10	0.85	1.00	1.00	0.71
Adogo	0.78	0.26	0.39	0.10	0.10	1.00	1.00	0.78	0.55
Eroko	0.00	0.00	0.44	0.65	0.00	0.95	0.90	1.00	0.49
Icheu	0.44	0.11	0.72	0.50	0.00	0.85	1.00	1.00	0.58
Shintaku	0.00	0.16	1.00	0.35	0.00	1.00	0.55	0.00	0.38
Odogwu	0.89	0.84	0.89	0.90	0.10	0.90	1.00	1.00	0.81
Ogba Ojubo	1.00	1.00	0.94	0.60	0.05	1.00	1.00	1.00	0.82
Onyedaga	0.89	0.58	0.89	0.75	0.05	1.00	1.00	0.33	0.69
Ichekene	0.56	0.42	0.67	0.35	0.10	0.50	1.00	0.89	0.56
Ichala Edeke	0.89	0.21	1.00	0.00	0.00	1.00	1.00	1.00	0.64
Adaha	0.22	0.05	1.00	0.00	0.05	0.15	1.00	1.00	0.43
Akpaku	0.67	0.05	0.94	0.05	0.15	0.00	1.00	1.00	0.48
Koton karfee	0.00	0.05	1.00	0.05	0.05	0.85	1.00	1.00	0.50
Kakanda	1.00	0.00	0.94	0.00	0.95	0.85	0.05	1.00	0.60
Adankolo	0.89	0.00	0.83	0.15	0.95	1.00	0.00	1.00	0.60
Karara	1.00	0.05	0.89	0.00	0.15	1.00	0.00	1.00	0.51
Itobe	0.44	0.05	0.00	0.10	1.00	1.00	0.50	0.89	0.50
Olukudu	0.44	0.00	0.94	0.05	0.15	1.00	0.45	1.00	0.50
Bagana	0.89	0.00	0.94	0.95	0.15	1.00	0.70	1.00	0.70
Abejukolo	0.78	0.05	0.94	1.00	0.10	0.40	0.75	1.00	0.63

Source: Author's (Peter B. Oyedele) analysis of data from the field, 2022

Map 15: Lack of resilience map of the study area



Source: Author's (Peter B. Oyedele) analysis of data from Fieldwork and Diva-GIS, 2022

The map 15 shows that households in more than half of the sampled community have between moderate to very high lack of resilience. This account for about 55% of the total communities. While the remaining 45% have between low to very low lack of resilience to cope and adapt flooding.

4.1.1.4. Ranking of the communities based on the FVI and other sub-indices' Values

To further understand the relativity of these communities in retaliation to the factors of vulnerability, the computed FVI, and other sub-indices values, the selected communities were ranked following (Krishnan et al., 2019). Table 18 shows the ranking of the communities and the FVI is represented by the length of the bar[12].

Table 18: Ranking of the communities based on their FVI values

LGAs	Communities	FVI	Ranked based on			
			FVI	SIE	SIS	SILoR
Ibaji	Odogwu		**1st**	5th	8th	2nd
Ibaji	Onyedaga		2nd	3rd	5th	5th
Ibaji	Ogba Ojubo		3rd	7th	10th	**1st**
Idah	Ichala Edeke		4th	13th	**1st**	6th
Kogi Koto	Koton karfe		5th	**1st**	16th	15th
Kogi Koto	Akpaku		6th	2nd	9th	18th
Lokoja	Karara		7th	4th	12th	13th
Bassa	Icheu		8th	10th	3rd	10th
Ofu	Itobe		9th	6th	4th	16th
Kogi Koto	Adaha		10th	8th	2nd	19th
Ajaokuta	Adogo		11th	11th	7th	12th
Lokoja	Adankolo		12th	14th	6th	8th
Lokoja	Kakanda		13th	12th	14th	9th
Ofu	Olukudu		14th	9th	17th	14th
Omala	Bagana		15th	18th	18th	4th
Bassa	Eroko		16th	15th	13th	17th
Omala	Abejukolo		17th	17th	15th	7th
Ajaokuta	Geregu		18th	16th	19th	3rd
Idah	Ichekene		19th	20th	11th	11th
Bassa	Shintaku		20th	19th	20th	20th

At a glance, the table revealed the selected LGAs, communities, and their respective ranking in relation to computed FVI and other components considered. Based on the FVI in particular, it was

[12] The FVI value is represented by the length of the bar in each cell. Low-rank values (1, 2, 3,…) for the FVI, SIE, SIS, and SILoR indicate higher flood vulnerability, higher exposure, higher susceptibility, and a higher lack of resilience, correspondingly and conversely at a relative level.

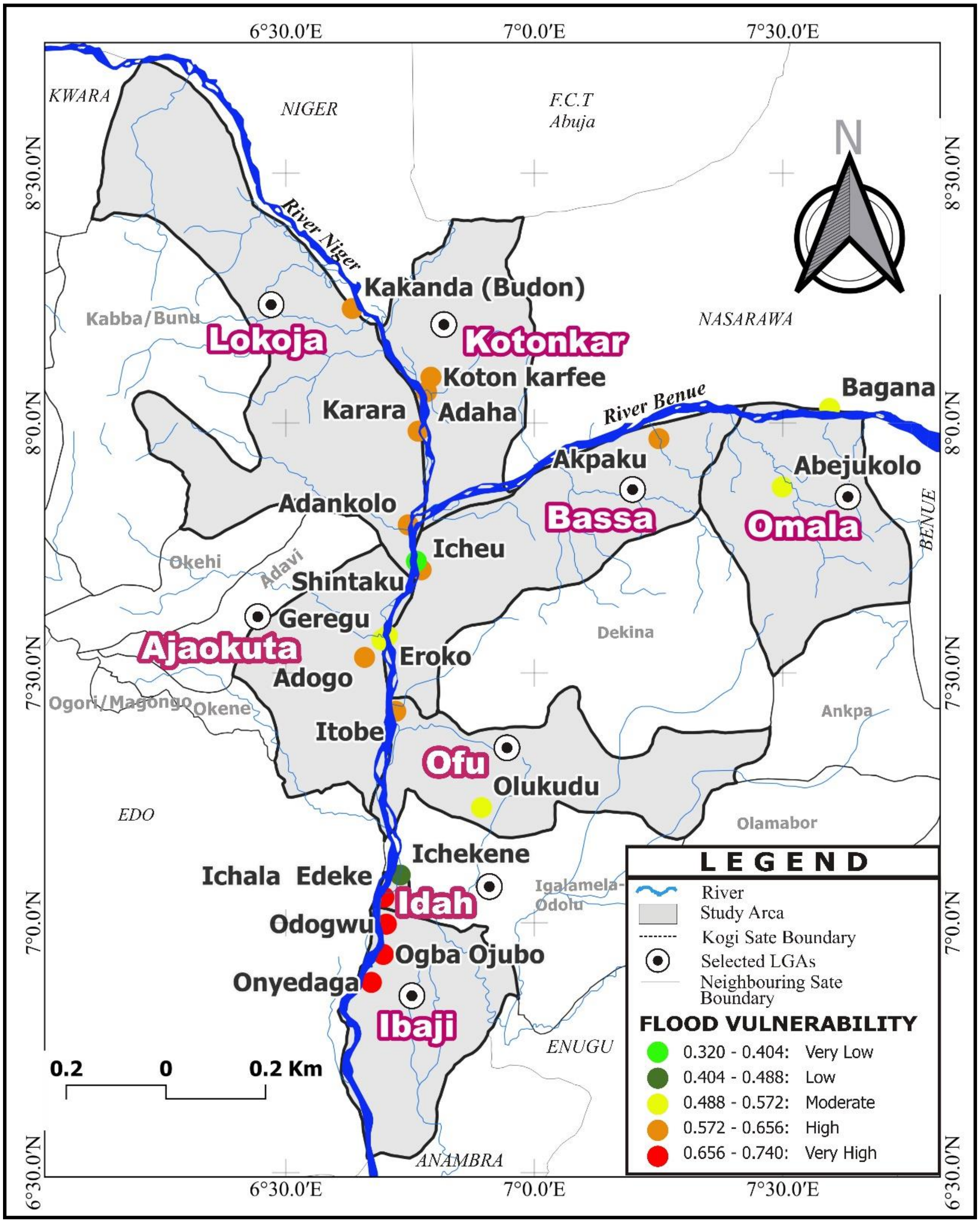
found that Odogwu and Shintaku communities were ranked the highest and lowest, respectively. More so, all three communities sampled in Ibaji LGA were found to have the highest FVI. For the exposure level, Koto-Karfe and Ichekene were found to be the highest and lowest exposed communities, respectively. Similarly, considering the sub-index susceptibility, Ichala Edeke was found to be the community with the highest flood susceptibility, while Shintaku ranked as least comparatively. Concerning the lack of resilience, households in the Ogba Ojubo and Odogwu communities were both ranked first in the prevailing characteristics of a higher lack of resilience accordingly. In contrast, Shintaku on the other hand was ranked as the community with the lowest lack of resilience to flooding. The study showed that the first three ranked communities are from the Ibaji local government area.

4.1.1.5. Categorization and identification of flood vulnerability hotspot in the area

From Table 16 as earlier displayed, it was seen that the computed FVI for all the communities values lie between 0.32 and 0.74, while the sub-indices values of exposure, susceptibility, and lack of resilience were (0.17–0.87), (0.28–0.83), and (0.38–0.82) respectively. This results further suggests and affirmed that there are considerable spatial variations in tract-level flood vulnerability, exposure, susceptibility, and lack of resilience across the selected communities. In this regard, the computed FVIs values were used to identify the specific hotspot of flood vulnerability across the communities as earlier used by Nazeer and Bork (2021).

Following Kablan et al. (2017), the ranked communities were further categorized into five subcategories, with a 0.74 FVI value considered as very high flood vulnerability and 0.32 indicating very low flood vulnerability. According to Quesada-Román (Quesada-Román, 2022), an index for flood risk was designed to comprehend the risk drivers' role (hazard, exposure, and vulnerability). This was done by overlaying a map of potential flood-prone areas estimated based on the he indices of vulnerability components of the sampled communities into the GIS environment, the produced map shows the hotspot of flood vulnerability across the study area. Finally, the output flood vulnerability hotspots map generated is shown in Map 16.

Map 16: Flood vulnerability hotspots across the sampled communities in Kogi State



Source: Author's (Peter B. Oyedele) analysis of data from Fieldwork and Diva-GIS, 2022

This shows each community falling into at least one of the categories. It was observed that almost 20% (four) of the communities were designated in red colour (very highly vulnerable, red colour).

Similarly, highly vulnerable (orange) communities accounted for 50% (10), and 25% (five) were identified to be moderately vulnerable to flooding in the area. The result as displayed in the map shows how some communities that are seemly close to river bodies were found to be less vulnerable than those that of distant, the reason for this is not farfetched due to some other inherent factors such as the soil type, percentage of share values of exposed farmland, lack of evacuation facilities, lack of financial capacity to cope or adapt to frequent flooding in the community.

To further strengthen the result above, the experience and opinions of respondents in relation to how they are affected by flood and in identifying the hotspot of flooding were captured during the Focus Group Discussion (FGD) session and presented as follows: *"Flooding in Ibaji LGA is always disastrous, the destruction is not limited to our farmlands, and houses but also causes serious damages and injuries to several people in this area. Sometimes during flooding, people use to stay on top of trees to protect their life and later come down after the floodwater might have subsided…*" (Report from a 52-year-old male member of the FGD group session at Onyedega community in Ibaji LGA).

To further appreciate why there exist disparities among different communities despite the fact that they seem to be closer to the river bodies than one another, the following section helps in understanding the factors that drives vulnerability to floods among households in the community.

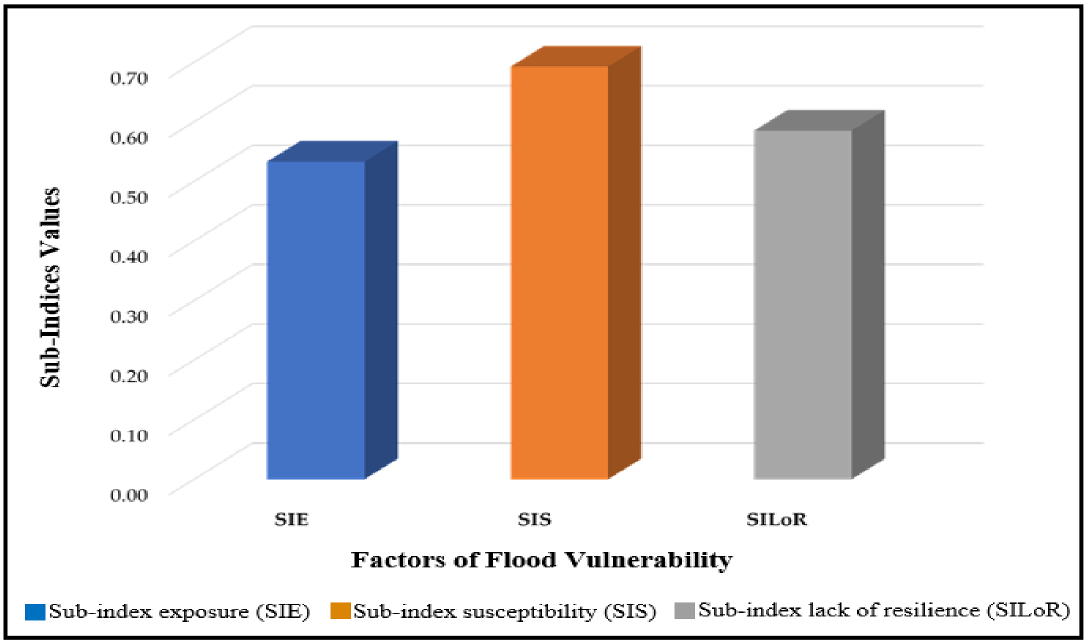
4.1.2. Understanding the drivers of household's vulnerability to flood

To better inform decision-makers and professionals on the underlying causes of flood vulnerability in the area of study, the contribution of the indicators and sub-indices of exposure (SIE), susceptibility (SIS), and lack of resilience (SILoR), to the flood vulnerability indices for each of the sampled community was evaluated. In addition to this, efforts were made to clarify the contribution of the single indicator in each of the vulnerability sub-indices across the community. Although 18 sets of indicators were initially selected through an extensive literature review, expert opinion, and field observation *(please see annex)*. However, with the an understanding that a high degree of relationship between indicators may distort the vulnerability index and mislead the end users, hence the need to discard certain highly correlated indicators (Damm, 2010; Nazeer & Bork, 2019). In the end, sixteen indicators in total were retained to construct the flood vulnerability index and identify the drivers of flood vulnerability among households.

4.1.2.1. Contributing factors to flood vulnerability in the study area

Flood vulnerability itself is the combination of all the components of vulnerability, that is, exposure, susceptibility, and the lack of resilience. The contributions of vulnerability sub-indices to the prevailing levels of households' flood vulnerability in the communities. The factors that contribute more to how households are vulnerable to flooding in the study area were assessed as shown in Figure 17.

Figure 17: Contributions of vulnerability sub-indices to household's flood vulnerability



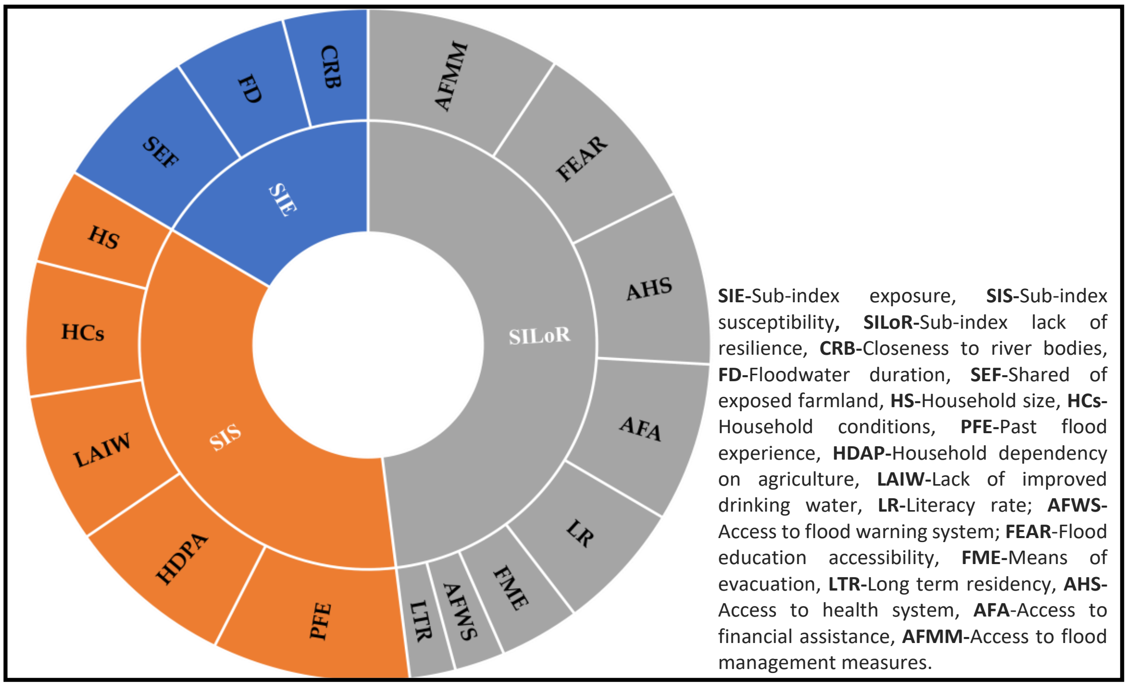
Source: Peter B. Oyedele, 2022

In comparison, the result clearly showed that the sub-index susceptibility contributed most to flood vulnerability, followed by lack of resilience and exposure, in that order. This implies that many of the households were found to be highly susceptible to flooding,

4.1.2.2. Drivers of flood vulnerability in the study area

To provide practitioners and decision-makers with a deeper understanding of the underlying factors influencing households' flood vulnerability, the contributions of the indicators selected for each vulnerability component were further evaluated. Following Krishnan et al. (Krishnan et al., 2019), a sunburst plot was used to show the indicators considered in measuring each of the vulnerability components. On one hand, certain indicators were found to "push up" the flood vulnerability value due to either high exposure, high susceptibility, and/or a high lack of resilience, which we designate as "drivers" of vulnerability. While on the other hand, variables that "pull-down" flood vulnerability levels due to either low exposure, low susceptibility, and/or low lack of resilience in a given area were considered "buffers" (Figure 18).

Figure 18: Sunburst plot showing contributors in the flood vulnerability in the study area



Source: Peter B. Oyedele, 2022

From the figure, household past flood experience (PFE), household dependency on agriculture (HDPA), lack of access to improved and portable drinking water (LAIW), house conditions (HCs), access to flood management measures (AFMM), flood education access rate (FEAR), access to the healthcare system (AHS), access to financial aid (AFA), a low literacy rate (LTR), percentage of share of exposed farmland (SEF), and floodwater duration (FD) were found to have influence high household's vulnerability to flooding in the area. It is evident from the foregoing that high vulnerability is structural, in part due to the obvious predominately agrarian economy and unpleasant memories from previous flood events, largely defined by a relative lack of access to financial assistance, leading to a high percentage of flooded farmland. Included also is not having access to clean water and hygiene, which is further exacerbated by a lack of flood education rate and poor accessibility to the healthcare system. The key buffers that stabilised "vulnerability" were long-term residents at least 10 years + (%) (LTR), access to a flood warning system (AFWS), and means of evacuation facilities (FME). This result will help practitioners and agencies aiming to intervene to know at a glance areas to concentrate on in terms of flood intervention programs and planning.

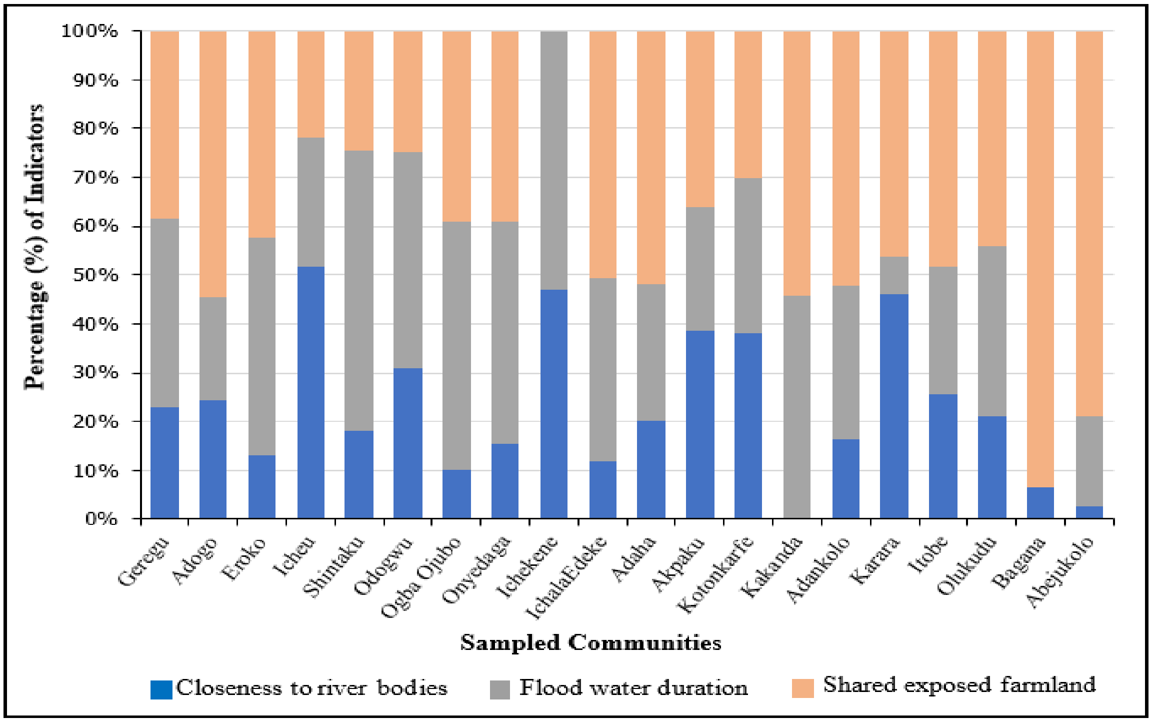
4.1.3. Contributions of selected indicators to the sub-indices values of flood vulnerability drivers across the communities

The sub-index exposure, susceptibility, and lack of resilience were further subjected to analyses at the community level. The results showed the percentage contributions of each indicator as it influences the community's vulnerability to flooding. This analysis was considered germane to critically understand the indicator that drives or influences each component of vulnerability, and secondly, to develop spatial contingency plans that allow for prompt response in the event of a flood disaster and promote resilience building:

4.1.3.1. Contribution of the single indicator to the sub-index exposure (SIE)

Three indicators were selected for the development of sub-index exposure. It followed the approach of Hagenlocher and Castro (2015). The three indicators that contributed to prevailing levels of flood exposure among the communities: are (1) share of exposed farmland, (2) closeness to river bodies, and (3) floodwater duration. Figure 19 shows the contributions of these indicators to flood exposure across the communities.

Figure 19: Contribution of the single indicator to the sub-index exposure *(SIE)*



Source: Peter B. Oyedele, 2022

In addition, the analysis of the household survey conducted showed that more than half of the respondents (73%) engaged in farming and other forms of agricultural activity. First, this implies that farming is an important economic activity and a major aspect of the livelihoods of the people. It equally suggests the likelihood of the households' farmlands being impacted during flooding. In Koton-Karfe in particular, the three indicators have a similar percentage contribution to flood exposure; this generally accounts for the reason why the community had the highest sub-index exposure value (0.87) compared to others. Observation mad during transect and fieldwork equally confirmed that most of the settlements and farmlands close to waterbodies which is a sign of high exposure to flooding as revealed by the results of the analysis (Photo 10).

Photo 10: Picture showing the settlements close to waterbody in the community

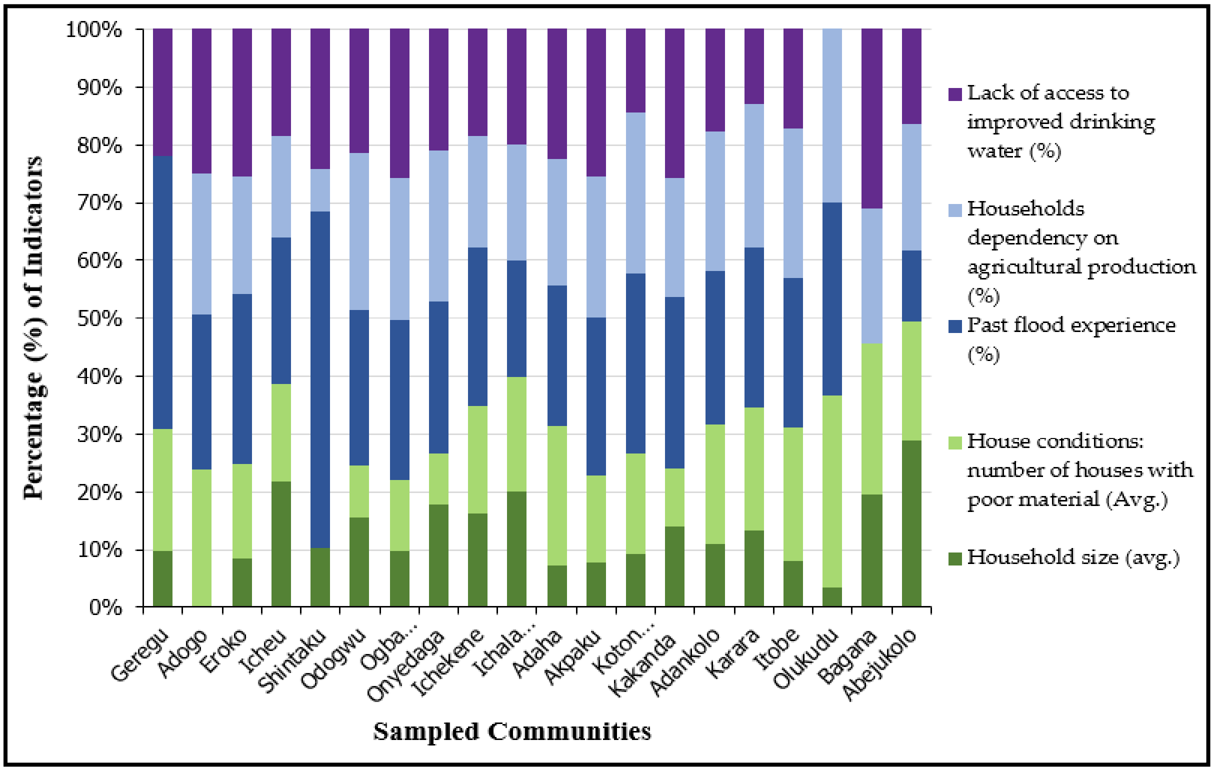
Source: Author's (Peter B. Oyedele) Fieldwork, 2022

The photo shows as observed on the field, many houses are close to the river bodies. This will mostly increase the exposure rate of people to flood disasters.

4.1.3.2. Contribution of the single indicator to the sub-index susceptibility (SIS)

The sub-index susceptibility is the aggregation of five indicators: household size (HS); household conditions (HCs); household past flood experience (PFE); household dependency on agriculture (HDAP); and households' lack of access to improved drinking water (LAIW). Each indicator was assessed to determine its contribution to flood susceptibility. The results showed that all the indicators have significant contributions to flood susceptibility (Figure 20).

Figure 20: Contribution of the single indicator to the sub-index exposure susceptibility *(SIS)*



Source: Peter B. Oyedele, 2022

This implies that household past flood experience, over-dependence of households on agriculture, lack of access to improved drinking water, and households' poor housing/building conditions were all identified as the main drivers of households' flood susceptibility. Here, the indicator household condition implies the number of houses with poor building materials (as observed during the field survey) such as walls made with either corrugated sheets or wooden planks, the floors of houses being bear soil and not cemented, the tops of rooves of houses being made with thatch or leaves, etc., were all found to make such households more susceptible to the impact of foods (Photo 11).

Photo 11: Nature of building observed in the community

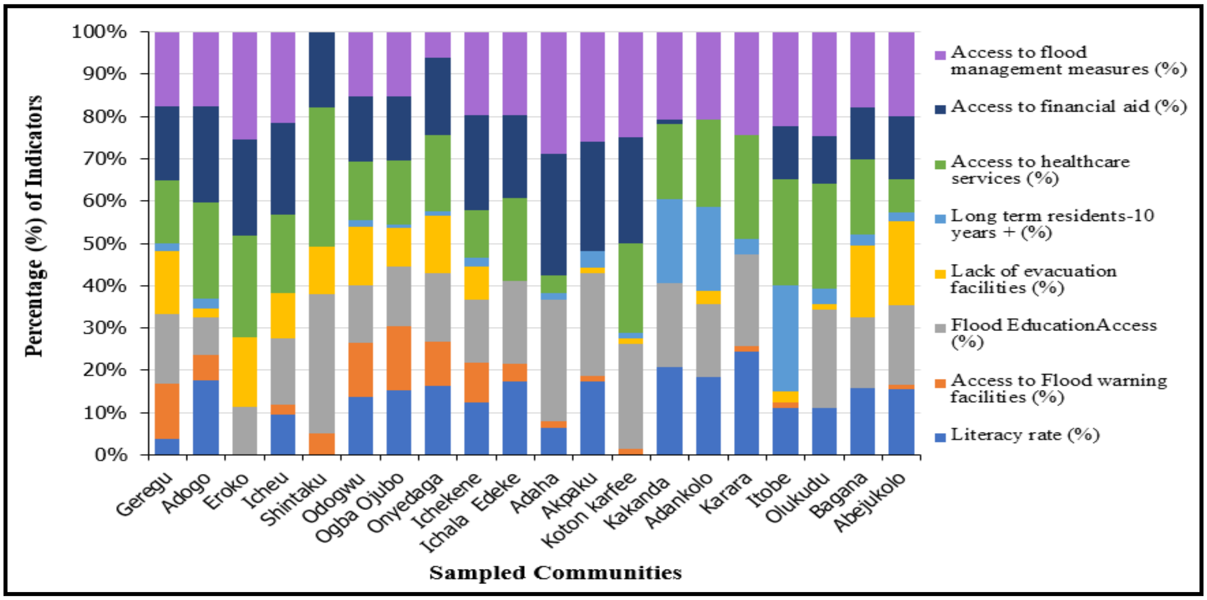
Source: Author's (Peter B. Oyedele) Fieldwork, 2021

Concerning households' over-dependence on agriculture, more than 95% of the respondents indicated a high dependency on agricultural activities as their major source of income. Being largely dependent on agriculture for income may make people more vulnerable to the effects of flooding. This study result corroborated the findings of an earlier study that flooding usually has negative consequences on individuals engaging in agriculture-related activities who use agricultural lands as a source of their livelihoods (Rafiq & Blaschke, 2012).

4.1.3.3. Contribution of the single indicator to sub-index lack of resilience (SILoR)

The results of the study indicated that all the surveyed communities were mostly characterised by a lack of resilience to flooding, thereby making them more vulnerable to the impact of flooding. How the indicator contributes significantly to the sub-index lack of resilience across the communities in a relative proportion is illustrated in Figure 21.

Figure 21: Contribution of the single indicator to the sub-index lack of resilience (SILoR)



Source: Peter B. Oyedele, 2022

Indicators such as households' lack of evacuation and flood management measures, low levels of flood education, a high percentage of flood experience, low literacy rate, lack of access to flood warning facilities, and weak household economic capacity, were identified as the major drivers of vulnerability and lack of resilience. However, five of these indicators were found to contribute most to prevailing levels of lack of resilience as observed across the communities. In specific terms, these include: are low literacy rates, lack of access to flood management measures, inadequate financial support to recover after floods, lack of access to healthcare facilities, lack of evacuation facilities, and low flood education.

Discussion

The identification of flood vulnerability hotspots as demonstrated in this study revealed in clarity the communities that are relatively likely exposed, susceptible and lacking resilience and capacity to recover or adapt to the risk of flooding. This corroborates the findings of Jalayer et al. (2014) that "the flooding risk hotspots are areas with high probability of the occurrence of flooding within an a geographical area. In addition, the findings from this study gave a detailed understanding of the most vulnerable communities and population that are vulnerable to flooding in Kogi State. Also, it helps in identifying the key indicators that drives flood vulnerability among the population in line with their exposure, susceptibility and resilience level. The adopted methodology has been used in other climes and was found to be useful for the development of an encompassing disaster risk programe, recovery plans , and policies capable of plunging the people out of poverty as a result of the negative effects of flooding on their lives and livelihood (Karagiorgos et al., 2016; Nazeer & Bork, 2019, 2021).

With respect to each components of vulnerability (exposure, susceptibility and lack of resilience) and the generated maps, the results revealed considerable spatial variations in tract-level flood vulnerability, exposure, susceptibility, and lack of resilience across the selected communities. First, talking a about the exposure of households, the results shows that majority of the sampled communities are highly exposed as seen during the filed survey, many of the farms and houses were not far in distance to river bodies. The near a settelem is to waterbosies, higher their exposure probability. Similar results by Ntajal et al. (2017) documented that communites in Mono River, Togo were found to be higly exposed as a result of the hig proximity to riverbodies. Similarly, the susceptibility map also revealed that majority of the housholds are higly exposed. With regards to the overall flood vulnearbility, the computed FVIs lied between 0.32 and 0.74 and were used to identify the hotspots of flood vulnerability across the communities.

Majority of the communities have relatively high flood vulnerability, while the others fell between moderate and low flood vulnerability. Interestingly, the findings showed that all the sampled communities in Ibaji LGA (Ogba Ojubo, Onyedega, and Odogwu) had comparatively very high flood vulnerability. This implies that households in this area have a high chance of being affected by floods and it corroborates the findings of previous studies in Kogi State (Ajodo & Olawepo, 2021; Ndukson Buba et al., 2021; Okpala-Okaka et al., 2013). Similarly, This result is consistent with the assertions of Audu (2016), that a some parts of Lokoja metropolis are highly vulnerable to yearly flooding which had led to total destruction of houses, major infrastructures like schools, health centers, agricultural lands as well as farm produce.

The overall flood vulnerability maps serve as tools for identifying households in communities that are vulnerable to flooding, based on the level of exposure, susceptibility, and lack of resilience, thus facilitating the planning and prioritization of location-specific interventions for flood control as found by earlier studies (Akande et al., 2017; De Risi et al., 2018; Jalayer et al., 2014; Nazeer

& Bork, 2019, 2021; Ntajal et al., 2017). According to Quesada-Román (Quesada-Román, 2022), an index for flood risk was designed to comprehend the risk drivers' role (hazard, exposure, and vulnerability). This was done by overlaying a map of potential flood-prone areas estimated based on the he indices of vulnerability components of the sampled communities into the GIS environment, the produced map shows the hotspot of flood vulnerability across the study area.

The contribution of individual indicators to the FVI and other sub-indices so as to better understand the underlying factors which are drivers of flood vulnerability in the communities holistically was studied as equally noted by (Jalayer et al., 2014). The analyses revealed that some indicators contributed to the prevailing levels of exposure, susceptibility, and lack of resilience at varying degrees, which in turn resulted in the observed higher household vulnerability to flooding across the study area. In particular, the indicators percentage of shared flooded farmland, closeness of houses, and the longer period of days the floodwater remained in the community all contributed to the household exposure level. This conforms with the findings of Ntajal (2015), who found that factors such as proximity to water bodies, longer flood duration, and the location of field crops in flood zones tend to increase the exposure of communities, thus likely leading to negative impacts on humans and ecological systems.

Knowing the drivers of susceptibility, the indicator household past flood experience, over-dependence of households on agriculture, lack of access to improved drinking water, and households' poor housing/building conditions were all identified as the main drivers of households' flood susceptibility. Here, the indicator household condition implies the number of houses with poor building materials (as noticed during the field survey) such as walls of houses made with either corrugated sheets or wooden planks, the floors of houses being bear soil and not cemented, the tops of rooves of houses being made with thatch or leaves, etc., were all found to make such households more susceptible to the impact of foods. With respect to households' over-dependence on agriculture, more than 95% of the respondents indicated high dependency on agricultural activities as their major source of income. Being largely dependent on agriculture for income may make people more vulnerable to the effects of flooding. This study result corroborated the findings of an earlier study that flooding usually has negative consequences on individuals engaging in agriculture-related activities who use agricultural lands as a source of their livelihoods (Rafiq & Blaschke, 2012).

Pertaining to lack of resilience, several indicators, such as households' lack of evacuation and flood management measures, low levels of flood education, high percentage of flood experience, low literacy rate, lack of access to flood warning facilities, and weak household economic capacity, were identified as the major drivers of vulnerability and lack of resilience. There is evidence in the literature that education can help increase people's resilience to flood disasters (Müller et al., 2011; Nazeer & Bork, 2019). The results of the survey analysis showed that 85.6 % earn NGN 50,000 (equivalent of USD 120) or less per month. Of this proportion, 62.8% live below the national minimum wage of NGN 30,000. This supports the claim of high inequality in the region as indicated by a Gini coefficient of 0.64 (Adelekan & Asiyanbi, 2016; UN-HABITAT, 2014); with this low monthly income, the people may not be able to gather resources to prepare, anticipate, and recover from flood disasters. It is generally assumed that households with a high income or wealth are less vulnerable than those with a low income or wealth (Hamidi et al., 2020). In general, these factors inhibit the household's capacity to anticipate, cope with, and recover from flooding, which supports the premise that vulnerability to flooding occurs due to households' lack of preparedness, as shown by Ismail and Saanyol (Ismail & Saanyol, 2013). Many households depend mainly on agriculture as their major source of economic survival, causing the inhabitants to have a strong affinity for these flood-prone areas (Aderoju et al., 2014).

Conclusion

The analysis showed that households' vulnerability to flooding, exposure level, susceptibility, and lack of resilience to flood impacts varies considerably across the study area. It clearly revealed the areas that are highly exposed, susceptible and lack resilience to adapt and recover from flooding. The drivers of flood vulnerability with specificity to each of the vulnerability components were equally documented. The computed flood vulnerability indices' and overall flood vulnerability maps serve as tools for identifying households in communities that are vulnerable to flooding, based on the level of exposure, susceptibility, and lack of resilience, thus facilitating the planning and prioritization of location-specific interventions for flood disaster control, management and planning. . Lastly, the highlighted contributions of each indicator to the FVI and other sub-indices present local evidence of the issues that need to be addressed in order to design spatial contingency plans and enable swift community/policy engagement and actions to effectively reduce households' vulnerability to flooding in the area, thereby reducing poverty among the population.

CHAPTER FIVE

PERCEPTION HOUSEHOLDS' FLOOD DISASTER RISK AND THEIR CHARACTERISTICS

Introduction

Flood has been globally recognized as one of the most destructive natural hazards as it destructive nature cut across races and borders. Likewise, in the study area, flood has claimed thousands of deaths, displaced millions of households and resulted to the destructions of properties and degradation of contiguous farmlands. However, the prevention and adaptation behaviors to the flood hazards cannot be engaged by a population if the reality of the risk is known by them. Perception refers to the sensations associated with a manifest reality, or even its interpretation, whereas risk is an association of a hazard and the stakes (human, housing, activities, etc.) that are vulnerable. This chapter focuses on how households understand and interpret flooding, and its negative effects on their lives and livelihoods. The analysis also focuses on identifying the factors that influence household perception to the risk of flood disaster in the study area.

5.1. Results

5.1.1. Personal and socioeconomic characteristics of the respondents

The socioeconomic and demographic characteristics of four-hundred respondents interviewed in the twenty selected communities from eight local government areas surveyed are presented in Table 19. Fifty-six percent of respondents were male while 44 % were female. This was also the situation during the focus group discussions where there were more males than females. This may be because Kogi State is known to be mostly dominated by the Muslim religion, and so not all women are allowed to meet with strangers without the consent of their spouse or the head of the family. The sample population comprised different age groups with the age group 40 years above accounting for 60 % of total respondents. The average age of the respondents was 42 years.

Table 19: The Socioeconomic and demographic characteristics of the respondents across the selected study area

Variable	Local Government Areas (Total)	Ajaokuta LGA	Bassa LGA	Ibaji LGA	Idah LGA	Koto-karfe LGA	Lokoja LGA	Ofu LGA	Omala LGA
Number of respondents *n (%)*	400 (100%)	40 (10%)	60 (15%)	60 (15%)	40 (10%)	60 (15%)	60 (15%)	40 (10%)	40 (10%)
Gender *n (%)*									
Male	225 (56.3%)	24 (60%)	25 (41.7%)	32 (53.3%)	23 (57.5%)	41 (68.3%)	34 (56.7%)	22 (55.0%)	24 (60.0%)
Female	175 (43.7%)	16 (40%)	35 (58.3%)	28 (46.7%)	17 (42.5%)	19 (31.7%)	26 (43.3%)	18 (45.0%)	16 (40.0%)
Age (years) *n (%)*									
Below 20	3 (0.7%)	0 (0.0%)	0 (0.0%)	1 (1.7%)	2 (5.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
20-29	42 (10.5%)	5 (12.5%)	7 (11.7%)	3 (5.0%)	5(12.5%)	7 (11.7%)	12 (20.0%)	1 (2.5%)	2 (5.0%)
30-39	115 (28.8%)	14 (35.0%)	11 (18.3%)	13 (21.7%)	6 (15.0%)	27 (45.0%)	28 (46.7%)	7 (17.5%)	9 (22.5%)
40-49	164 (41.0%)	18 (45.0%)	22 (36.7%)	25 (41.6%)	22 (55.0%)	23 (38.3%)	18 (30.0%)	22 (55.0%)	14 (35.0%)
Above 50	76 (19.0%)	3 (7.5%)	20 (33.3%)	18 (30.0%)	5 (12.5%)	3 (5.0%)	2 (3.3%)	10 (25.0%)	15 (37.5%)
Length of stay in current residence (years) *n (%)*									
Less than 20	14 (3.5%)	4 (10.0%)	0 (0.0%)	2 (3.4%)	2 (5.0%)	1 (1.7%)	0 (0.0%)	3 (7.5%)	2 (5.0%)
20-29	54 (13.5%)	5 (12.5%)	11 (18.3%)	12 (20.3%)	6 (15.0%)	1 (1.7%)	0 (0.0%)	13 (32.5%)	6 (15.0%)
21-30	109 (27.3%)	12 (30.0%)	10 (16.7%)	11 (16.9%)	4 (10.0%)	10 (16.7%)	19 (31.7%)	17 (42.5%)	26 (65.0%)
Over 30	223 (55.7%)	19 (47.5%)	39 (65.0%)	35 (59.3%)	28 (70.0%)	48 (80.0%)	41 (68.3%)	7 (17.5%)	6 (15.0%)
Educational Qualification *n (%)*									
No Formal Education	38 (9.5%)	3 (7.5%)	5 (8.3%)	13 (21.7%)	9 (22.5%)	1 (1.7%)	2 (3.3%)	0 (0.0%)	5 (12.5%)
Primary school	107 (26.8%)	13 (32.5%)	13 (21.7%)	19 (31.7%)	15 (37.5%)	8 (13.3%)	10 (16.7%)	21 (52.5%)	8 (20.0%)
Secondary school	161 (40.2%)	15 (37.5%)	19 (31.7%)	26 (43.3%)	11 (27.5%)	32 (53.3%)	19 (31.7%)	14 (35.0%)	25 (62.5%)
Tertiary Education	94 (23.5%)	9 (22.5)	23 (38.3%)	2 (3.3%)	5 (12.5%)	19 (31.7%)	29 (48.3%)	5 (12.5%)	2 (5.0%)
Monthly income (Naira) *n (%)*									
Less than ₦10,000	94 (23.5%)	18 (45.0%)	8 (13.3%)	15 (25.0%)	3 (7.5%)	16 (26.7%)	19 (31.7%)	14 (35.0%)	1 (2.5%)
₦10,000-₦20,000	157 (39.3%)	14 (35.0%)	9 (15.0%)	40 (66.7%)	10 (25.0%)	31 (51.7%)	30 (50.0%)	20 (50.0%)	3 (7.5%)
₦21,000-₦50,000	91 (22.8%)	6 (15.0%)	15 (25.0%)	3 (5.0%)	12 (30%)	12 (20.0%)	10 (16.7%)	6 (15.0%)	27 (67.5%)
₦51,000-₦100,000	34 (8.5%)	2 (5.0%)	13 (21.7%)	2 (3.3%)	7 (17.5%)	1 (1.7%)	1 (1.7%)	0 (0.0%)	8 (20.0%)
More than ₦100,000	24 (6.0%)	0 (0.0%)	15 (25.0%)	0 (0.0%)	8 (20.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.5%)
Household size *n (%)*									
1-4	52 (13.0%)	11 (27.5%)	10 (16.7%)	6 (10.0%)	3 (7.5%)	3 (5.0%)	6 (10.0%)	7 (17.5%)	6 (15.0%)
5-8	232 (58.0%)	25 (62.5%)	33 (55.0%)	34 (56.7%)	12 (30.0%)	44 (73.3%)	38 (63.3%)	24 (60.0%)	22 (55.0%)
Above 9	116 (29.0%)	4 (10.0%)	17 (28.3%)	20 (33.3%)	25 (62.5%)	13 (21.7%)	16 (26.7%)	9 (22.5%)	12 (30.0%)
Household Dependency on Agriculture *n (%)*									
Not dependent at all	5 (1.2%)	0 (0.0%)	2 (3.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (3.3%)	0 (0.0%)	1 (2.5%)
Low dependency	52 (13.0%)	4 (10.0%)	12 (20.0%)	0 (0.0%)	2 (5.3%)	5 (8.3%)	1 (1.7%)	18 (45.0%)	10 (25.0%)
Medium dependency	83 (20.8%)	11 (27.5%)	19 (31.7%)	2 (3.3%)	9 (18.4%)	12 (20.0%)	8 (13.3%)	9 (22.5%)	13 (32.5%)
High dependency	260 (65.0%)	25 (62.5%)	27 (45.0%)	58 (96.7%)	29 (76.3%)	43 (71.7%)	49 (81.7%)	13 (32.5%)	16 (40.0%)

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

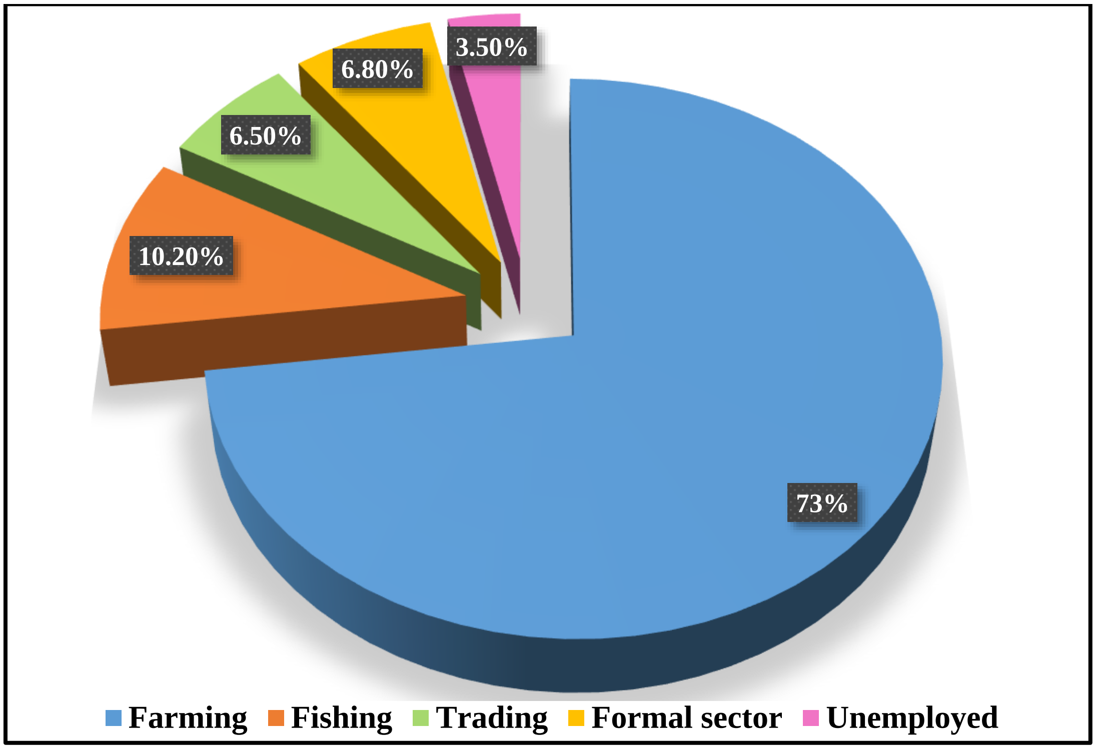
With regard to the education level, most of the respondents have formal education (either primary and secondary school or tertiary) accounting for 81.5% of the total sample, whereas only 9.5% are with no formal education. It is crucial to take education levels into account while trying to mitigate the effects of climate change such as flooding because education plays a crucial role in securing information.

Furthermore, almost 97% of the respondents have been living in their current residence for over ten years. From responses gathered in the field during the survey, the people alluded to the fact that staying in a place for a long time helps them to understand the terrain and better put them ahead of coping and adjusting to any sudden change in the environment such as flooding events. When asked about the ownership of the land they occupied, 56% accounted for people who owned the land, while about one-third (38%) of respondents live on family lands where they pay no rent and the remaining 6% pay rent for the land they occupied. The landowners are more likely to be alerted in making more inclined decisions and to devote their financial resources to making structural changes to their houses and farmlands to cushion the effect of flooding.

On the account of the income level of respondents, a majority (85.6 %) of the respondents earn 50,000 Naira (the equivalent of USD 120, as at the time of carrying out the research) or less per month. Of this proportion, 62.8% live below the national minimum wage of 30,000 Naira. This supports claim of high inequality as indicated by a Gini coefficient of 0.64 (UN-HABITAT, 2014). Recovery from flooding comes with a high cost which translates to a higher income. People with high income have been found to have a likelihood of high recovery ability from flood losses and destructions. For the people to overcome the challenges posed by flooding, having another source of income has been found very important, when asked about another source of income, a majority (81%) emphatically said they have no other source of income while just 19% have. According to them, they get income from other sources such as pensions, co-operative/development groups, house rent, and remittance.

Furthermore, the distributions of respondents about their occupational status across the study area were documented and presented in Figure 22.

Figure 22: Distribution of respondents' occupational status in the study area



Source: Peter B. Oyedele, 2022

In Figure 22, farming was found to be an important economic activity and a major source of livelihood among the sample population with over half of respondents (73%) engaged in farming and other forms of agricultural activities. Other main occupations are fishing (10.3%), trading (6.5%), and 6.8% work in formal sectors, while only less than 3.5% were unemployed. In addition, almost all sampled households (98.2%) indicated their dependency on agricultural activities as their major source of income.

5.1.2. Distribution of the respondents' flood experience and other characteristics

It is natural for people affected by events, such as flooding to experience difficulty sleeping, frustrations, sadness, angry moods as well as heightened feelings of anxiety. Therefore, in understanding the perception of the people concerning flooding, there is the need to evaluate their current state of flood experience. The distribution of respondents regarding their flood experience and other factors (intensity, length of floodwater in the community, frequency) across all LGAs are shown in Table 20.

Table 20: The distribution of respondents regarding their flood experience and other factors

Variable	Local Government Areas (Total)	Ajaokuta LGA	Bassa LGA	Ibaji LGA	Idah LGA	Koto-karfe LGA	Lokoja LGA	Ofu LGA	Omala LGA
Number of respondents *n (%)*	400 (100%)	40 (10%)	60 (15%)	60 (15%)	40 (10%)	60 (15%)	60 (15%)	40 (10%)	40 (10%)
Flood experience *(%)*									
Every year	316 (79.0%)	25 (62.5%)	51 (85.0%)	58 (96.7%)	35 (87.5%)	60 (100%)	60 (100%)	26 (65.0%)	1 (2.5%)
Every two years	35 (8.7%)	11 (27.2%)	5 (8.3%)	2 (3.3%)	3 (7.5%)	0 (0.0%)	0 (0.0%)	6 (15.0%)	8 (20.0%)
Every three years	42 (10.5%)	4 (10.3%)	3 (5.0%)	0 (0.0%)	2 (5.0%)	0 (0.0%)	0 (0.0%)	8 (20.0%)	25 (62.5%)
Don't know	7 (1.8%)	0 (0.0%)	1 (1.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (15.0%)
Respondents' willingness to relocate *(%)*									
Not very likely	95 (23.7%)	6 (15.0%)	10 (16.7%)	46 (76.7%)	11 (27.5%)	0 (0.0%)	4 (6.7%)	18 (45.0%)	0 (0.0%)
Not Likely	62 (15.5%)	7 (17.5%)	12 (20.0%)	11 (18.3%)	15 (37.5%)	1 (1.7%)	5 (8.3%)	1 (2.5%)	10 (25.0%)
Indifferent	48 (12.0%)	0 (0.0%)	1 (1.7%)	2 (3.3%)	6 (15.0%)	0 (0.0%)	0 (0.0%)	9 (22.5%)	30 (75.0%)
Likely	61 (15.3%)	14 (35.0%)	24 (40.0%)	1 (1.7%)	2 (5.0%)	8 (13.3%)	9 (15.0%)	3 (7.5%)	0 (0.0%)
Very likely	134 (33.5%)	13 (32.5%)	13 (21.6%)	0 (0.0%)	6 (15.0%)	51 (85.0%)	42 (70.0%)	9 (22.5%)	0 (0.0%)
Flood knowledge education *(%)*									
Strongly Disagree	18 (14.5%)	2 (5.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (5.0%)	4 (6.7%)	0 (0.0%)	9 (22.5%)
Disagree	77 (19.2%)	11 (27.5%)	20 (33.3%)	0 (0.0%)	7 (17.5%)	3 (5.0%)	14 (23.3%)	18 (45.0%)	4 (10.0%)
Neutral	42 (10.5%)	3 (7.5%)	6 (10.0%)	3 (5.0%)	0 (0.0%)	14 (23.3%)	10 (16.7%)	4 (10.0%)	2 (5.0%)
Agree	145 (36.3%)	21 (52.5%)	26 (43.3%)	16 (26.7%)	19 (47.5%)	23 (38.3%)	23 (38.3%)	7 (17.5%)	10 (25.0%)
Strongly Agree	118 (29.5%)	3 (7.5%)	8 (13.3%)	41 (68.3%)	14 (35.0%)	17 (28.3%)	9 (15.0%)	11 (27.5%)	15 (37.5%)
Flood mgt. responsibility *(%)*									
Strongly Disagree	6 (1.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.7%)	3 (5.0%)	0 (0.0%)	2 (5.0%)
Disagree	15 (3.8%)	0 (0.0%)	1 (1.7%)	0 (0.0%)	4 (10.0%)	3 (5.0%)	4 (6.7%)	0 (0.0%)	3 (7.5%)
Neutral	4 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.7%)	1 (1.7%)	0 (0.0%)	2 (5.0%)
Agree	91 (22.7%)	4 (10.0%)	10 (16.7%)	18 (30.0%)	11 (27.5%)	10 (16.7%)	13 (21.6%)	15 (37.5%)	10 (25.0%)
Strongly Agree	284 (71.0%)	36 (90.0%)	49 (81.7%)	42 (70.0%)	25 (62.5%)	45 (75.0%)	39 (65.0%)	25 (62.5%)	23 (57.5%)

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

5.1.2.1. Respondents' experience of flooding and its effects on their livelihood

As shown in Table 20 (earlier), about 80% of the respondents confirmed they experience flood yearly putting the percentage of people with flood knowledge to about 66%. Studies revealed that the flood experience can increase flood risk perception and people with recent flood experience would acquire good knowledge of flood and do well in flood mitigation. 355 out of the 400 respondents who experienced floods, specified that their severity and significance hurt their households, such as destroying farmlands and produce, damages to their homes, disrupting farming activities, suffering personal injuries, interrupting public services (schools, hospitals, electricity, water), closure of important roads, and general damages in their neighborhood. When asked about the willingness and readiness to relocate from the area where floods affect them on yearly basis, about 49% are willing to relocate to safer zones to avert further flood damage.

To further strengthen the result above, the flood experience of respondents and their opinion on moving away from flood risk zones were captured during the Focus Group Discussion (FGD) session and presented as follows:

"Floods indeed have serious impacts on our lives and livelihoods, but it used to be funny to us especially me when people asked me if I will move away from here or not. It is simple as I also used to ask whoever asked that question back. To move to where? On getting to that place, to do what? It is so painful that many of you don't know what we are going through. Many of you used to judge us from the outside. In fact, to some of you, we are not serious at all. This is not true. When you said we should move, what is the provision, I am talking of meaningful provisions has been provided for us to continue our lives in that place you want us to move to. See, my brother, if not for this my son that you contacted to talk to us (talking about the contact person in the community), I will not be sitting with you here to interrogate me again. Many people including government officials have been coming here to confuse, lie, and even deceive us. They get data from us every time, we write down names and all our items that flood destroyed, but in the end, we hear nothing! Just like one of us had told you, and at this age, if you ask me to move away from here, I will say it to go and continue to suffer in the new place, without a job, no source of income unlike here, that we do our farm, fish, and plant what we eat. Indeed, floods used to disturb us very well, all I will tell us is that you people used to help us, we can manage our situation. Please help

us to do the necessary things like provide us with early-matured seeds and seedlings, chemicals, tractors, and other farm inputs. With these, we can quickly plant and harvest our farm produce before another flood event comes..." (Report of an elderly man of 65 members of the FGD group session at Onyedega community in Ibaji LGA).

The flood experience of another participant was documented as follows:

"It is no longer new to us and everyone in and around Lokoja that flood affects us, our homes, and our farmlands. We are only pleading and begging the government need to do more and we are counting on them. This is the capital of Kogi State and we are sure they won't want it to disappear this gives us confidence that they will do something to prevent flooding in the coming year. They have been making some constructions along the riverside at the International market going towards Abuja road…" (Report of a 42-year-old female participant of the FGD group session at Adankolo community in Ajaokuta LGA).

5.1.2.2. Respondents' experience with floodwater

Further, the result of the analysis shows that the majority (78.8%) of the respondents revealed that floodwaters take up to forty-five days for it to dry up in their neighborhoods (Figure 5.2).

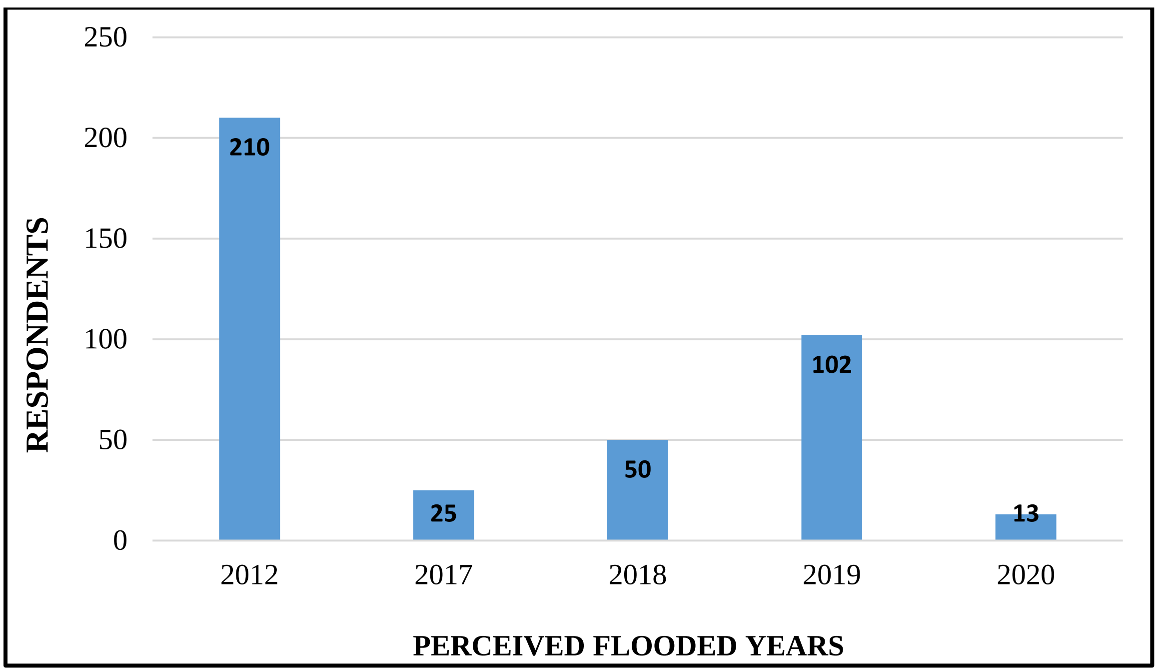
Photo 12: A community in Ibaji LGA where floodwaters remain stagnant for a long period of days

Source: Kogi State Ministry of Environment and Natural Resources

It was stated that the floodwater remains stagnant with a foul smell, becoming a conducive environment for pest and disease proliferation. This according to the respondents pose a lot of difficulties and threats to their lives and affects movements to market place, religious centers, and farms. In addition, it destroys belongings, causes damage to vital infrastructures, and also prevents access to essential public services. During this period, schools are closed down and the children are restricted to settling in safe zones until the water subsided. This connotes that people are at serious risk of contracting diseases and sustaining fatal injuries from floodwater.

Respondents were asked based on their experience to indicate the year to be considered the most flooded year within the last decade. The majority of the respondents stated that the 2012 floods were the most severe and unforgettable floods year within the last ten years (Figure 23).

Figure 23: Respondents' perceived most flood years in the last decade



Source: Author's (Peter B. Oyedele) Fieldwork, 2022

The results corroborate the findings of Aderoju et al. (2014) that identified Kogi State as the most affected state in the year 2012 floods due to its location at the confluence of the country's major rivers (Niger-Benue). The 2012 floods caused rivers to burst their banks, engulfing hundreds of kilometers of rural and urban areas, thereby destroying hectares of farmlands and scores of houses.

5.1.3. Households' flood risk perception (HFRP) in the selected communities

In their work on flood risk perception in flood-affected communities in Lagos, Nigeria, Adelekan and Asiyanbi (2016) emphasized that understanding the risk perception of the public in response to flooding remains a holistic approach to managing flood risk as it considers their social information, and equally aids the understanding of the factors underlying exposure to flood hazard. It is against this background that this section of the thesis presents the results of the analysis concerning the household flood risk perception in the study area.

5.1.3.1. Descriptive statistics of household flood risk perception in the study areas

The description of households' perception of flood risk across the selected eight LGAs is shown in Table 21.

Table 21: The descriptive statistics of household flood risk perception in the study areas

LGAs	Mean	N	Std. Deviation	Std. Error	***p* Value**
Ajaokuta	3.56	39	1.483	0.237	0.001 *
Bassa	3.36	58	1.423	0.187	
Ibaji	1.30	60	0.619	0.080	
Idah	2.43	40	1.357	0.214	
Koto-Karfe	4.82	60	0.504	0.065	
Lokoja	4.33	60	1.244	0.161	
Ofu	2.60	40	1.646	0.260	
Omala	2.79	38	0.413	0.067	
Total	**3.21**	**395**	**1.604**	**0.081**	

Note: *with statistical difference ($p<0.05$)

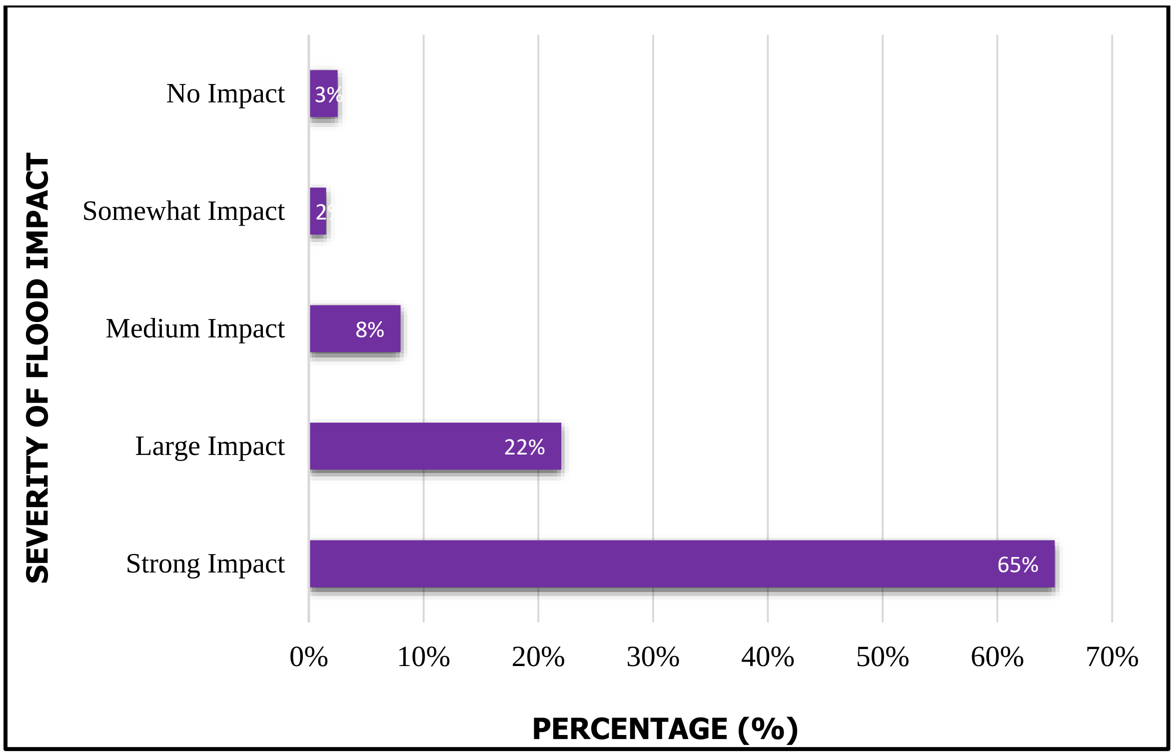
Source: Peter B. Oyedele, 2022

From the result, the *p*-value was less than 0.05, indicating that household perceptions of flood risk across the area were statistically significant. This means that the respondents across the study area similarly perceive the risk of flooding. As a result, the comparison of scores between these eight LGAs was thus accurate, credible, and reliable. As far as the LGAs are concerned, the analysis has found that there was a statistically significant difference between households' flood risk perception in the sampled flood-prone LGAs in Kogi State.

5.1.3.2. Perceived severity of flooding impact among the households

According to the analysis of the data that was collected and the discussions that took place during an in-depth interview and FGD sessions, respondents' perceptions of the severity of the impact of floods differed.

Figure 24: Severity of flood impact -measurement of household flood risk perception (HFRP)



Source: Peter B. Oyedele, 2022

In Figure 24, over half (65%) of the respondents believed that flooding had a strong impact on them. These categories of respondents indicated that floods had an extremely serious effect on their daily lives, destroyed their farms, and damaged their homes, pets, and several means of livelihood. Similarly to this, 22% of respondents agreed that the impact was large in magnitude. The shutdown of all activities until the floodwater receded, injuries, starvation, and the loss of certain economic opportunities, among other inconveniences experienced, they argued, make the impact highly significant. Also, 8% of the respondents chose "medium impact" because they believed that their lives and livelihoods had been affected but not severely. Only 2% of respondents stated that a flood had no impact on them because they are never affected.

Photo 13: Images depicting the severity of floods in the Budon, Kakanda community, Lokoja LGA

Source: Author's (Peter B. Oyedele)Fieldwork, 2021

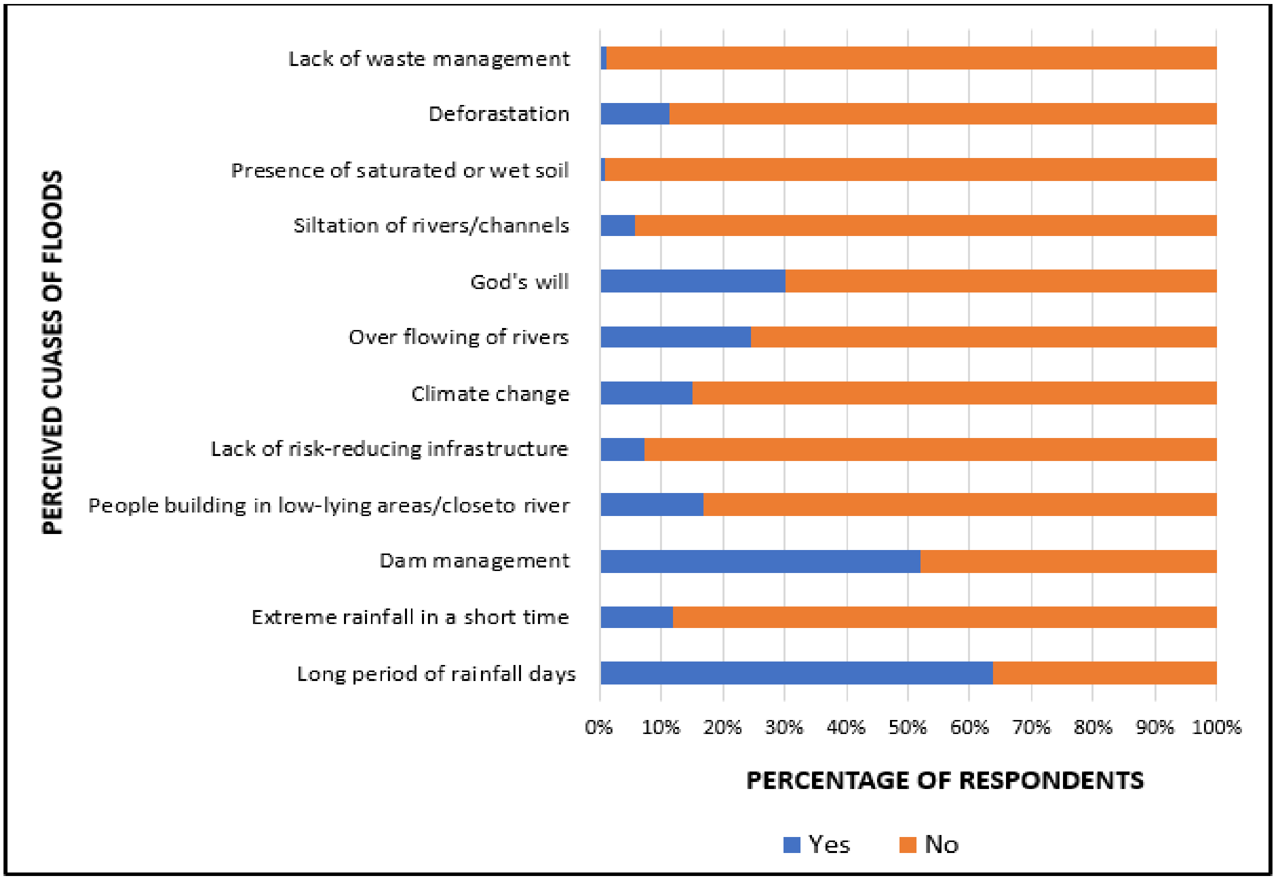
The photo was captured at Budon community in Lokoja LGA, where most of the houses collapsed due to the severe impact of the flood. It was gathered from the field also that destroying these houses were so enormous that almost all the building are submerged under them as seen in the photo[13].

5.1.3.3. Respondents' perceived causes of floods

On the respondents' perceived cause(s) of floods, several reasons were given by the respondents. Some opined that floods happened in the community owing to some factors such as the existence of a long period of rainfall, poor dam management leading to overflow of rivers, people building structures along waterways, and the will of God. Of these, the length and amount of rainfall were ranked as the main causes. Figure 25 presents the respondents' perceived causes of floods in the study area.

[13] (A) Shows the sign of floodwater level marked on the wall of a building; (B) a collapsed building due to the impacts of flood disaster.

Figure 25: Respondents' perceived causes of flooding in the study area



Source: Peter B. Oyedele, 2022

To further strengthen the result above, the opinion on the causes of flood in the study were captured during the Focus Group Discussion (FGD) session and presented as follows:

"…In my own opinion, I think the major cause of this flood is that we now have a very huge amount of rainfall and this increases the water volume in Rivers Niger and Benue. This excess water begins to overflow the river banks, causing what we now experience. The truth is that we cannot stop rain from falling, because it is the work of God, but another reason which I think causes the flood is that dams are not well managed. They even release the dam, doing this makes the volume of the water in the Niger and Benue rivers increase more and it goes like that. So what I think the government can help us do is that they should help me manage the dam very well, help us clear the riverways so that there can be an easy flow of water along its course…" (Report of a 46-year-old divorcee during the FGD group session at Shintaku community in Bassa LGA).

In addition, the view of another participant was captured as follows:

"…In my opinion, floods are caused by an act of God and the will of God so we should not deceive ourselves. God knows about this flood, that's the fact I can tell you. He's our creator and nothing happens behind him. He allowed this to punish us because of our various acts of wickedness. Today, our sins are so huge that God is angry, and for your information, the floods are the way he wishes to tell us to stop doing bad things. For many years, we are not used to experiencing flood as it is today. So why always almost every year these days? We better repent of our evil ways and acts, else, more floods may happen again…" (Report of a 69-year-old woman during the FGD group session at the Shintaku community in Bassa LGA).

5.1.4. Factors influencing households' flood risk perception

As was previously defined in the model specification, the respondents' socio-demographic characteristics as well as the other factors (respondents' flood experience, flood knowledge, responsibility for flood management, and willingness to relocate from flood risk zones) that could influence the household perception of flood risk in the study area were considered. 95% confidence was applied in this case. Table 22 shows the result of the analysis of variance (ANOVA) used to determine the relationships between the factors and households' perceptions of flood risk across all of the selected communities. When p value < 0.05, it means the factors would influence the flood risk perception.

Table 22: Analysis of variance (ANOVA) between household flood risk perception and its influencing factors

Variable	*p* Value
LGAs	0.001*
Gender	0.421
Age	0.019*
Education level	0.006*
Occupation	0.570
Income per month	0.001*
Length of stay in the community	0.001*
Respondents' flood experience	0.001*
Flood knowledge	0.001*
Management/protection responsibility by themselves	0.002*
Willingness to relocate	0.001*

Note: * with statistical difference ($p < 0.05$)

Factors, such as LGAs, gender, age, educational level, income per month, length of stay in the community, respondent's experience, flood knowledge, flood management and responsibility and respondent's willingness to relocate all have a significant relationship with the flood risk perception. These results imply that there was no significant correlation between households' flood risk perception and two factors; gender and occupation. Whereas, it was seen that other influencing factors (LGAs, education level, income per month, length of stay in the community, respondents' flood experience, management/protection responsibility, and willingness to relocate) had statistically significant differences with households' perception of flood risk.

5.1.5. Understanding how different individuals between and among groups perceived flood risk in the study area

To further understand how different individual between and among groups perceived flood risk, Post Hoc Tests was conducted to find the flood risk perception difference between different groups under the same impact factor among all the respondents. As far as the LGAs are concerned, the above analysis has found that there was a statistically significant difference between households' flood risk perception in the sampled flood-prone LGAs in Kogi State. Compared with the other seven LGA, the respondents in Lokoja were shown to have a relatively lower perception of flood risk. This is the LGA that doubles as the capital of the state and so most people expected the government to do more in the management and aversion of future flood risk in the area. Table 23 shows the results of these analyses.

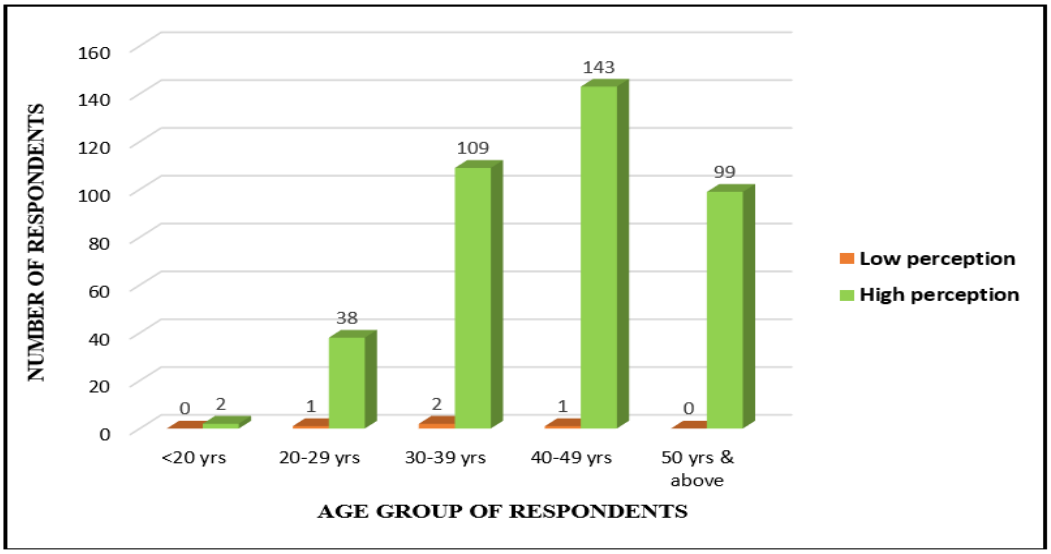
Table 23: Multiple comparisons for factors influencing household flood risk perception

Variables	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
LGAs (vs. Lokoja)					
Ajaokuta	0.82*	0.144	0.001*	0.38	1.26
Bassa	0.57*	0.130	0.001*	0.18	0.97
Ibaji	0.12	0.128	0.985	-0.27	0.51
Idah	0.27	0.143	0.538	-0.16	0.71
Koto-Karfe	0.07	0.128	1.000	-0.32	0.46
Ofu	0.87*	0.143	0.001*	0.44	1.31
Omala	1.15*	0.149	0.001*	0.70	1.60
Gender (vs. Male)					
Female	-0.073	0.092	0.427	-.255	0.109
Age (vs. 40 – 49 years)					
<20 years	-0.08*	0.564	0.000*	-1.63	1.46
20-29 years	-0.25*	0.148	0.048*	-0.65	0.16
30-39 years	-0.31*	0.101	0.020*	-0.58	-0.03
50 years & above	-0.02	0.105	1.000	-0.31	0.27
Education Level (vs. Tertiary Education & above)					
No Formal Education	0.30	0.144	0.149	-0.07	0.68
Primary school	0.41*	0.115	0.002*	0.11	0.71
Secondary school	0.30*	0.101	0.015*	.04	0.56
Occupation (vs. Farming)					
Fishing	0.26	0.158	0.631	-0.20	0.73
Trading	-0.01	0.205	1.000	-0.62	0.60
Artisan	-0.12	0.464	1.000	-1.49	1.26
Formal sector (government)	0.14	0.199	0.993	-0.45	0.73
Formal sector (private)	-0.12	0.464	1.000	-1.49	1.26
Unemployed	-0.24	0.218	0.935	-0.88	0.41
Monthly Income (vs. < ₦10,000)					
₦ 10,000 - ₦ 20,000	-0.50*	0.101	0.001*	-0.78	-0.22
₦ 20,001 - ₦ 50,000	-0.08	0.116	0.967	-0.39	0.24
₦ 50,001- ₦ 100,000	-0.08	0.145	0.978	-0.48	0.31
Above ₦ 100,000	-0.46	0.176	0.070	-0.94	0.02
Length of stay in the community (vs. 11 -20 years high)					
=10 years	-0.62*	0.184	0.005*	-1.09	-0.14
21- 30 years	-0.40*	0.104	0.001*	-0.67	-0.13
>30 years	-0.78*	0.095	0.001*	-1.03	-0.54
Flood experience (vs. Every year lower)					
Every two years	-1.17*	0.139	0.001*	0.81	1.53
Every three years	-1.22*	0.107	0.001*	0.95	1.50
Don't know	-0.25	0.242	0.723	-0.37	0.88
Flood knowledge (vs. climate change)					
Inadequate government support	-0.35*	0.105	0.008*	-0.64	-0.06
Poverty	-0.77*	0.104	0.001*	-1.06	-0.49
Environmental degradation	-0.68*	0.137	0.001*	-1.06	-0.30
Cultural attachment	-0.95	0.426	0.170	-2.12	0.22
Flood management/protection responsibility by themselves (vs. Strongly Agree)					
Strongly Disagree	-0.41	0.162	0.090	-0.85	0.04
Disagree	-0.34*	0.101	0.009*	-0.61	-0.06
Neutral	-0.45	0.177	0.088	-0.93	0.04
Agree	-0.19	0.113	0.449	-0.50	0.12
Willingness to relocation (vs. Indifferent)					
Not very likely	-0.34*	0.113	0.025*	-0.65	-0.03
Not Likely	-0.64*	0.125	0.001*	-0.98	-0.30
Likely	-0.45*	0.126	0.004*	-0.79	-0.10
Very likely	-0.70*	0.106	0.001*	-0.99	-0.41

Note: * with a statistical difference ($p < 0.05$). The mean difference among gender using an Independent T-test because only two groups exist, male and female.

Different age groups had different flood risk perception levels. However, respondents aged 40-49 years old had the highest flood risk perception comparing it with other aged groups. This was followed by the respondent in the age group 30-39 years and then 50 years and above. Figure 26 further shows the graphical representations of flood risk perception among the different age groups.

Figure 26: Comparison of flood risk perception among the different age groups



Source: Peter B. Oyedele, 2022

This implies that the older the respondent, the higher the flood risk perception level. This result is logical in the sense that respondents in the higher age group must have experienced or witnessed different flooding events and their negative consequences, thereby availing them of the ability to be knowledgeable and think more about family safety.

To further strengthen the result above, the perception of flood with its consequences on both the lives and livelihoods of the people were captured in detail during the Focus Group Discussion (FGD) session and presented as follows:

"… Flood is happening in our community every year and so what can we do? See, the truth is we cannot vacate this land. If we leave here, where do we go? We only move away for a short time especially when the water is very much. If you can see around our houses, you can see some of the structures we made like steps at the entrance of our rooms, not only that, we try to place our food items like yam, maize, and other far produce on a high wooden material. This has been the general

practice among all of us because we don't have a choice other than to face it. After all, the flood is happening every year..." (Report of a 52-year-old man during the FGD group session at Ichekene community in Idah LGA).

5.2. Discussion

This section presents the explanation to the statistical and empirical analyses of the study to understand the factors that influence the household perception of flood risk in the selected communities in Kogi State. The results of ANOVA established that location, level of education, income per month, length of stay in the community, flood experience, the responsibility of flood management, and willingness to relocate were strongly correlated with flood risk perception, hence, regarded as the factors that influence how household perceived flooding in the area.

From the empirical analysis, the local government area (LGA) where each households are located was found to be statistically significant with households' perception of flood risk. It shows there is a positive correlation between the closeness of the flood hazard and the risk perceived by the households. It implies that the physical location which ideally reflects the proximity of the floods hazard (say the probability of its occurrence) makes people to display a higher level of risk perception as they seek information to leverage upon so as to avert the occurrence of the disaster to the minimum. This findings corroborates the findings of previous researchers such as Botzen et al. (2009; Bubeck et al. (2012); and Lechowska (2018). When comparing the LGAs, households from Lokoja were found to have relatively low perception of floods. This reason for this may likely be because the LGA houses the capital of the state and it's regarded as the administrative and commercial hub of the Kogi State. As a results, people may assume their economic and urban orientation may put them ahead anytime flood disaster strikes.

In the analysis of this study, age as a factor had positive correlation with flood risk perception (see the ANOVA Table 20). Further analysis shows that different age group had different flood risk perception levels. Respondents aged 40-49 years old had the highest flood risk perception comparing it with other aged groups. This is not quite different from respondents with the aged 50 years and above. This implies that the older the respondent, the higher their perception of flood risk. This result is logical in the sense that respondents with higher age group must had experience or witness different flooding events and its negative consequences, thereby availing them the ability to be knowledgeable and thought more about the family safety. This results support the assertion made by Kellens et al. (2013) that older age group is most often linked to a perception of higher risk. In relation to respondents' gender, The results of this study revealed that there was no significant correlation between gender and respondents' perception of flood risk and was found to be consistent with findings from Liu et al. (2022). This implies that both male and female gender in the study area perceived flood risk alike. Most importantly because women were found to have lower socio-economic status than men in facing flood, as such, they are motivated and willing to seek flood information so as to enhance their preparedness against flooding (Wang et al., 2018).

Regarding respondents' educational level, the results of the analysis revealed that education significantly and positively influenced flood risk perception in Kogi State indicating that education makes people aware of flood disaster as also earlier noted by Botzen et al. (2009) . In particular, respondents with Tertiary education and above were found to perceive flood risk much lower when compared to other respondents from other education levels (no formal education, primary school and secondary school). In other words, the more-educated respondents had the lowest perception of flood risk. The may be because they may feel they had more abilities and a higher degree of confidence due to their higher and more educational status to control the occurrence and damages caused by flood disasters (Kellens et al., 2013; Liu et al., 2022; Qasim et al., 2015). Furthermore, the results shows that there was no significant correlation between occupation and respondents' perception of flood risk. However, the empirical analysis revealed that respondents who are into farming had the highest flood risk perception. Earlier researcher noted that the reliance of many agrarian economies on rain-fed agriculture (such as farming) exposed them to risk from floods (Danso-Abbeam et al., 2021). Hence, the justification for farmers highly perceived flood in seeking information on how to adapt with the objective of averting further losses and damages to their livelihoods.

About respondents' monthly income, the result shows that respondents within the lower income group (less than ₦10,000 per month) had the highest flood perception level compared to other groups especially those with higher income. While those with higher monthly incomes lowly perceive flooding with the mindset that they had the ability and monetary capacity to deal with loss and damages caused by flood disasters (Liu et al., 2022). This supports the assertions from previous findings that higher educated people had higher income, hence, observable low perception of flood risk that was similar (Kellens et al., 2013).

Flood experience, knowledge, flood management responsibilities as well as the willingness of respondents to relocate from the disaster-prone area all were found to be positively correlated with household perception of floods. On flood experience, it was found that respondents who experience flood annually were found to high perception of flood events compared to those in other groups. This may be because people who experience flooding annually suffered more damages and losses (Lechowska, 2018; Oyedele et al., 2022). As such, they tend to have a clearer and more systematic understanding of the risks thereby availing themselves of the opportunity to acquire information and measures to protect themselves, family, and their livelihoods. This corroborates the findings of Dzoka et al. (2017), that, people place a high value on the security of their lives and livelihoods, which reduces their vulnerability to a specific disaster to the absolute minimum as a result of their perspective and interpretation of the factors influencing the incidence of disasters. From the foregoing, there is therefore the need to integrate flood experience of flood victims in risk perception as this plays a very important role in flood management, and adaptation processes (Lawrence et al., 2014).

On respondent’s knowledge on the cause of flooding, there varying perceived causes of flood as shown in the result. Respondents who admitted that flood is mainly caused by climate change were found to have highest perception. In fact, during our field research, majority of the respondents agreed that the climate had changed over long period. In particular, they majority believed the raining season for instance had changed compared to what it used to be. It was gathered that even when it rained, it is excess resulting into several damages of farmlands, buildings and other livestock. Alternatively, some person. This implies that the knowledge of flooding is very important in understanding its causes, consequences and way of adapt and mitigate it. Hence, there is the need to spread flood knowledge education among respondents.

Participants’ were asked as to whether flood protection and management should be the sole responsibility of an individual. In this study, the respondents who strongly agree with the statements were had the highest perception of flood risk compared to others. This implies that people now decided to seek information in managing flood risk out of their personal way. This was much revealed during fieldwork where a participant decried the inability of government officials and other functionaries to meet their need in term of flood crisis, thus they perceived high flood risk and prefer to take self-protection measures instead. This result also reflects the fact that raising public responsibility for flood protection is very helpful for flood mitigation and risk management (Bradford et al., 2012)bra.

Respondents' willingness to relocate was found to have positive correlation with their perception of flood risk. This contains four groups ("Very Likely", "Likely", "Indifferent", "Not Likely", and "Not Very Likely"). Among these group, the indifferent were found to have the highest flood risk perception. Despite the challenges of flooding being faced by the people, they remain in the area. In particular, during field work engagement with the respondents, we found out that many wish to relocate but presented with the fear of where exactly to relocate. Aside that, land was found to be cheaper in the area. More so, it was equally note that farming and fishing were the major means of livelihood, hence, the reason for their staying back to flood-prone zone due to availability of water for planting and fishing activities. This made majority to be indifferent, hence, decided to seek for information to better position them in adapting to flooding.

Conclusion

The chapter presented the perceived flood risk of sampled household. This perception was relate to the severity of the flooding as experienced by the households. Similarly, the factors that influence these perception were itemized. These factors were compared within and among group such as the location, age, occupation, gender and income level, etc. This study is important as it provides clarity on how respondents' socioeconomic characteristics and other factors influence their perception of flood disasters and their management. The study revealed different flood risk perceptions among households, in this case, government and relevant agencies can leverage this important factor to encourage and promote flood prevention strategies such as smart agriculture, change of planting calendar, and flood insurance policy to avert flood losses. The flood risk perception factors identified should be emphasised to improve public and household perception of flood risk, with an objective of reducing common idea of ignoring or underestimation of the flooding by community and decrease potential flood-related disaster losses. This can be an entry point for community leaders, and government and non-governmental organizations (NGOs) to intensify risk awareness creation through training and education of the general public.

CHAPTER SIX

HOUSEHOLDS' ADAPTATION STRATEGIES AND DECISION-MAKING TO FLOOD DISASTERS

Introduction

The negative impacts remains a major setbacks to development, environmental sustainability, and human security, hence, exacerbating poverty in the region. Their prevention and management is a concern for the populations and the decisional authorities of the city. To cope with them, the former develop and activate endogenous adaptation strategies while the latter develop and implement structural and non-structural resilience measures. This chapter analyzes these strategies and the decision making of household to either remain or quite the flood-prone areas.

6.1. Results

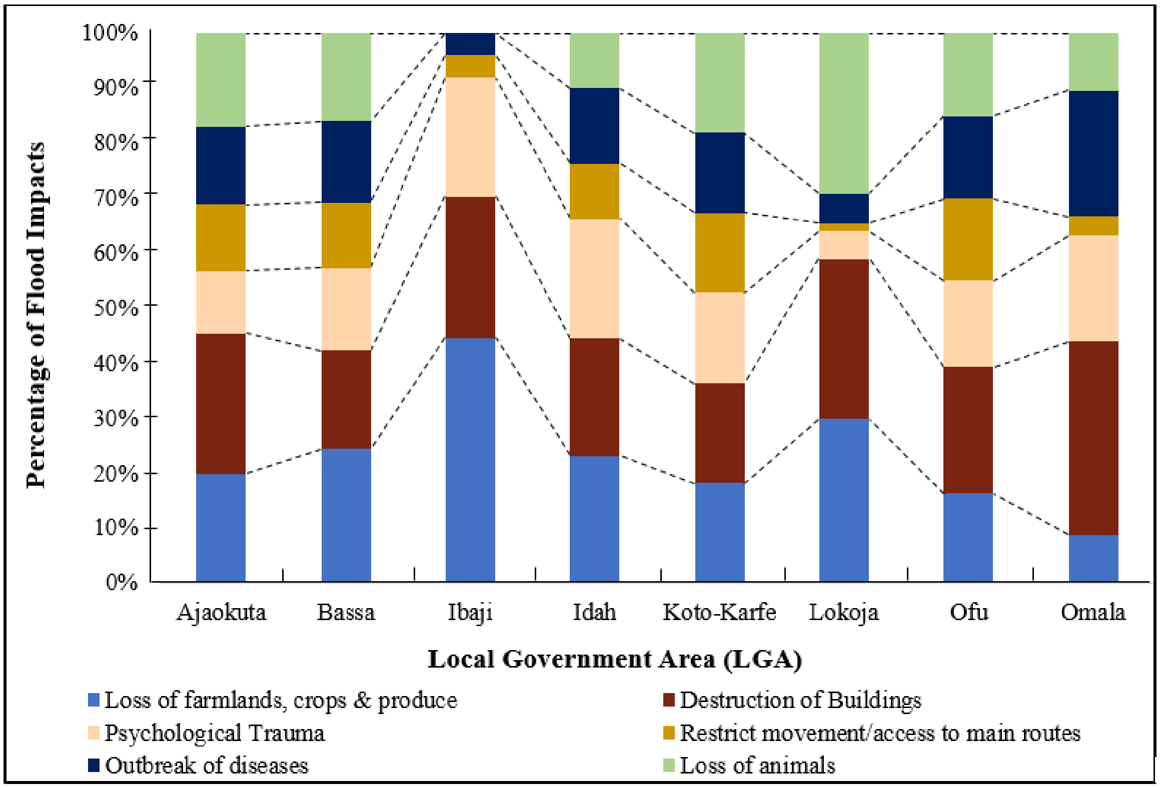
6.1.1. Impacts of flood disaster on households in the communities

Oftentimes, it is believed that the aftermath of a flood event comes with only negative experiences, this is not the case in the study area see floods have positive effects on the environment, lives, and livelihoods increment in particular.

6.1.1.1. Negative impacts of floods on the communities

From the results of the empirical survey conducted, the negative effects of flood events in the community among the households include: loss of farmlands, crops, and farm produce; destruction of buildings, critical infrastructures such as drainage systems, hospitals, and electric poles; restriction of movement and access to main routes due to the accumulation of flood water; outbreaks of diseases such as cholera and malaria in particular; loss of animals and other livestock; psychological trauma, injuries, and death in some critical cases were all recorded. Graphically, Figure 27 shows the various negative impacts of floods as noted by the households across the sampled LGAs in the study area.

Figure 27: Negative impacts of flood disasters in the sample community



Source: Peter B. Oyedele, 2022

As observed from the Figure, the negative impacts of floods vary in the extent of occurrence from one LGA to another. It is important to accept the fact that the impact of a disaster affects those who have a low capacity to cope and recover. Taking Ibaji LGA for instance, it was found to be the hotspot of flood vulnerability due to households' high lack of resilience. This accounts for how households in the area recorded the highest loss of farmlands, crops, and farm produce.

6.1.1.2. Positive impacts of floods on the communities

When asked if there were any good impacts of floods, almost half (46%) of the respondents indicated positive opportunities they derive from flooding. These include:

- It helps in washing and clearing the drainage systems,

- promotion of fishing activities, it's believed that flood occurrence leads to an increase in fish catch and is equally favourable when the flood duration is long enough to sustain the breeding of fish as it helps increase the number of fish in the rivers
- it guides us in a change of focus and vision in the management of the environment
- floods help in replenishing soil fertility thereby supporting farming activities to produce more yields

To further strengthen the result above, both the positive and negative impacts of floods were captured during the Focus Group Discussion (FGD) session and presented as follows:
"…yes, we agree there are many negative effects from this flood, in fact so many, like causing of injuries, we lost many of our animals, and sometimes lives. I remembered very well that in the 2019 flood, about two people were lost. Not only that, we lost thousands and millions of naira worth of farm produce. This used to happen particularly when it is about time for us to harvest our farm produce. The 2012 floods are still an event I can never forget, as I lost close to 4 Million Naira worth of rice farms. Now, talking about the positive aspect, we enjoy flood events happening. This is because we are farmers and fishermen, flood helps us to increase the soil fertility and the amount of fish in the river…" (Report from 1st participants at Budon, Kakanda community in Lokoja LGA in Kogi State)

Another participant during the FGD session also has the following to say:

"…according to stories I was being told by my great grandfather, the British colonization, hardly conquer the Kakanda people because they were afraid of coming to our place due to the water that surrounded us. We live our whole lives on the water, this, of course, makes it difficult to be attacked by the enemies and so for us this is an advantage we get from flood and water bodies …" (Report from 2nd participants at Budon, Kakanda community in Lokoja LGA in Kogi State).

6.1.2. Awareness, channels, and dissemination of flood information among households

Having good preparation and knowing what to do before, during, and after every flood event is an important action taken to increase safety and reduce damages due to flooding. The success of this information is dependent on different which include the sender, timing, clarity, and the channel of passing such information.

6.1.2.1. Dissemination of flood information among farm households in the community

Respondents were asked whether or not they received flood education and sensitization. Table 24 presents the result of households' awareness of flood early warning in the study area.

Table 24: Distribution of respondents concerning Flood Early Warning and Awareness

Variables	Frequency	Percentage
Received sensitization and education before a flood		
Yes	88	22.0
No	299	74.8
Clarity of flood warning messages		
Not clear at all	98	24.5
Not clear	108	27.0
Neutral	38	9.5
Clear	43	10.8
Very clear	6	1.5
The timing of flood warning messages is early enough		
Yes	49	12.3
No	234	58.5
Access to Means of evacuation		
Yes	252	63.0
No	106	26.5

Source: Peter B. Oyedele, 2022

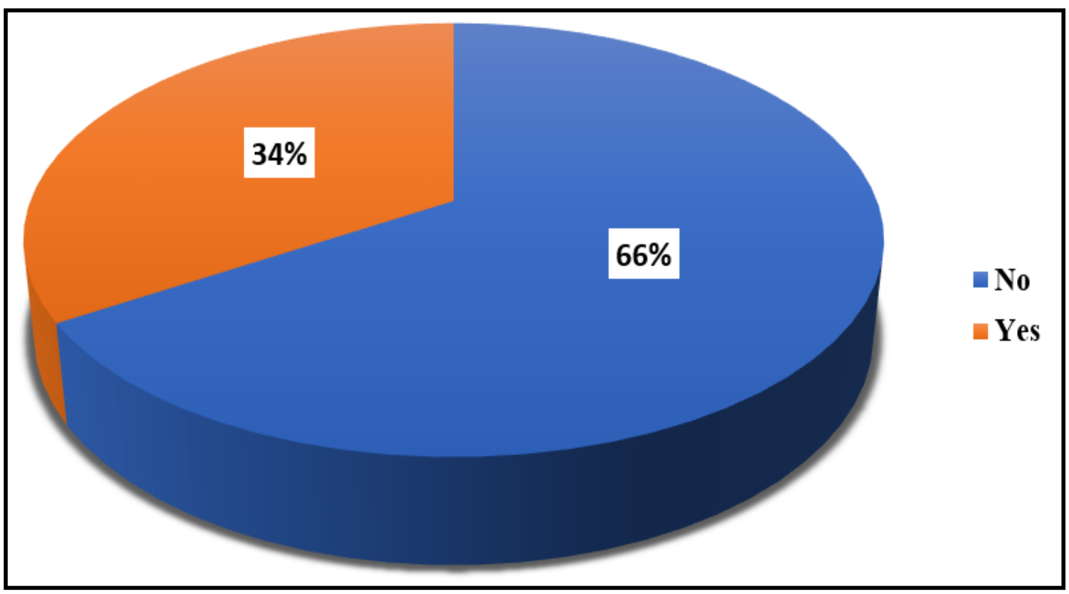
About 75% of respondents indicated they had never received any sensitization, while only 22% had. The population of those that have access to flood warning messages is quite a few. Family members (32.%), Social media like Facebook (25.7%), Radio (15.4%), Television (10.9%), Community-based organization (5.4%), Newspaper (6.8%), and SMS text messages (2.7%) were all indicated as the media through which flood information are passed to the households in the community. These results show that the major information source is family members, followed by social media.

When asked about the clarity of such information received, more than half (51.5%) of the respondents indicated the messages were not clear while only a few (12.3%) said it was clear. Since the messages are not clear to the majority, this may be responsible for the great consequences of flood damages noticeable in the communities in the past. Aside from the clarity, the timeliness of flood information is another important factor that can help people to take action against flood occurrence. However, about 59% of the respondents noted that the messages are not early enough, and as such, they had very little time to prepare. Message clarity and source credibility mediate and moderate the relation between information sufficiency and intention to prepare.

6.1.2.2. The early warning system (EWS) for flood disaster alert

The capacity to anticipate, cope and recover from a disaster is very crucial in disaster management. In the community, two major ways of being aware of flood events were identified. These are the early warning system and local indicators. Figure 28 shows the percentage of respondents that are aware of the flood early warning system.

Figure 28: Households' awareness of flood early warning system (EWS)



Source: Peter B. Oyedele, 2022

From Figure 27, more than half (66%) of the sampled respondents indicated that they are not aware of the flood early warning systems, while the other 34% are aware. Not being aware of technology such as the early warning system device, installed along river course that can help detect the rising of water level that could be capable of causing harm to lives and properties, may have been the cause of the extent of damage recorded among the flood-prone communities in Kogi State. Educating and encouraging farmers to heed early warning systems is quite important in flood risk awareness-related issues. Photo 13 shows the picture of a “Balise” observed on the field.

Photo 14: A “Balise” found at Adankolo community in Lokoja LGA

Source: Author’s (Peter B. Oyedele) Analysis of Fieldwork, 2022

Photo 13 shows the image of the “Balise” (a flood early warning system), found in one community in Lokoja LGA during the fieldwork. The unavailability of the “Balise” can partly explain why the people were not aware. Wherever there is the absence of reliable early warning systems, poor countries are disproportionately affected by flood disasters.

6.1.2.3. Indigenous knowledge identified by households for flood hazard anticipation

Indigenous knowledge has been in existence since antiquity but has not been given the required attention in scientific studies. In this era of increasing disasters, it is very important to integrate it into empirical studies. In that regard, the communities under study have identified some local indicators, which serve as a flood disaster and early warning system. A few of the local indicators were identified by respondents across the entire community. These observations were found to be similar among all respondents and presented in Table 25.

Table 25: Local Indicators Identified as Flood Disaster Early Warning System

S/N	Local Indicator	Number of Respondents
1	Bearing fruits of some native trees that normally do not	120
2	Hens staying on rooftops of houses and other buildings	155
3	Increase in water volume of rivers without rain	210
4	Snails are found climbing trees and getting stuck to them	118
5	Croaking of Frogs	382
6	Prevalence of ringworm & snakes	129
7	Prevalence of mosquitoes in the community	355
8	Shedding of leaves of trees	256
9	Observable foam-like substance on the water surface	112
10	Dryness of rivers	320

Source: Author's (Peter B. Oyedele Fieldwork, 2022

From the Table 24, it can be seen that the majority of the respondents have identified frog croaks as the most common and relatively reliable indicator of flooding. According to them, the croaking of the frogs signifies that there is going to be heavy rainfall, which might lead to flooding. An observable sharp dryness in the volume of water in some rivers was also identified as a strong indication of flooding. When snails are found climbing trees and getting stuck, it served as a local indicator of flooding and is widely used in all the communities. The result shows that households adopt practices such as indigenous knowledge to anticipate flooding.

To further strengthen the result above, households' indigenous knowledge considered in anticipation of flood disaster was captured during the Focus Group Discussion (FGD) session (Photo 15) and presented as follows:

Photo 15: Presentation of an indigenous knowledge system to forecast flood disaster

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

The above photo was taken during a FGD session meeting at Onyedega community during which the participants presented a leaf of a tree called the *Ajalija*[14].

"…there is a particular tree in our community called Ajalija, it does not bear fruit normally, but after long observation, we realize that this tree bears fruit whenever a flood will happen. Since the day we established this fact, we don't joke with it any longer whenever we see fruits on it. Which to us has become a very strong indication and a warning sign that flood will happen that year…" (Report from participants at Onyedga community in Ibaji LGA in Kogi State).

[14] The *Ajalija* Tree, according to the particpants, is one of the indigenous knowledge system through which they use to forecast flood occurrence in the community. They remarked that the tree does not produce fruits and whenever it does, it's a sign that they will be hit by flood that year.

6.1.3. Resilience, adaptation, and coping capacity of households to flood risk

When asked how they respond in tackling and dealing with flood events, most (95%) of the respondents identified some actions and activities engaged in, capable of making them resilient to flooding and its effects. These include economic, relocation, preparedness, and infrastructural adjustments as presented in Table 26.

Table 26: Distribution of respondents concerning actions/adjustment toward flood disaster in the community

Variable		Frequency*	Percentage
Infrastructural	Acquiring Canoes	265	72.0
	Raising house foundation	254	69.0
	Raising building entrances	249	67.7
	Landfilling (with stones, sand, waste, etc.)	203	55.2
	Building walkways around the house	195	53.0
	Building of drainage systems	190	51.6
	Clearing drainage	189	51.4
	Mounting flood defense structures around the house	189	51.4
	Building an embankment/dyke close to the river	175	47.6
Relocation	Temporarily moving households including children to safe zones	322	88.5
	Having a temporary house in a safe zone	251	69.0
	Permanently move away from flooded area	71	19.5
Preparedness	Hanging household items in high places	270	74.6
	Storing food items in safe places	268	74.0
	Assist one another in case of emergency	253	69.9
	Acquiring and storing medication	177	48.9
	Attending flood preparedness training	62	17.1
	Contingency plan	56	15.5
Economic	Saving money in anticipation of the flood	170	87.2
	Accept additional employment to save more	85	43.6
	Buying flood insurance	15	7.7

Source: Authors' (Peter B. Oyedele) Field survey, 2022   *Multiple responses

6.1.3.1. Infrastructural adjustments to flooding in the community

With respect to infrastructural adjustment, the result shown in Table (above) is that 72% of the respondents adopted the use of canoes made of wood, in conveying house items, members, and food items from flood areas to safe zones. In addition, the raising of house building, and entrances were another infrastructural adjustment engaged in. Raising house foundations with bricks, and blocks were observed to be a common practice as it was found to be effective in breaking the movement of floodwater in gaining access into the building (Photo 16).

Photo 16: Infrastructural adjustment –house foundations raised to prevent floodwater

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

Similarly, according to the respondents, mounting flood defense structures around the houses, building walkways made with planks and woods, and constructing embankments and dykes around river bodies were other infrastructures used in coping and adapting to flood incidence. Public responsibility for flood protection enhances flood risk management and mitigation (Wang et al., 2018)

To further strengthen the result above, means of adjustment to flooding were captured during the Focus Group Discussion (FGD) session and presented as follows:

"…floods destroy our lives and means of sustenance, this is why we do something to prevent further destruction. One of those is that not all of us can afford to buy cement and bricks blocks, so what most of us do is look for used bags of cement, pack sand and stone in them, and position such around our houses including the roads. We come together as one to assist one another. Again, we equally build some water breakers around the rivers that are close to us, but I will be sincere with you that we can't do that alone, we only use materials that can't last. We need the government to come and help in this regard so that our community can be safe to live by all of us…" (Report from participants at Ichala community in Ida LGA in Kogi State).

6.1.3.2. Relocation as a means of adjustment to flooding in the community

Respondents further indicated relocation as another means of adjusting to flood disaster events in the community. From the multiple response analysis results presented in Table 20 (above), the majority (88.5%) of the respondents indicated a temporary movement of households, particularly the vulnerable like children, pregnant women, and aged people to safer zones. However, public buildings and institutions including schools, churches, town halls, mosques, and libraries are made to serve as Internally Displaced Person (IDP) camps in the case of flooding, according to research findings. Relocation of flood-impacted communities to areas that are less prone to flood can help to lessen the impacts of flood (Nathaniel et al., 2019).

In addition, it was found that several challenges render the objectives of the IDP camps to be jettisoned. These include unequal distribution of resources, theft and rape occurrences, and other issues. As a result, they are obliged to return to their original place as soon as the floodwaters were gone. Only a very few (19.5%) of the respondents indicated moving permanently away from the flood areas. Ideally, a permanent move away from these flood hotspots would have been expected but the results and field observations show that households are attached due to quite several reasons such as the usability of the occupied land for farming, fishing, cultural, and other social values (Wani et al., 2022).

To further strengthen the result above, the issues of relocation as a means of coping with the flood were clarified during the Focus Group Discussion (FGD) session and presented as follows:

"…temporary relocating to IDP camps made by the government would have been the best but it is just unfortunate that these camps are not meeting our needs at all, rather it even compounds our challenges. The management of the camp has been hijacked and politicized. Many times, the food items, and other relief materials distributed are cornered and will never get to a lot of us, which is sad…" (Report from 1st participant at Eroko community in Bassa LGA in Kogi State).

"During the year 2012 flood event, an International Non-Governmental Organization (NGO), gave us varieties of food, stoves, medications, and other useful items. One of the items given to us is called the Shelter Box. This was provided for each family in the community. We took this box to a high land where the flood waters did not reach, mount it, and settle there temporarily for about 3 months before we returned to our home after the floods. Unfortunately, these boxes are spoilt now as no one has ever come to our help again since that time. We use the opportunity to call on the government and NGOs to please come to our help us…" (Report from 2nd participants at Eroko community in Bassa LGA in Kogi State).

A further investigation and observation revealed that Rotary International donated and distributed the Shelter Box to the households in flood-affected communities during the year 2012 flood disaster in Kogi State. Photo 17 shows the Shelter Box[15], which is a mini home with doors, windows for ventilation, and an inbuilt mosquito net by the window.

Photo 17: The Shelter Box

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

[15] A Shelter Box donated to the 2012 flood victims in Eroko Community, Kogi State for a temporary location from flood affected place. The Picture was taken at the temporary location when the people move onto during flood disaster. ***Source: Author's Fieldwork, 2021***

6.1.3.3. Preparedness as a means of adjustments to flooding in the community

The multiple-response analysis of responses from the respondents about preparedness as a means of coping and adjusting before, during, and after flooding was presented above (see Table 20). These include: hanging household items in high places (74.6%), storing food items in safe heights (74%), assisting one another in the community during flood emergencies (69.9%), acquiring and storing medication (48.9), attending flood preparedness training (17.1%) as well as contingency plans (15.5%). Storing food items traditionally was adopted in the community to avoid food and agricultural produce spoilage due to floodwater (Photo 18).

Photo 18: Traditional methods of food storage to prevent food losses due to flooding

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

Also, drugs and medications were found to be some of the most important practices among households before any flood event. By so doing, they can guard against food insecurity before, during, and after because the foods are well stored to avoid being destroyed by floodwaters.

Training and preparation of flood contingency plans were found to have low responses among the respondents. This may be due to inadequate orientation and information on the import of such training and sensitization, which if given much attention can help in improving preparedness and enhance disaster resilience at the community level (Abunyewah et al., 2020).

6.1.3.4. Economics upscaling as a means of adjustments to flooding in the community

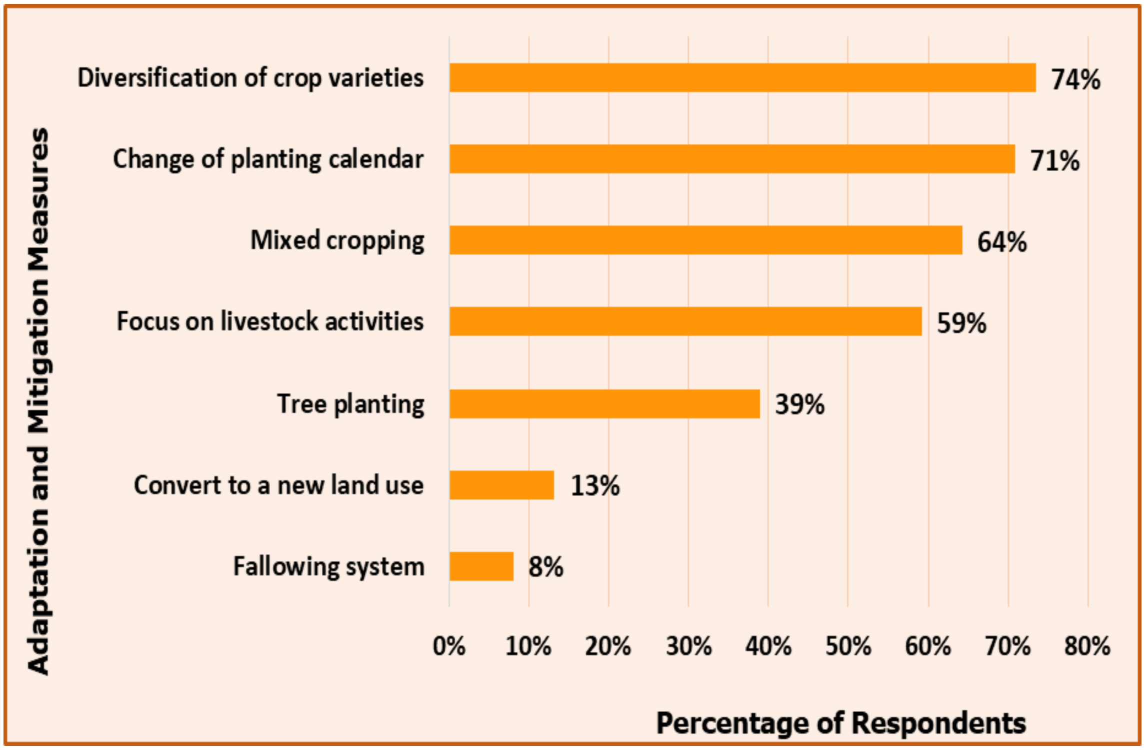
The ability to access resources such as finances, food, job, and other resources that are essential to life, increases the capacity of a household to respond, cope and adapt to any form of hydrological disaster like flood. Respondents in the study area indicated the importance of economic capacity and upscaling as a means of responding and adjusting to flood disasters and the associated impacts. From the multiple response analysis results presented in table 6.4, the majority (87.2%) of the respondents considered saving money in anticipating floods. About 44% take up additional job/employment to recover from financial losses experienced on their livelihood as a result of the disastrous flooding.

Only 7.7% considered buying flood insurance. People save money to meet their needs (Rufat et al., 2015), particularly during flooding when all activities are grounded. However, flood insurance hasn't yet gained awareness in the area as only a few are involved in it. This suggests that not all households are aware of flood insurance which may likely be due to lack of awareness or financial constraints. Risk transfer strategies, such as insurance, are one way to lessen the financial effects of flooding (Mai et al., 2020; Wagner et al., 2022).

6.1.4. Adaptation and mitigation measures developed for farming against flooding

Due to observable high vulnerability and lack of resilience, households regularly experience floods and their associated impacts on lives and livelihood. Agriculture activities in particular are one of the key human activities mostly affected in the study area. Strategies to enhance local adaptation capacity, and mitigation are therefore needed to minimize flood impacts and maintain farming activities and food production in particular. Figure 29 presents adaptation strategies by households to increase their capacity and resilience to flooding.

Figure 29: Households' adaptive measures developed for framing activities against flooding



Source: Peter B. Oyedele, 2022

Considering the multiple responses, more than 70% of the respondents indicated diversification of crop varieties and changing of planting calendar as the topmost actions taken in adapting to flooding. Sixty-four percent of the respondents indicated mixed and intercropping. About 60% engaged and diversified into the rearing of livestock production and almost 40% indicated planting trees. Other actions are conversion of land use (13%) and bush fallow system (8%). This clearly shows that households being fully aware of the adverse effects of flooding on their livelihood engaged in possible coping strategies such as planting early maturing crops and flood-resistant varieties of staple crops and thus supports the findings of earlier researchers (Nemine, 2015; Tologbonse et al., 2011).

6.1.5. Modelling of household decision-making to flood risk

Making decisions entails choosing from the available possibilities, literally. It involves selecting a plan of action from a variety of options put forth by an individual. For instance, we decide what to eat, what to wear, where to live, and where not to live. Selecting the best option from a range of options depends on several factors that must be thoroughly studied and understood. Similarly to this, understanding an individual's decision to remain in a floodplain despite the potentially adverse effects is essential for managing the risk of flood disasters.

6.1.5.1. Explanation of the models

The parameter estimates of the multinomial logistic regression analysis for the factors influencing household (Hh) willingness to relocate (WtR) from flood-prone areas were some of the variables considered in building the model. Underneath the **WtR** are four replicates of the predictor and their corresponding eighteen (18) variables, representing the four models that are estimated: "Not Very Like" relative to "Very Likely", "Not Likely" relative to "Very Likely", "Indifferent" relative to "Very Likely", and "Likely" relative to "Very Likely". Household's WtR and Very Likely are the estimated multinomial logistics regression coefficient and the referent level, respectively, for the model. In this case, Very Likely was set as the referent group (i.e. WtR==Very Likely is the base outcome) and therefore estimated a model for Not Very Likely, Not Likely, Indifferent, and Likely relative to Very Likely. Eighteen (18) explanatory (independent) variables were loaded into the model. Only significant explanatory variables at a p-value of 0.05 were accepted and used in explaining each model. Here, we reject the null hypothesis and conclude that the regression coefficient for each explanatory variable is statistically different from zero for Not Very Likely relative to Very Likely given that all other variables are in the model. Table 27 'a' and 'b' presents the parameter estimates of the multinomial logistic regression used in the analysis.

- **Model Summary:**

Multinomial logistic regression	Number of obs=	254	
	LR chi2(90)	=	372.64
	Prob > chi2	=	0.0000
Log likelihood = -170.96901	Pseudo R2	=	0.5215

Table 27a: Parameter estimates of the multinomial logistic regression for the factors influencing Households' Willingness to Relocate from Flood zones (For Models 1 & 2)

Willingness to relocate (WtR)	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Not Very Likely						
LGA	.1412492	.1603688	0.88	0.378	-.1730679	.4555664
Gender	-.8767232	.7858514	-1.12	0.265	-2.416964	.6635172
Age	.0201182	.0344745	0.58	0.560	-.0474505	.087687
Education	-.8342093	.3511293	-2.38	0.018*	-1.52241	-.1460085
Length of stay	.7445845	.499638	1.49	0.136	-.234688	1.723857
Occupation	.3416793	.188473	1.81	0.070	-.027721	.7110797
Income	.781723	.2984996	2.62	0.009*	.1966746	1.366771
Household Size	-.0237739	.0983635	-0.24	0.809	-.2165628	.1690151
Floodwater stay period	.3523228	.4259993	0.83	0.408	-.4826206	1.187266
Evacuation means	3.159462	1.085611	2.91	0.004*	1.031703	5.287221
Access to health services	1.974001	1.021035	1.93	0.053	-.0271903	3.975192
Alternative livelihood	.1461609	.890031	0.16	0.870	-1.598268	1.89059
Usability of the area	1.699774	.7959376	2.14	0.033*	.1397653	3.259783
Access to flood Mgt. Info	.401393	.5500389	0.73	0.466	-.6766634	1.479449
Flood experience	-2.778718	.8090222	-3.43	0.001*	-4.364372	-1.193064
Flood frequency	-.0078451	.6120356	-0.01	0.990	-1.207413	1.191723
Flood affecting farmland	-1.646343	1.084539	-1.52	0.129	-3.772	.4793149
Flood training participation	-.3893058	.5131502	-0.76	0.448	-1.395062	.61645
_cons	-2.976467	5.775455	-0.52	0.606	-14.29615	8.343217
Not Likely						
LGA	-.0844276	.1745458	-0.48	0.629	-.426531	.2576759
Gender	-1.088764	.8539401	-1.27	0.202	-2.762456	.584928
Age	.0013851	.0349003	0.04	0.968	-.0670183	.0697885
Education	-.3298118	.3631076	-0.91	0.364	-1.04149	.381866
Length of stay	.8256124	.5359243	1.54	0.123	-.2247799	1.876005
Occupation	.3418205	.1967461	1.74	0.082	-.0437948	.7274359
Income	1.245684	.3005545	4.14	0.000*	.6566084	1.83476
Household Size	-.0299209	.1005341	-0.30	0.766	-.2269641	.1671223
Floodwater stay period	-.1821837	.3778983	-0.48	0.630	-.9228508	.5584834
Evacuation means	3.068981	1.127899	2.72	0.007*	.8583406	5.279622
Access to health services	1.985947	.9542085	2.08	0.037	.1157326	3.856161
Alternative livelihood	1.117483	.8894123	1.26	0.209	-.6257331	2.860699
Usability of the area	1.832518	.799868	2.29	0.022*	.2648054	3.40023
Access to flood Mgt. Info	-1.144679	.7409364	-1.54	0.122	-2.596887	.3075301
Flood experience	-1.957023	.8205217	-2.39	0.017*	-3.565216	-.34883
Flood frequency	.5059798	.6641501	0.76	0.446	-.7957305	1.80769
Flood affecting farmland	-1.531111	1.128044	-1.36	0.175	-3.742036	.6798136
Flood training participation	-1.201566	.6996152	-1.72	0.086	-2.572786	.1696549
_cons	1.99092	5.961142	0.33	0.738	-9.692704	13.67454
Very likely	(baseoutcome)					

(WtR= =Very Likely base outcome)

6.1.5.2. Parameter estimates of the multinomial logistic regression for the factors influencing households' willingness to relocate

- **Model #1: "Not Very Likely" relative to "Very Likely"**

Five explanatory variables (education, income, evacuation means, usability of the area, and flood experience) found to be statistically significant were used to explain this model (Table 26a, above).

- Education: When the educational status of the household was to increase by one unit, the multinomial log-odds for choosing the option of "Not Very Likely" relative to "Very Likely" when a household considering relocating from the flood-prone areas, would be expected to decrease by 0.834 unit while holding all other variable constants in the model. In this model, the z-test statistics for the predictor education (-0.834/0.351) is -2.37 with an associated p-value of 0.018.
- Income: For a unit increase in HH income for the "Not Very Likely" option relative to "Very Likely" in relocating from the flood-prone area, given the other variable is held constant. This means that if the HH income were to increase by one unit, the multinomial log-odds for choosing the option of "Not Very Likely" relative to "Very Likely" when the household is considering relocating from the flood-prone area, would be expected to increase by 0.782 unit while holding all other variable constants in the model. In this model, the z-test statistics for the predictor income (0.782/0.299) is 2.62 with an associated p-value of 0.009.
- Means of evacuation: If the means of evacuation increases by one unit, the multinomial log-odds for choosing the option of "Not Very Likely" relative to "Very Likely" would be expected to increase by 3.160 unit while holding all other variables constant in the model. The z-test statistics for the predictor mean of evacuation (3.160/1.086) is 2.91 with an associated p-value of 0.004.
- Usability of the area: for a unit increase in the usability of the area for the "Not Very Likely" option relative to "Very Likely", given the other variable is held constant. This means that if the usability of the area increases by one unit, the multinomial log-odds for choosing the option of "Not Very Likely" relative to "Very Likely" in their decision to relocate, would be expected to increase by 1.700 units while holding all other variables constant in the model.

The z-test statistics for the predictor usability of the area (1.700/0.796) is 2.14 with an associated p-value of 0.033.

- Flood experience: As households' flood experience increases by one unit, the multinomial log-odds for choosing the option of "Not Very Likely" relative to "Very Likely" when households are considering relocating, would be expected to decrease by 2.779 units while holding all other variable constants in the model. In this model, the **z-test** statistics for the predictor flood experience (-2.779/0.809) is -3.43 with an associated p-value of 0.001.

➢ **<u>Model #2: "Not Likely" relative to "Very Likely"</u>**

Four statistically significant explanatory variables (income, evacuation means, usability of the area, and flood experience) were used to explain this model.

- Income: If income were to increase by one unit, the multinomial log-odds for choosing the option of "Not Likely" relative to "Very Likely" when households are considering relocating from the flood-prone area, would be expected to increase by 1.246 units while holding all other variable constants in the model. In this model, the z-test statistics for the predictor income (1.246/3.006) is 4.14 with an associated p-value of 0.000.

- Means of evacuation: If the means of evacuation increases by one unit, the multinomial log-odds for choosing the option of "Not Likely" relative to "Very Likely" would be expected to increase by 3.069 units while holding all other variables constant in the model. The z-test statistics for the predictor mean of evacuation (3.069/1.128) is 2.72 with an associated p-value of 0.007.

- Usability of the area: for a unit increase in the usability of the area for the "Not Likely" option relative to "Very Likely", given the other variable is held constant. This means that if the usability of the area increases by one unit, the multinomial log odds for choosing the option of "Not Likely" relative to "Very Likely" would be expected to increase by 1.833 units while holding all other variables constant in the model. The z-test statistics for the predictor usability of the area (1.833/0.800) is 2.29 with an associated p-value of 0.022.

- Flood experience**:** As households’ flood experience increases by one unit, the multinomial log-odds for choosing the option of “Not Likely” relative to “Very Likely” when the household is considering relocating, would be expected to decrease by 1. 957 units while holding all other variable constants in the model. In this model, the z-test statistics for the predictor Flood experience (-1.957/0.821) is -2.39 with an associated p-value of 0.017.

➢ **<u>Model #3: “Indifferent” relative to “Very Likely”</u>**

Here, none of the explanatory variables for the option of “Indifferent” relative to “Very Likely” in relocating from flood-prone areas was found to be statistically significant.

➢ **<u>Model #4: “Likely” relative to “Very Likely”</u>**

- Occupation: When the occupational status of the household was to increase by one unit, the multinomial log-odds for choosing the option of “Likely” relative to “Very Likely” when households are considering relocating from the flood-prone area, would be expected to increase by 0.362 unit while holding all other variable constants in the model. In this model, the z-test statistics for the predictor occupation (0.362/0.153) is 2.36 with an associated p-value of 0.018 (See Table 21b).

- Income: If household income were to increase by one unit, the multinomial log-odds for choosing the option of “Likely” relative to “Very Likely” when households are considering relocating from the flood-prone area, would be expected to increase by 0.846 units while holding all other variable constants in the model. In this model, the z-test statistics for the predictor income (0.846/3.002) is 2.82 with an associated p-value of 0.005.

- Household size: If household size increases by one unit, the multinomial log-odds for choosing the option of “Likely” relative to “Very Likely” when households are considering relocating, would be expected to decrease by 0.225 units while holding all other variables constant in the model. In this model, the z-test statistics for the predictor income (-0.225/0.111) is -2.02 with an associated p-value of 0.043.

- Means of evacuation: If the means of evacuation increases by one unit, the multinomial log-odds for choosing the option of “Likely” relative to “Very Likely” would be expected to increase by 2.533 units while holding all other variables constant in the model. The z-test statistics for the predictor mean of evacuation (2.533/1.128) is 2. 52 with an associated p-value of 0.025.

Table 27b: Parameter estimates of the multinomial logistic regression for the factors influencing Households' Willingness to Relocate from Flood zones (For Models 3 & 4)

Willingness to relocate (WtR)	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Indifferent						
LGA	91.66134	13365.34	0.01	0.995	-26103.93	26287.25
Gender	-16.70397	24181.22	-0.00	0.999	-47411.03	47377.63
Age	-1.251185	823.3203	-0.00	0.999	-1614.929	1612.427
Education	13.5143	11079.28	0.00	0.999	-21701.47	21728.5
Length of stay	-8.095003	6597.355	-0.00	0.999	-12938.67	12922.48
Occupation	7.260851	5962.652	0.00	0.999	-11679.32	11693.84
Income	24.98906	13684.53	0.00	0.999	-26796.2	26846.17
Household Size	-4.748006	2276.686	-0.00	0.998	-4466.971	4457.475
Floodwater stay period	28.66711	9425.849	0.00	0.998	-18445.66	18502.99
Evacuation means	303.8316	50848.47	0.01	0.995	-99357.34	99965.01
Access to health services	-63.48278	29109.37	-0.00	0.998	-57116.8	56989.84
Alternative livelihood	-55.37727	24747.06	-0.00	0.998	-48558.73	48447.98
Usability of the area	7.013994	5184.317	0.00	0.999	-10154.06	10168.09
Access to flood Mgt. Info	-68.15424	21010.2	-0.00	0.997	-41247.38	41111.08
Flood experience	-32.65826	15844.77	-0.00	0.998	-31087.83	31022.51
Flood frequency	-179.7765	61590.76	-0.00	0.998	-120895.5	120535.9
Flood affecting farmland	-37.88721	16163.36	-0.00	0.998	-31717.49	31641.72
Flood training participation	53.9611	11113.56	0.00	0.996	-21728.21	21836.13
_cons	-528.5274	171461.3	-0.00	0.998	-336586.6	335529.5
Likely						
LGA	-.1264574	.1769175	-0.71	0.475	-.4732094	.2202945
Gender	-1.289265	.7846487	-1.64	0.100	-2.827148	.2486182
Age	-.0264212	.0352498	-0.75	0.454	-.0955095	.0426671
Education	-.2359538	.3425466	-0.69	0.491	-.9073327	.4354252
Length of stay	.6021389	.4628864	1.30	0.193	-.3051018	1.50938
Occupation	.361835	.1532803	2.36	0.018*	.0614111	.6622589
Income	.8462325	.3001884	2.82	0.005*	.2578741	1.434591
Household Size	-.2245102	.1109363	-2.02	0.043*	-.4419414	-.0070791
Floodwater stay period	-.4284278	.3003564	-1.43	0.154	-1.017116	.16026
Evacuation means	2.533172	1.127477	2.25	0.025*	.3233567	4.742987
Access to health services	.7871422	.6626574	1.19	0.235	-.5116424	2.085927
Alternative livelihood	.4878329	.8815455	0.55	0.580	-1.239964	2.21563
Usability of the area	1.054285	.8267994	1.28	0.202	-.5662125	2.674782
Access to flood Mgt. Info	.8396274	.4773493	1.76	0.079	-.09596	1.775215
Flood experience	-2.220354	.8083536	-2.75	0.006*	-3.804698	-.6360096
Flood frequency	-1.446217	1.199148	-1.21	0.228	-3.796504	.9040691
Flood affecting farmland	-3.495564	1.508678	-2.32	0.021*	-6.452519	-.5386087
Flood training participation	-.5676293	.5811992	-0.98	0.329	-1.706759	.5715002
_cons	8.191697	5.601176	1.46	0.144	-2.786406	19.1698
Very likely	(baseoutcome)					

(WtR= =Very Likely base outcome)

- Flood experience: As households' flood experience increases by one unit, the multinomial log-odds for choosing the option of "Likely" relative to "Very Likely" when households are considering relocating, would be expected to decrease by 2.220 units while holding all other variable constants in the model. In this model, the z-test statistics for the predictor flood experience (-2.220/0.808) is -2.75 with an associated p-value of 0.006.
- Flood affecting farmland: If the rate at which household farmland is being affected by floods increases by one unit, the multinomial log-odds for choosing the option of "Likely" relative to "Very Likely" when considering relocation, would be expected to decrease by 3.496 unit while holding all other variable constants in the model. In this model, the z-test statistics for the predictor flood affecting farmland (-3.496/1.509) is -2.32 with an associated p-value of 0.021.

6.1.5.3. Marginal effects from the multinomial logistic regression for the determinant of households' willingness to relocate

Table "A" (please see the appendixes) shows the parameter estimates of the marginal effects from the multinomial logistic regression for the determinant of households willing to relocate from this area because of flood risk. The marginal effects show the change in probability when the predictor or independent variable increases by one unit. Consistent with the earlier results, the marginal effects show how, on average, total household income has a positive and significant impact on "Not Likely" relative to "Very Likely" of whether to relocate or not due to flood risk in the study areas. 1 unit increase in total household income, increases the probability of taking "Not Likely" as an option to relocate to another place rises by 5.7 percent approximately.

Similarly for education, 1 unit increase in the educational level of a household decreases the probability of taking "Not Very Likely" as an option to relocate by 6.1 percent. Others are: for household size, it decreases the option of "Likely" by 3.4%; evacuation means increases the option of "Not Very likely" by 1.1%; based on the usability of the area, it increases the choice of both "No Very Likely" and "Not Likely" by 5.9% and 6.3% respectively. All these were consistent with the previous results and emphasized the importance and significance of each of the predictors as they guide or interfere in the decision-making ability of households as to whether or not they should relocate from the flood-prone area or not.

6.1.6. Factors influencing household decision-making to flood in Kogi State

The in-depth analysis provided on each factor and as substantiated by excerpts from respondents served to reveal the underlying realities that influence people's decisions about either staying in or moving away from flood-prone locations. These factors are summarized below:

1. Socioeconomic characteristics (income, education level, occupation, household size)
2. Sense of attachment to the place (scared of starting afresh in a new place, conflicts in the new location
3. Farmers’ expectations (flood affecting farmland, usability of the area, flood experience)
4. good living conditions (as claimed by some participants that the area is devoid of noise and other pollution
5. Government/Institutional support (access to means of evacuation)
6. Social harmony (cross and intermarriage, peaceful co-existence)
7. Sense of community (strong community-based organization and other support group systems)

To further strengthen the result above, historical background information was given during a one-on-one interview with a community leader in one of the communities, and several factors guiding their decision to remain in the flood-prone areas were captured and presented below.

“…I will tell you why we cannot move away from here. First, our history is very important to us. This land on which our community is situated has been in existence for many years ago, in fact long before Nigeria got her independence in 1960. That was even before I was born. We have been here, lived here, buried our loved ones here, and given birth here. So to move will not be possible. Besides, if we move, where can we go to that we will be as convenient as we are on our land? Secondly, long before the 1950s, our major occupation here is water transportation, it was the advent of cars that shifted the attention of our people to fishing and farming as we have today, although we are still involved in the water transportation system but not like before. You will agree with me that these three jobs need water to thrive. When you take us away from water, it is the same as you taking us away from our source of income, food, and survival. We can count the number of houses we built in the community. Most people live and do their lives inside the boat right on the water. This is our culture, it is our symbol. The third point I will tell you is that our

land and the area we are serves as our place of protection. It was because we live on and are very close to the water that enemies were not able to conquer us in terms of war back in the olden days. Even during the British colonization, they hardly conquer the Kakanda people because they were afraid of coming to our place due to the water that surrounded us. There are many others I would have said but there is no time. So these for us are the advantages we get from living in and on water, so moving will not be possible. The flood happening today is not because we are here but because the dam is not well managed, so we pray the government helps us solve that problem…" (Report from a one-on-one interview with the Community Leader of the Kakanda community in Budon, Lokoja LGA Kogi State). Photo 19 was taken during the interview.

Photo 19: One-on-one interview with the community head of Budon Kingdom

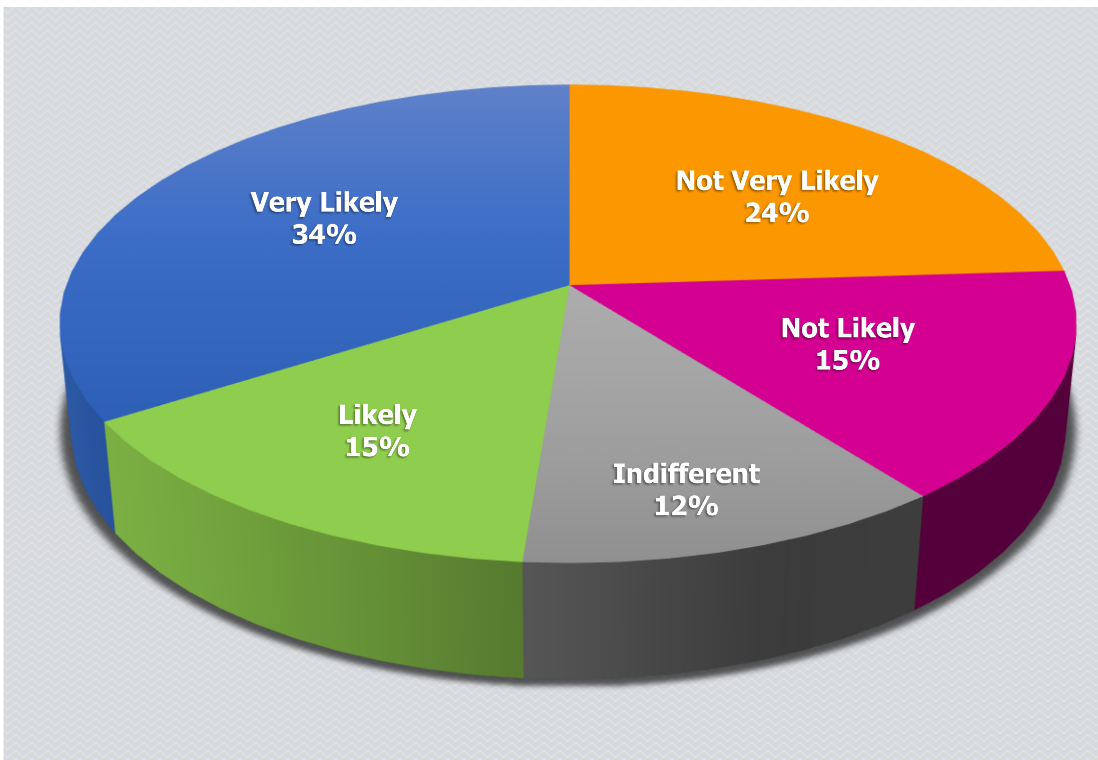
Source: Author's (Peter B. Oyedele) Fieldwork, 2022

Photo 19 was taken during the one-on-one interview with the head of the community at Budon Palace, the headquarters of the Kakanda community, Lokoja LGA, Kogi State.

6.1.7. Respondents' willingness to relocate across the study area

Approximately 34 percent of the respondents said they will very likely to relocate due to flood risk. Subsequently, of 96 respondents about 24 percent said they are not very likely to relocate due to flood disaster whereas about 15 percent said they are likely to relocate because of flood disaster. Moreover, 12 percent said they are indifferent about willing to relocate or not willing to do so. In addition, approximately 15 percent said they are not likely to move to another place due to flood risk. Figure 30 presents the distribution of respondents with respect their willingness to relocate.

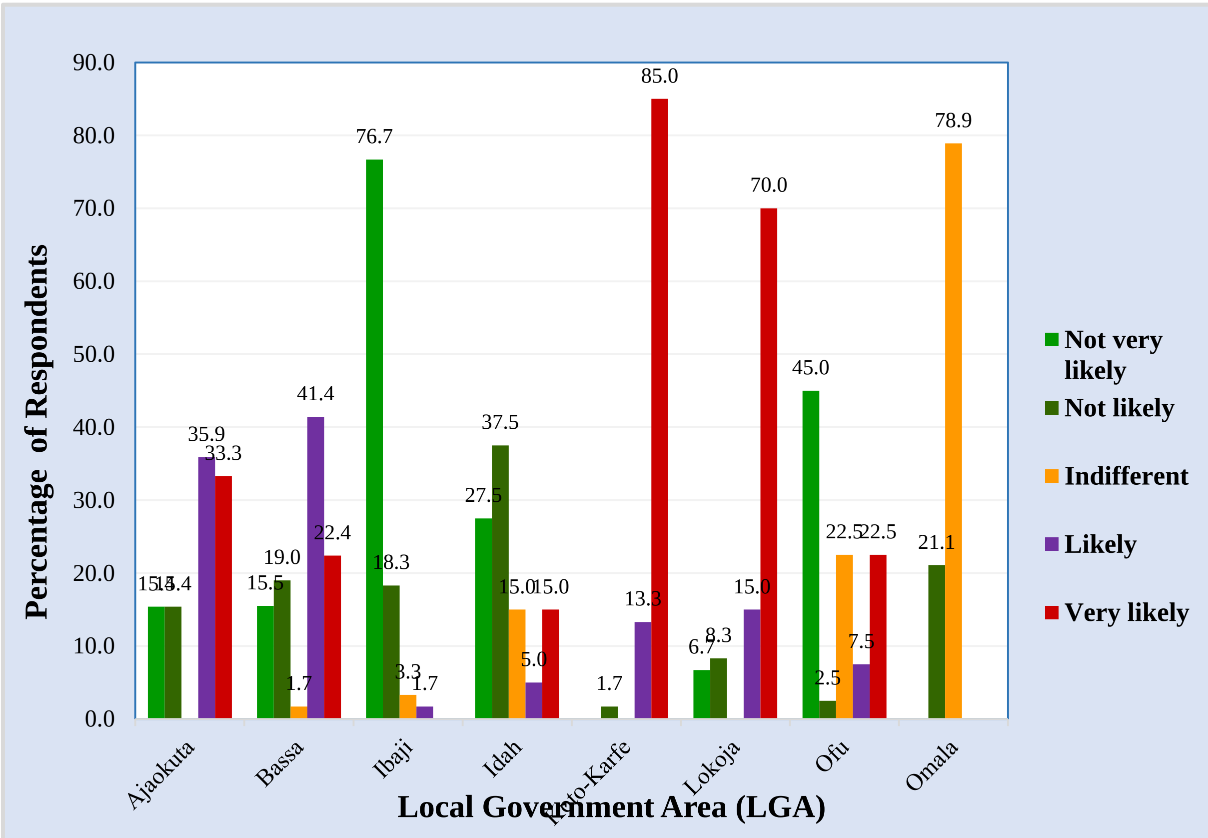
Figure 30: Distribution of respondents' willingness to relocate across the study area



Source: Peter B. Oyedele, 2022

Similarly, the willingness of respondents to relocate across each selected LGA studied was equally considered. The result was represented in Figure 31.

Figure 31: Respondents' willingness to relocate across the LGAs comparatively



Source: Peter B. Oyedele, 2022

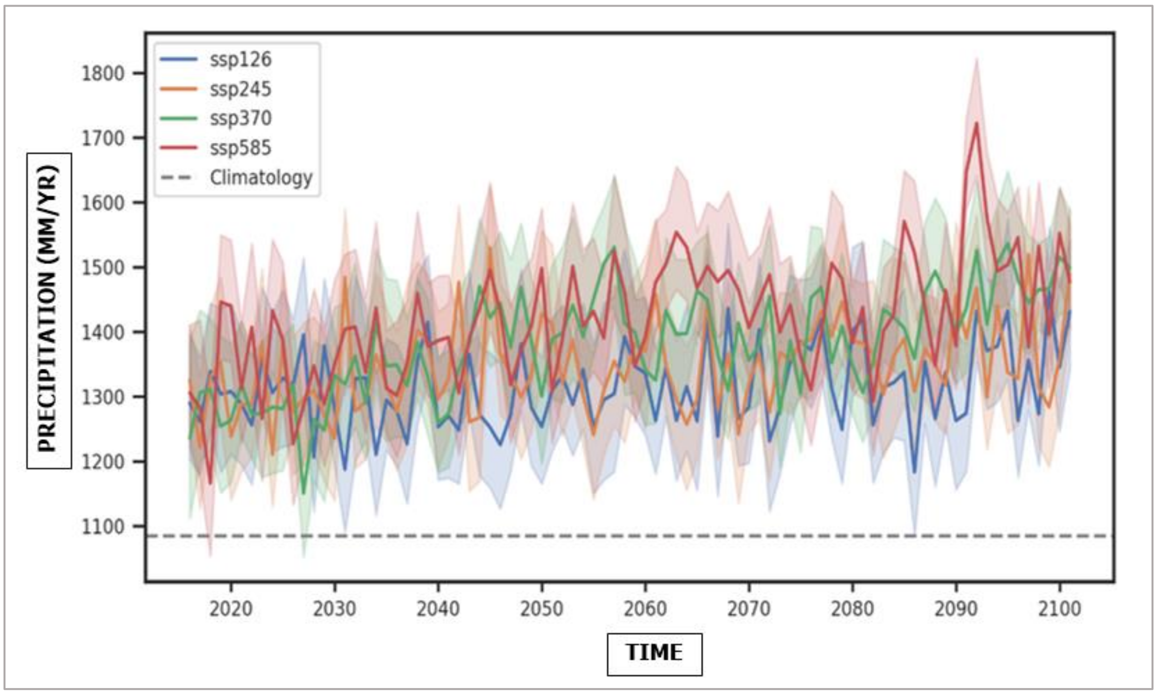
The Figure shows that respondents in communities in Koto-Karfe (98%), Lokoja (85%), Ajaokuta (69.2%), Bassa (63.8%), Ofu (30%), Idah (20%), and Ibaja (1.7%) indicated their willingness to relocate from flood area into a safer place. Households in Ibaji are more attached to their area despite being at the hotspot of flood vulnerability due to several reasons such as cultural, economic, and farming as their major livelihood, among many others.

6.2. Climate trend analysis in Kogi State (The future of Kogi State)

6.2.1. Future climate conditions of Kogi State

A situational analysis of future climatic condition and flood impacts in Kogi State based on available precipitation and temperature in-situ data from the climate hazards center infrared precipitation with station data (CHIRPS), a 30+ year quasi-global rainfall data set, remains the crux of this section. Further, the assessment under different scenarios is carried out under the Representative Concentration Pathways (RCP) scenario which represents climate change, and Shared Socio-economic Pathways (SSP) scenario which represents socio-economic change. To effectively estimate future changes, four scenarios were employed, namely: SSP1-Sustainability; SSP2-Middle of the Road; SSP3-Regional Rivalry; and SSP5-Fossil-fuelled Development based on the available data. All these scenarios were employed from the Intergovernmental Panel on Climate Change 5th Assessment Report. To determine current mean monthly precipitation and temperature, 2020–20100 data were used (see Appendix 5 and 6). It was observed that both precipitation and temperature with increase in the future with very high degrees of variability. The Figure 32 shows the projected rainfall increase in Kogi State under the different scenarios.

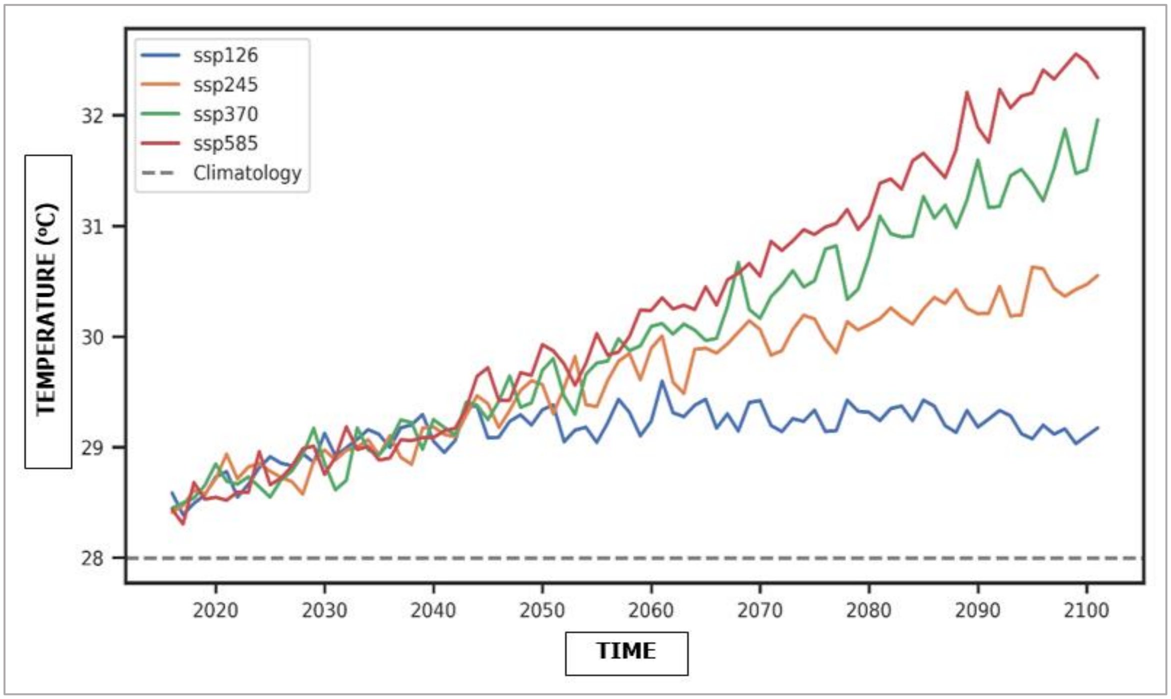
Figure 32: Future precipitation projection (2020-2100) in Kogi State under different scenarios



Source: Author's analysis of CHIRPS data from Climate Hazards Center
https://data.chc.ucsb.edu/products/CHIRPS-2.0/

From the graph, the precipitation of the area has been projected to increase in the future more than the average as compared to the past. This means that more rainfall is being expected in the future and this may likely exacerbate flooding in the area particularly, when proper checks and management measures are not in place. In the scenario, there more variability, we shall be expecting similar variation in the precipitation pattern but at a more increasing rate by the end of the century. This therefore, calls for more proactive and deliberate economic growth that is climate friendly, adaptation and environmental conservation. In the past, the IPCC reports have been focusing more on the concentration pathways, with respect to what will be the amount of CO2 in the air, this is like more focusing on the emission, and future trajectory of the economy will also have an impact. So this mean that if we go for a greener economy, it means that we have to expect more transformation. This means that we would expect less emission in the future. So if the economy is going towards strong globalization using coal, natural gas and the like, it means that this will result in much more emission of CO2. So how that translate into more emission and how it will affect the climate system is of greatest importance. The Figure 33 shows the projection of temperature under different scenarios in Kogi State. Increasing and significant trend under the different scenarios was also observed.

Figure 33: Future temperature projection in Kogi State (2020-2100) under different scenarios



Source: Author's analysis of CHIRPS data from Climate Hazards Center
https://data.chc.ucsb.edu/products/CHIRPS-2.0/

This is way similar to the observed situation under the precipitation regime. Specifically, the SSP5 is very higher than other scenarios under study. In most scenarios, there is going to be an increase in precipitation at a degree that is more than what was observed in the past. In the sustainable scenario, there is going to be more rainfall, and so there is need to be proactive in investing in infrastructures to curb flooding in the future. Even if we go in the more sustainable way, that is the SSP1 we need to be prepared, and be more alert in the issue of climate adaptation to flooding.

6.2.2. The implication of the projection

- There is high tendency increase in flooding in the area
- High level of vulnerability of the communities and their livelihood
- High likelihood of drought and its consequences
- There is high tendency of the Rivers Niger and Benue to overflow therefore with a potential damage to communities and farmland around the bank of the rivers

6.3. Flood disaster risk reduction and management in the community

Flood disaster risk has gained worldwide attention because of its commonness and destructive nature. The management of flood risk to avert its consequences is therefore expedient. Its strategies require a series of processes and activities that are aimed at reducing the overall impacts of the flood on the population. When asked whether or not flood disasters can be averted, majority (98%) of the respondents indicated that the impacts of flood can be reduced on their live livelihoods. Based on the results of fieldwork and information gathered during the FGD session, two major stakeholders, the community and institutions were identified to play important role in the management of flood and the reduction of it its negative effect on the people.

6.3.1. Communities' role in flood disaster reduction

In disaster risk reduction, capacity building at national, regional, and local levels is very important. Local efforts in the form of projects or communal labour toward flood disaster risk reduction were assessed in the selected communities through FGD sessions. The results revealed that many support systems existed within and among members of the community. This was equally noted to be extended to neighbouring communities. For example, at Ichala Edeke community in Idah local government area, communal labour is organized at times to help dredge some parts of a tributary of the River Niger but such activities are also found in other communities like Eroko, Icheu, and Shintaku. Other roles and activities by the community are: coordination of flood warning among members of the communities; community-based organization in helping and supporting one another before, during, and after flood emergency; and forming small financial contributory savings scheme called *Ajo*, where people contribute a daily portion of their trading profit to fall back to in the days of the disaster. They however noted that the dredging of the waterways can be best done with the support of the government with the use of heavy machines like dredgers for more effective results. According to (Villamayor-Tomas et al., 2019), community-based activities in flood management should be seen as an effective complement to institutional and governmental action rather than as an "alternative."

6.3.2. Institutional role in flood disaster reduction

As enshrined in the Sendai Framework for Action (2015 – 2030), every stage of disaster risk reduction has some required actions (Center, 2015). Humanitarian organizations and relief institutions carry out some of the activities. Table 28 presents the institutions responsible for flood disaster response and management in Kogi State.

Table 28: Institutions Responsible for Flood Response and Management in Kogi State

S/N	NAME OF INSTITUTION	ABBR.	RESPONSIBILITY
1	Kogi State Ministry of Environment and Natural Resources	KSMENR	• Flood warning and sensitization • Participate in flood rescue and evacuation • Profiling of flood victims • Provide and distribute relief materials • Provide jingles and awareness creation
2	National Inland Waterways Authority	NIWA	• Dredging of waterways for easy flow of water • Collaborates with other intuitions during flood victim • Provide information relating to the dynamics of water bodies and their course
3	National Emergency Management Agency	NEMA	• Collaborates with other intuitions during flood victim • Engage in flood early warning • Flood response • Flood recovery • Distribution of relief materials
4	Kogi State Emergency Management Agency	KoSEMA	• Collaborates with other intuitions during flood victim • Performed NEMA function at the State level • Provides advisory, building materials, mattresses, and blankets to flood victims after flood events • Provision of shelter to temporarily relocate the flood victims
5	Nigerian Meteorological Agency	NiMet	• Reports seasonal rainfall prediction • Provide suggestions and guidance in case of looming disasters • Engage in weather forecast • Collaborates with other intuitions during flood victim
6	Kogi State Town Planning and Development Board	KSTPD	• Monitor and prohibit the building of structures along the high-risk areas along the river • Gives advisory services and • Collaborates with other intuitions during flood victim
7	Kogi State Ministry of Agriculture	KSMA	• Profiling of flood victims especially farmers • Provide support and relief materials • Collaborates with other intuitions during flood victim • Provision of improved seedlings to the farmers
8	Red Cross	RC	• Collaborates with other intuitions during flood victim • Provision of improved relief materials
9	Nigeria Hydrological Services Agency	NIHSA	• Provide timely information on water-related hazards through forecasting

Source: Author's (Peter B. Oyedele) Fieldwork, 2022

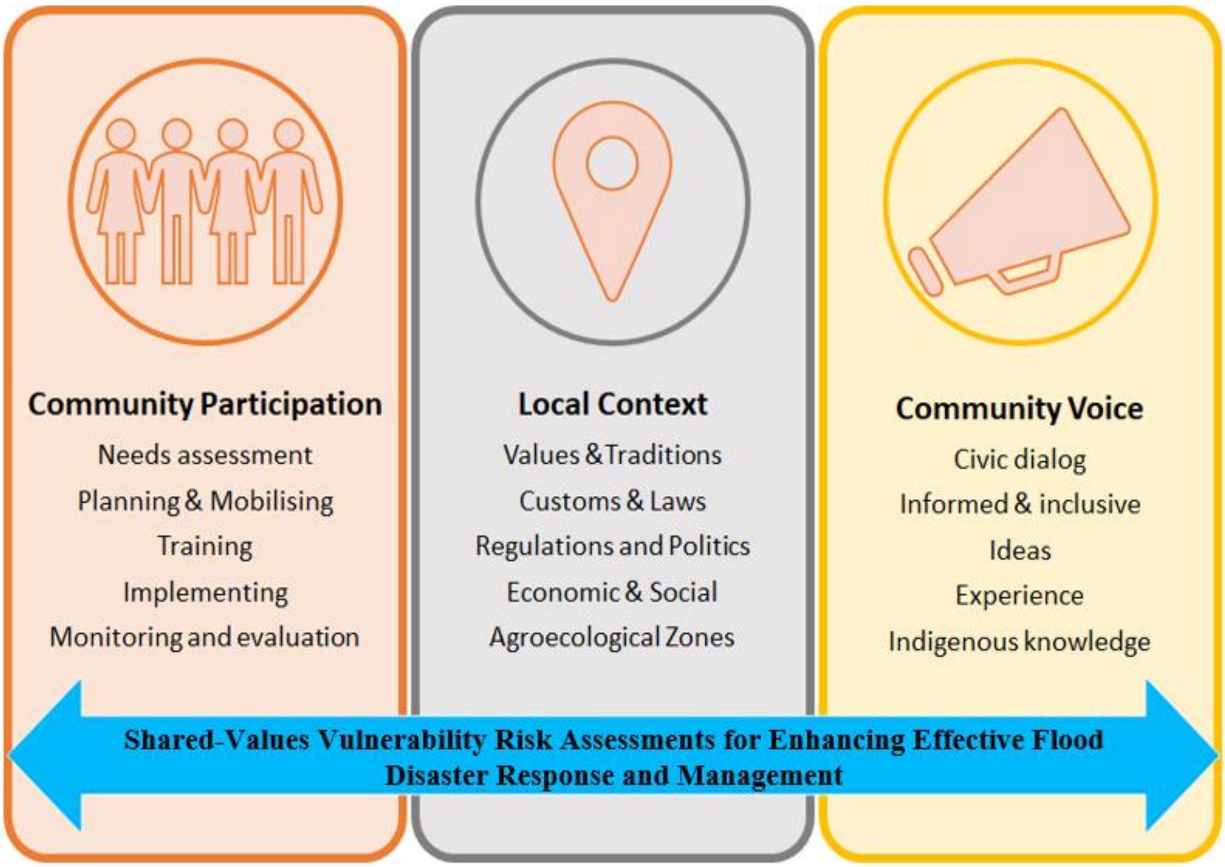
These were the main disaster relief bodies identified during the fieldwork activities. Flood early warning systems and evacuation facilities were provided by these institutions. During one of the stakeholder engagements, it was discovered that each institution was saddled with different commitments and responsibilities with the global aim of safeguarding, rescuing, and preventing further destruction of people and their livelihoods across the entire state. Regarding rapid response and recovery processes, respondents noted not much has been done by these institutions. Besides, there are also reports of some persons sabotaging some of the relief materials. Corruption, nepotism, and sharp practices as these can only jeopardize the objectives of the rescue and response mission. From the foregoing, it was seen that institutional synergy was noted to be ineffective and as such efficient which eventually slows flood risk management efforts in the study area. This corroborates the finding of (Abdulmajid et al., 2021).

6.3.3. Shared-values vulnerability risk assessments for enhancing effective flood disaster response and management in Kogi State – a framework

Evidence gathered from the fieldwork shows clearly that the adverse effects of floods often entail far-reaching socioeconomic and environmental implications. The majority of the respondents indicated that they had not been ultimately involved in flood management and that most of the solutions by institutions are not solving the problem, rather, it creates more problems in the community. *"The government failed to realise that it will be somehow impossible for a family of seven to eight people to live in a small apartment built for flood victims in Lokoja, besides, those that are there have no job to do, I am one of them and still facing the consequences…"* (A flood victim in Geregu, Ajaokuta, LGA in Kogi State).

A framework for sustainably managing flood risk in the area was prosed. This framework will help in preventing further damage to lives and livelihoods as a result of flooding. In addition, it when bringing about a holistic approach in the dissemination of flood information, cater to inclusiveness and guard against the lack of trust in government and other relevant authorities The lack of regulating agency and flood protection policies is will likely prolong definite development in flood hazardous zones thereby increasing people's exposure to flooding (Asrat, 2015). The proposed framework is called an integrated shared-values vulnerability assessment for effective flood management. The framework is graphically represented in Figure 34.

Figure 34: Proposed Framework for an integrated shared-values vulnerability assessment for effective flood management



Source: Peter B. Oyedele 2022

In the framework, it was proposed that vulnerability risk assessment and management of flood disasters require an integrated rather than a fragmented approach. In this context, three main approaches were considered: community participation; local context; and community voice. The process of flood management should be participatory. In other words, affected communities should be proactively involved in the needs assessment, planning and mobilizing, training, implantation, and monitoring and evaluation stages. Any solutions aiming at solving the issues of flooding within the vulnerable groups should be locally construed. People should be allowed to bring to the table meaningful and sustainable ways of solving their problems. These results confirm Cuesta et al. (2022) claim that policy actions and practices should be bottom-up participatory and learning-process oriented if they are to promote particular disaster risk reduction (DRR) among the target groups.

6.4. Discussion

Based on the qualitative and quantitative statistical approach considered in this study, the in-depth analysis revealed the underlying realities that influence people's decisions about either staying in or moving away from flood-prone locations. These factors include: socioeconomic characteristics (income, education level, occupation, household size); sense of attachment to the place (scared of starting afresh in a new place, conflicts in the new location); farmers’ expectations (flood affecting farmland, usability of the area, flood experience); good living conditions (as claimed by some participants that the area is devoid of noise and other pollution); government/Institutional support (access to means of evacuation); social harmony (cross and intermarriage, peaceful co-existence); and sense of community (strong community-based organization and other support group systems).

With respect to household decisions to either relocate or not from the flood-prone areas, the following factors were identified as one of the factors influencing these decision. a strong link between household socioeconomic cultural conditions as it influences their decision towards the development of their localities, which unequivocally serves as a bottleneck to the progress and development of their place of origin (Kokou & Kola, 2015).

The results revealed that households’ income in the study area has a significant positive impact on the probability of farm households not being willing to relocate due to the risks of flooding. As income increases, the decision of households’ willingness to relocate from flood-prone areas by choosing from the available predictors: “Not Very Likely”, “Not Likely”, or “Likely” in relocating approximately increase by 0.78%, 1.3%, and 0.9% respectively. The results show income as a key factor for relocation and therefore as income rises, the farm households are more likely to relocate to another area, the author noted. A high income will help increase farm household capacity to cope and adapt and be resilient to flood disasters. For instance, they will be able to build some infrastructures to control floods such as dykes, levees, the raising of house foundations, etc. due to their increased financial resources. In contraction, those farmers with no money in flood disasters will force them to relocate or have certain consequences such as health issues, agriculture loss, etc. Increased household income and access to grants reduced households’ risk of flooding (Musyoki et al., 2016).

This result revealed that the usability of the area has a significant positive impact on the probability of households not being willing to relocate from flood disaster risk areas. As the usability and importance of the area increase, among the households, the “Not Very Likely” and “Not Likely” options in relocating increase approximately by 1.7% and 1.8% respectively. This shows that the importance household placed on their areas of residence influences their decision concerning relocating from flooded areas. This clearly shows that the more household find an area particularly flood zones useable, the more they decide to remain in such an area and decide not to relocate. This analysis supported the findings gathered during FGD sessions, where the majority of the farm considered flood zones important, first, they noted that the soil in the area particularly after flood events is rich in nutrients that support crop growth naturally. Secondly, it is believed Fishermen have more catches during and immediately after flooding, hence increasing their financial capacity and supporting their livelihood this corroborates the finding of Ntajal et al. (2017).

This result revealed that the means of evacuation have a significant positive impact on the probability of households not being willing to relocate. As the possibility of the household being able to access means of evacuation during flooding increases, the “Not Very Likely”, “Not Likely” and “Likely” options in relocating increase approximately by 3.2%, 3.1%, and 2.5% approximately. This shows that ability and the likelihood of households to have access to means of evacuation play a key factor in their decision concerning relocating from the flood-prone area. This implies that when a household considers easy access to means of evacuation such as a boat, water for sanitation and drinking, food items, swimmers, helicopter, first aid kits, life jackets, etc., the more they decide to remain in such area not very likely ready to relocate. To safeguard damages to properties and livelihood, household tends to likely relocate especially when the means for evacuation are accessible and available at their disposal. To increase the ability of citizens to evacuate during a flood, the communities should collaborate with local authorities to conduct regular evacuation training (Liu et al., 2022).

The results revealed that household education has a significant negative impact on the probability of not being willing to relocate from flood-risk zones. As household education increases, the option for “Not Very Likely” by household in relocating decreases by 0.83% approximately. This shows that education plays a key factor in the decision of households in relation to relocate from flood risk zones. The educated farm households are more knowledgeable and aware of the consequences of their actions. With higher education or a unit in education, the option of "Not Very Likely" in relocating decreases, in order words, they end up moving away from the area. The use of early warning systems, flood education, sensitization, and many more may help in educating farm households, thereby helping them in making decisions that will better pay off for their health, activities, and livelihood. These current findings corroborate previous researchers (Adelekan, 2010; Kissi et al., 2015; Musyoki et al., 2016; Z. Wang et al., 2018).

The results revealed that household flood experience has a significant negative impact on the probability of Not Very Likely relocating from flood risk zones. As household flood experience increases, the option for "Not Very Likely", "Not Likely", and "Likely" for households relocating decreases approximately by 2.8%, 2.0%, and 2.2% respectively. This shows that household flood experiences are a very important factor in their decision-making to relocate away from flood-risk zones. Realistically, the experiences of many households from flooding are mostly negative. This includes among many incidences, the destruction of buildings, farmland submerged and destroyed by flood water, death, injuries incurred, which it corroborates the findings of Bello (2018). It then means that for a unit increase in households' flood experience, the option of "Not Very Likely" in relocating decreases. In order words, flood experiences of households instigate their decision in moving away from the floods area. According to earlier studies, flood experience could have a significant influence on people's preparedness efforts for managing flood risk and can also alter their behavioral reaction to flooding risk management (Liu et al., 2022; Qasim et al., 2015; Yildiz et al., 2021). In a similar study, Simes (2012) observed an inconsistency in the residents' perception of risk and their awareness of the flood hazard during his thesis, Decision-making for Living in Flood-Prone Areas Among Flood Affected Residents, which was conducted in Otago, New Zealand. This discrepancy was primarily caused by the residents' over-reliance on locally sourced information, Simes (2012) noted.

As household occupation changes and increases, the option for households "Likely" in relocating increases by 0.36% approximately. This means that households will be more willing and likely to relocate to avoid floods negatively impacting their occupation (Musyoki et al., 2016). They tend to settle in an area where their occupation will be threatened in any way. As flood affects farmland increases, the option for "Likely" by household in relocating decreases by 3.5% approximately. This implies that households are very likely to relocate to avoid the further impact of flooding on their livelihood and source of income. As household size increases, the option for households "Likely" to relocate decreases by 0.2% approximately. With increased household size, they are likely able to face and withstand challenges from flood events.

Relating the decision-making theory postulated by the great economist, Herbert A. Simon (earlier discussed on see page 42) reviewed in this study to the findings made from the study is very important for a holistic understanding and explanations. The theorist argued that making a decision is choosing between alternative courses of action. Bringing this to this current study, its shows that households in the study area actually makes decision among two alternatives -to continue to live in or to leave from flood disaster prone areas. Furthermore, the theory suggests that decision-making means the adoption and application of rational choice for the management one's business in an efficient manner. This shows that the theory is quite relevant to the way people make decision in relation to flooding and their livelihood activities. Here, households make choice based on the several factors as revealed in the result which support the assertion of Kousky and Shabman (2015), that decisions made are the outcome of multiple interacting influences, with one being the consideration of flood risk and disaster.

Conclusion

Even though they are disastrous to humans, floods have been found to have both negative and positive significant environmental impacts. Local indicators to sensitize and create awareness against flooding were itemised. These were found important to prevent further damage caused by flooding that caught people unaware. Also, several adaptation strategies employed by the farmers were documented. The majority of farm households indicated their interest to continue living in the flood-prone. This was based on decision household makes with the influence of some factors such as socioeconomic and cultural factors. Finally, a framework that will guide the assessment of flood risk vulnerability was proposed.

CONCLUSIONS TO PART TWO

The analysis showed that households' vulnerability to flooding, exposure level, susceptibility, and lack of resilience to the impacts of floods vary considerably across the area. It explains in detail a systematic, logical, data-driven, and methodological way of assessing flood vulnerability—the use of composite indicators to generate flood vulnerability index values for different areas, which is a new approach to assessing flood vulnerability in the region. The computed flood vulnerability indices' values and overall flood vulnerability maps serve as tools for identifying households in communities that are vulnerable to flooding, based on the level of exposure, susceptibility, and lack of resilience, thus facilitating the planning and prioritization of location-specific interventions for flood control.

Generally, the perception of flood risk of most respondents was found to be high, this accounts for 87% of the total. While only 8% and 2% perceived flooding as medium and low respectively. Respondents across the surveyed communities were found to have a perception of flooding on relative terms. In particular, those in Lokoja LGA were found to have the lowest perception of the flood, largely due to the area doubling as the capital of the state and most individuals perceived managing flood risk as government responsibility as revealed during the FGD session. Respondents with low monthly income (Less than Ten Thousand Naira), older age (40 years and above), and lower education level have a high perception of flood risk than others.

Flood was found to continuing impact the lives and livelihood of the people. Despite its negative effects, people also recognize the positive values derived from flooding. Several adaptation strategies employed by the farmers were documented. These are infrastructure adjustment, relocation which may be temporary or permanent, upscaling of the economy, and early preparation. The majority of farm households indicated their interest to continue living in the flood-prone. Factors that influence the decisions of farm households to remain in flood-prone areas in Kogi State were found to be: socioeconomic characteristics, sense of attachment to the place, farmers' expectations, government/Institutional support (access to means of evacuation), social harmony, and sense of community. Finally, a framework that will guide the assessment of flood risk vulnerability was proposed.

GENERAL CONCLUSION AND RECOMMENDATIONS

This study was carried out to provide a better understanding of how flood vulnerabilities among farming households in the riverine communities of Kogi State, Nigeria, may be overcome to achieve adaptation to floods. This chapter presents a summary of the key findings, the conclusion, and recommendations regarding each specific objective.

Summary of findings

- <u>Research objective 1: To determine farming households' flood vulnerability across the selected communities, using an Index-Based approach.</u>

The overall households' flood vulnerability and its factor were very high. The vulnerability level varies among households comparatively from one community to the other. The vulnerability indices (FVI) across the communities range from 0.32 to 0.74. Shintaku community was found according to the result to have the lowest vulnerability while in the Odogwu community, vulnerability to flooding of households was very high. Other communities that were found to have high vulnerability are Onyedega, Ogba Ojubo, Ichala Edeke, Koton-Karfe, Akpaku, Karara, Icheu, Itobe, Adah, Adogo, and Adankolo. The moderately vulnerable communities are Olukudu, Bagana, Eroko, Abejukolo, and Geregu. These results were used to identify the hotspot of flood vulnerability in Kog State.

Susceptibility and exposure factors were found to influence vulnerability, and communities had a high lack of resilience in the face of flood hazards. The computed sub-indices of vulnerability components are 0.53, 0.69, and 0.59 for exposure, susceptibility, and lack of resilience. It was clearly shown that the susceptibility factor has the greatest influence on the observable flood vulnerability index. The different indicators used in measuring the different vulnerability components helps in the identification of the drivers of vulnerability and their contributions to each of the component. The sub-index value of exposure (*SIE*) varies from one community to the other. The Ichekene community was found to have the lowest exposure value index (0.17) while Koto-Karfe has the highest exposure value (0.87). Three indicators, (1) share of exposed farmland, and (2) closeness to river bodies, were used to measure households' exposure level. All these indicators were found to contribute to the prevailing high exposure level. In Koton-Karfe in particular, the three indicators have a similar percentage contribution to flood exposure; this generally accounts for the reason why the community had the highest sub-index exposure value (0.87) compared to others.

The sub-index susceptibility is the aggregation of five indicators: household size (HS); household conditions (HCs); household past flood experience (PFE); household dependency on agriculture (HDAP); and households' lack of access to improved drinking water (LAIW). The results showed that all the indicators have significant contributions to flood susceptibility. In particular, household past flood experience, over-dependence of households on agriculture, lack of access to improved drinking water, and households' poor housing/building conditions were all identified as the main drivers of households' flood susceptibility. The Ichala Edeke community has a sub-index value of 1.00 and was ranked the most susceptible community as a result of the contribution of all the indicators. Similarly, indicators such as households' lack of evacuation and flood management measures, low levels of flood education, a high percentage of flood experience, low literacy rate, lack of access to flood warning facilities, and weak household economic capacity, were identified as the major drivers of vulnerability and lack of resilience.

➢ Research objective 2: To assess households' perception of flood disasters in the study area

The sample population comprised different age groups with the age group 40 years above accounting for 60 % of total respondents. The average age of the respondents was 42 years. The majority of the respondents were found to have lived in the community for over ten years, which helps to validate the responses to be close to reality. Farming was found to be an important economic activity and a major source of livelihood among the sample population with over half of respondents (73%) engaged in farming and other forms of agricultural activities. More than half of the respondents, however, indicated they have no other source of income, this was found to have contributed to their vulnerability as 80% show that flood affects them on a more or yearly basis. The results show that floodwater takes up to forty-five days before drying up. During this period, schools are closed down and the children are restricted to settling in safe zones until the water subsided as revealed during the focus group discussion sessions.

From the result, the *p*-value was less than 0.05, indicating that household perceptions of flood risk across the area were statistically significant. Over half (65%) of the respondents believed that flooding had a strong impact on them. This category of respondents indicated that floods had an extremely serious effect on their daily lives, destroyed their farms, and damaged their homes, pets, and several means of livelihood. Respondents' perceived causes of floods are the existence of a long period of rainfall, poor dam management leading to overflow of rivers, people building structures along waterways, and the will of God.

The results revealed that there was a significant correlation between respondents' flood risk perception and their age, educational level, monthly income, length of stay in the community, flood experience, flood knowledge, flood management, and responsibility at p-values of 0.019, 0.006, 0.001, 0.001, 0.001, 0.002, and 0.001 respectively. While there was no significant difference between the perception of flood risk and their gender as well as occupation. Findings also revealed that different age groups had different flood risk perception levels. Respondents aged 40-49 years old had the highest flood risk perception comparing it with other aged groups. Respondents within the lower income group (less than Ten Thousand Naira per month) had the highest flood perception level compared to other groups. Respondents with Tertiary education and above were found to perceive flood risk as much lower when compared to other respondents from other education levels (no formal education, primary school, and secondary school). More-educated respondents were found to have the lowest flood risk perception

- Research objective 3: To analyses households' adaptation and mitigation strategies in responding to flood disasters and factors influencing their decision-making to remain in flood-prone areas

It was revealed that households appreciate flooding despite the negative impacts on their lives and livelihoods. Positive impacts of floods according to the majority of households washing the drainage systems, and promoting fishing activities, that flood occurrence leads to an increase in fish catch and is equally favourable when the flood duration is long enough to sustain the breeding of fish as it helps increase the number of fish in the rivers guiding in a change of focus and that floods help in replenishing soil fertility thereby supporting farming activities to produce more yields. As important as awareness of flood information and warning to geared preparation, about 75% of respondents indicated they had never received any sensitization, while only 22% had. Family members (32.%), Social media like Facebook (25.7%), Radio (15.4%), Television (10.9%), Community-based organization (5.4%), Newspaper (6.8%), and SMS text messages (2.7%) were all indicated as the media through which flood information are passed to the households in the community. Only 34% of the respondents are aware of the flood early warning system, while the remaining 66% are not.

Indigenous knowledge of the anticipation of flood hazards was found to be invoked in most of the community but has not received the best attention required. Some of this indigenous knowledge for anticipating flooding as revealed are bearing fruits of some native trees that normally do not, hens staying on rooftops of houses and other buildings, increase in water volume of rivers without rain, snails are found climbing trees and getting stuck to them, observable foam-like substance on the water surface, among others.

Almost (95%) of all the households indicated they engaged in some adaptive strategies, which are infrastructural adjustment, relocation, preparedness, and economic upscaling. In specific terms, the actions and activities engaged in, are capable of making them resilient to flooding and its effects. Some of these are: raising house foundation, mounting flood defense structures around the house, building an embankment/dyke close to the river, temporarily moving households including children to safe zones, having a temporary house in a safe zone, hanging household items in high places, assisting one another in case of emergency, and saving money in anticipation of the flood, among others. Similarly, farming households equally identified some actions engaged in to specifically adapt their farming activities in the face of flooding, these include: diversification of crop varieties, change of planning calendar, mixed cropping, sometimes focus mainly on the rearing of livestock, planting of trees, convert to a new land use activities

Approximately 34 % of the respondents said they will very likely to relocate due to flood risk. Subsequently, of 96 respondents about 24 % said they are not very likely to relocate due to flood disasters whereas about 15 % said they are likely to relocate. Factors that influence the decisions of farm households to remain in flood-prone areas in Kogi State were found to be: socioeconomic characteristics (income, education level, occupation, household size); the sense of attachment to the place (scared of starting afresh in a new place, conflicts in the new location; farmers' expectation (flood affecting farmland, the usability of the area, flood experience); good living conditions (as claimed by some participants that the area is devoid of noise and other pollution; government/Institutional support (access to means of evacuation); social harmony (cross and intermarriage, peaceful co-existence); and sense of community (strong community-based organization and other support group system). Finally, a framework that will guide the assessment of flood risk vulnerability was proposed.

General conclusion

This study aimed to understand how adaptation to flooding could be achieved by overcoming flood vulnerabilities among farming households in the riverine communities of Kogi State, Nigeria. It also helped to understand farming households' flood vulnerability across the selected communities, using an Index-Based approach. Assessed the perception of households to flood disaster risk and analysed households' adaptation and mitigation strategies in responding to flood disasters and the factors that influence their decision-making to remain in flood-prone zones. Accordingly, three key conclusions can be derived from this study which is related to each specific research objective.

First, regarding the vulnerability of households to flooding, it was evident from available results that overall flood vulnerability and its factors (exposure, susceptibility, and lack of resilience) were very high among households, however, the level of vulnerability varies comparatively from one community to the other. Exposure, susceptibility, and lack of resilience influence the high vulnerability. Worthy of note is that these vulnerability components were measured in this study based on some composite indicators. In particular, exposure indicators (share of exposed farmland, closeness to river bodies, and floodwater duration); susceptibility (household past flood experience, over-dependence of households on agriculture, lack of access to improved drinking water, and households' poor housing/building conditions); and lack of resilience (households' lack of evacuation and flood management measures, low levels of flood education, a high percentage of flood experience, low literacy rate, lack of access to flood warning facilities, and weak household economic capacity). From that, and within the scope of this study it is concluded that these indicators are the main drivers of households' flood vulnerability in riverine communities of Kogi State. In order words, when these indicators that drive the vulnerability of households to flooding are not addressed, it makes people more exposed, and susceptible and cannot eventually remain resilient to floods and the damning consequences.

Secondly, the perception of the household to flood risk has been assessed. Farming households have good knowledge of flood hazards and suffered from severe flooding not only destroying the farmlands, buildings, and inflicting injuries but also constraining production in their farms which in the end put a stop to their livelihoods. In particular, farmers are the group most affected by flooding. Perceiving flood risk has a socioeconomic dimension in the area within and among the households. It is concluded that socioeconomic and other factors of households influence their level of flood risk perception. These factors include their location, age, educational level, monthly income, and length of stay in the community, among others. This can be leveraged in improving the knowledge system of respondents to become more resilient and less vulnerable to flooding.

Finally, farming households in the study area are using a wide variety of 28 adaptation and mitigation strategies such as temporarily moving households including children to safe zones, diversification of crop varieties, change of planning calendar, mixed cropping, sometimes focusing mainly on the rearing of livestock, and planting and conservation of trees, among others. Not all farming households are willing to relocate from flood-prone areas to a safer zone. Those willing to relocate are having the fair of the unknown as to where they are going, what they will be engaged in, and if the new location can be an exact model of their old location. Several factors were identified to influence an average household's decision to remain in a flood-prone area rather than move away to safe zones. Households' socioeconomic characteristics, sense of attachment to the place, farmers' expectations and usability of the area, government/institutional support, social harmony, and sense of community were all factors influencing their decision-making to either live or leave the flood-prone locations.

Recommendations

Recommendations for further research

Certain gaps and questions still need to be answered through this study conducted in the riverine communities of Kogi State, Nigeria.

- It is recommended that due consideration should also be given to the use of GIS and remote sensing (RS) to examine the physical and anthropogenic factors contributing to flood disasters and the vulnerability of households to flooding in the region. More so, the use of high-resolution remote sensing images may equally improve the work and give better results for better monitoring of flood risk and vulnerability over a long period.

- In addition to the flood vulnerability index-based approach used in this study, future research addressing vulnerability assessment at the household level should consider incorporating several indicators in disaster management plans, such as temporary relocation, insurance, communication networks, proximity to hospitals and medical care, and a flood early warning system.

- The likelihood that the population is going to embrace flood prevention measures, such as engineering constructions, which might have a tendency to prevent people from engaging in their previously stated livelihood activities, must be examined. As a result, prior to implementing such engineering solutions, further research should be conducted to comprehend the cost-benefit analysis and ascertain how the communities will react to them.

- As sea level rise, temperature, and rainfall changes are projected to increase in the future, it is recommended to further investigate the future flooding events in the region by including temperature and rainfall patterns which play an important role in vulnerability risk assessment.

- Farmers still need assistance from the government or concerned organizations to be able to improve their strategies and somehow introduce other strategies. Thus, further investigations on the impacts of adaptation and mitigation strategies may be useful for the improvement of existing flood management approaches.

Recommendations for policy

- The research findings explain in detail a systematic, logical, data-driven, and methodological way of assessing flood vulnerability—the use of composite indicators to generate flood vulnerability index values for different areas, which is a new approach to assessing flood vulnerability in the Kogi State, provide a baseline understanding future flood risk and vulnerability assessments and for monitoring changes over time in the selected area and, by extension, the entire Kogi State.

- Highlighted drivers of vulnerability and respective contributions of each indicator to the computed FVI and other sub-indices present local evidence of the issues that need to be addressed to design spatial contingency plans and enable swift community/policy engagement and actions to effectively reduce households' vulnerability to flooding in the

Kogi State and beyond.

- So far, farming households have a good perception of flood risk. However, despite their knowledge and understanding, they ended up becoming flood victims in their thousands as a result of failed infrastructures. For instance, in the case where highly educated individuals, as well as high-income people, have a low perception of floods with the opinion that they have high controllability, such a situation can be leveraged and serve as an entry point for community leaders, and government and non-governmental organizations (NGOs) to intensify risk awareness creation through training and education of the general public.
- There is a need for government at all levels, practitioners, and flood disaster risk managers to engage in public enlightenment on the trend in climate and weather about the floods and its implication, environmental education, and then resettlement of the identified communities.
- From this study, it was noticed that farming households have undertaken actions to reduce or better still cope with the impact of floods that need to be leveraged upon, improved, and reinforced for efficient results. Thus, it is recommended to develop and introduce new adaptation and mitigation technologies from decision-makers and relevant stakeholders for sustainable flood risk management.
- When and where the resettlement scheme proves very difficult due to strong cultural attachment and other factors, flood prevention mechanisms via engineering construction such as dykes, embankments, and ditches should be adopted.
- With respect to the future projections of the climatic condition in the area, as much as it is impossible to eliminate flood events, a diminution approach and proper planning and preparation before their occurrence reduce the economic and social losses is quite important. This means that here is the need to pursue and strengthen existing flood management strategies, adaptation and contingency plans.

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APPENDICES

APPENDIX 1: Questionnaires

WASCAL West African Science Service Centre on Climate Change and Adapted Land Use | Federal Ministry of Education and Research | Université de Lomé

PhD Research Thesis:

FLOOD RISK AND FARMING HOUSEHOLDS' DECISION-MAKING TO FLOOD DISASTERS IN KOGI STATE, NIGERIA

Dear Respondent,

This questionnaire is designed to obtain information on flood risk and farming households' decision-making to flood disasters in Kogi State, Nigeria. It is part of the requirements for the award of Doctorate in Climate Change and Disaster Risk Management, Department of Geography, Université de Lomé, Togo.

Please, your honest opinion is solicited as the survey and information to be obtained through this study is purely/strictly going to be utilized for academic purposes. You are assured of the confidential treatment of the valuable information provided.

Thank You.

Researcher's Name: Peter Boluwaji OYEDELE

Affiliation: West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Université de Lomé, Togo.

Questionnaire No.: …… | **Date of Interview:** ....../…..../ 20…. | **Interviewer's Name**: …………

SECTION A:	**GENERAL INFORMATION ABOUT THE COMMUNITY**			
Variables	**Question**	**Response**	**Code**	**Instructions**
A1	Local Government Area (LGA)	Ajaokuta	1	
		Bassa	2	
		Ibaji	3	
		Idah	4	
		Kogi Koto-Karfe	5	
		Lokoja	6	
		Ofu	7	
		Omala	8	
A2	Community/Village			
A3	Geographical coordinates	*X(Long):* *Y(Lat):*		

SECTION B: SOCIO-DEMOGRAPHIC CHARACTERISTICS				
Variables	**Question**	**Response *(Please, mark where appropriate)***	**Code**	**Instructions**
B1	Gender of Respondents	Male	1	
		Female	2	
B2	Who is the bread winner in your household	Father	1	
		Mother	2	
		Both	3	
		Other, please specify		
B3	Marital Status	Single	1	
		Married	2	
		Separated	3	
		Divorced	4	
		Widowed/Widower	5	
B4	Age of Respondent	________________ years		
B5	Ethic group			
B6	Religion	Christianity	1	
		Moslem	2	
		Traditional	3	
		Others *(please specify)*		
B7	Did you migrate to this community	Yes	1	
		No	2	
B8	Why did you choose to settle here?	I was born here	1	
		Availability of land for farming	2	
		Availability of land for grazing	3	
		Dry season alternative (water availability)	4	
		More productive compared to uplands	5	
		Availability of fish	6	
		Displaced by conflicts	7	
		Others *(please specify)*		
B9	For how long have you lived in this community (in years)?	≤10 years	1	
		11 -20 years	2	
		21- 30 years	3	
		> 30 years	4	
B10	Level of highest educational attainment	No Formal Education	1	
		Primary school	2	
		Secondary school	3	
		Tertiary Education	8	
		Apprenticeship/Vocational	9	

		Others *(please specify)*		
B11	Occupation status of the respondent	Farming	1	
		Fishing	2	
		Trading	3	
		Artisan	4	
		Formal sector (government)	5	
		Formal sector (private)	6	
		Unemployed	7	
		Others *(please specify)*		
B12	Monthly Income of respondent	Less than ₦10,000	1	
		₦10,000 - ₦20,000	2	
		₦20,001 - ₦50,000	3	
		₦50,001- ₦100,000	4	
		Above ₦100,000	5	
B13	Additional sources of income	Pension	1	
		Co-operative venture/ income from development groups	2	
		House Rent	3	
		Remittances	4	
		Peasant farming	5	
		Other, please specify		
B14	To what extent is your household income dependent on agricultural, livestock/fish activities?	Not dependent at all	1	
		Low dependency	2	
		Medium dependency	3	
		High dependency	4	
B15	What is the size/number of your household members			
B16	Status of land/housing tenure	Owner Occupier	1	
		Renter (paying rent)	2	
		Occupier (not paying rent)	3	
		Relation to Owner	4	
		Others *(please specify)*		
B17	Does your household have any of the listed items for communication?		Yes / No	
		a. Radio	1 / 0	
		b. Television	1 / 0	
		c. Newspaper	1 / 0	
		d. Cellular phone	1 / 0	
B18	Main Source of Drinking/Cooking water	Public water source	1	
		Hand-dug well	2	
		Rainwater Harvesting	3	
		Unprotected dug well	4	
		Pond/ lake/ river/ creek /Stream	5	
		Others *(please specify)*		

			Cooking		Lightning	
			Yes	No	Yes	No
B19	What are the primary sources of energy in your house	a) Wood	1	0	1	0
		b) kerosene	1	0	1	0
		c) Electricity	1	0	1	0
		d) Charcoal	1	0	1	0
		e) Gas	1	0	1	0
		f) Generator	1	0	1	0
		g) Candles	1	0	1	0
		h) Solar heating	1	0	1	0
		i) Others, please specify				

SECTION C: FLOODING EXPERIENCE AND PERCEPTIONS OF THE RESPONDENTS

Variables	Question	Response	Code	Instruction
C1	Which of the following are climate related hazards in your community?	Flooding (from rain & rivers)	1	
		Erratic rainfall	2	
		Drought	3	
		Soil erosion	4	
		Others *(please specify)*		
C2	Have you ever experienced a flood disaster in your community?	Yes	1	
		No	2	
C3	If yes, how frequently?	Once	1	
		Twice	2	
		More than twice	3	
C4	How many times have you experienced flood disasters in the past 30 years? Please state the actual number/year of event	Years ___________________ ___________________time(s)		
C5	In your own opinion, which flooding year was the most severe in which your household was most affected?	Year: _________________		
C6	Please rate the severity of flood disasters in your area (neighborhood) in the	Not highly severe	1	
		Not severe	2	
		Neutral	3	
		Severe	4	

	past 30 years	Highly severe	5	
C7	What were the characteristics of those years in terms of rainfall?	Normal	1	
		Surplus in rainfall	2	
		Deficit in rainfall	3	
		Severe	2	
		a little severe	3	
		Not severe	4	
		Neutral	5	
C8	How long does the floodwater stay in the village during flooding?	≤ 15 days	1	
		16 - 30 days	2	
		31-45 days	3	
		> 45 days	4	
C9	Please state how often floods occur in the community nowadays (period of reoccurrence in years)	Every year	1	
		Every two years	2	
		Every three years	3	
		Don't know *(Please, skip next question)*	4	
C10	Please indicate in which months floods usually occur nowadays (indicate the time period(s))		The month(s) of ____________________	
C11	Do you have fear that flood disaster may occur again in this area in the future?	Very unlikely	1	
		Unlikely	2	
		Neutral	3	
		Likely	4	
		Very likely	5	
C12	If likely or very likely, please give reasons for your response			
C13	Would you be willing to relocate from this area because of flood risk?	Not very likely	1	
		Not likely	2	
		Indifferent	3	
		Likely	4	
		Very likely	5	
C14	If likely, please give reasons for your answer			
C15	What long-term changes in flooding over the last 30 years in the community have you noticed?	Increased	1	
		Decreased	2	
		Unchanged	3	
		Don't know	4	

C16	In your own opinion, what do you think are the causes of flooding over the last 30 years?	Long period of rainfall	1	
		Extreme rainfall in a short time	2	
		Dam management	3	
		People building houses in low-lying areas/areas close to the river	4	
		Lack of risk-reducing infrastructure (e.g. drainages, dams, …)	5	
		Changing climate	6	
		Over flowing of rivers	7	
		God's will	8	
		Siltation of rivers/channels	9	
		Presence of saturated or wet soil	10	
		Deforestation	11	
		Lack of waste management	13	
		Others, p*lease specify*		
C17	Will you say that climate has changed over the past 30 years?	Yes	1	
		No	2	
C18	If Yes, please give your reason			
C19	What are the changes you observed with regards to rainy seasons in the past 30 years? (mention all that apply)	Shorter rainy seasons	1	
		Longer rainy seasons	2	
		Late rainy seasons	3	
		Earlier rainy seasons	4	
		More rain	5	
		Less rain	6	

Kindly respond to these perceptional statements on your flood experiences, knowledge, future flood risk and the management of flood disaster in your community.

PLEASE MARK ONE PER QUESTION	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Flood Experience					
This community frequently experience flooding					
floodwater normally takes longer time (≥15 days) before it dry off during flooding periods					
Experiences from flooding has not been good but bad					
The threats from flooding in this community have been					

increasing, disastrous and highly severe					
Floods disaster always lead to economic, properties losses and even death of people					
Flood Knowledge					
I am aware that I live in an area that is at risk from flooding					
I received information about flooding from government/local leaders, media, etc.					
There is a shared responsibility of flood management within the community					
Good benefits do comes from flooding					
There are other environmental risk I am more concerned about than the risk of floods					
I am aware and well knowledgeable on how to protect myself, households and the environment from the potential risk of flooding					
PLEASE MARK ONE PER QUESTION	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Future Flood Risk					
I will be affected by a flood event in the future **directly** (affect my home/property or almost affected property)					
Future flood event will affect me **indirectly** (affect your community/travel)					
I am somewhat worried about future floods					
I am extremely worried about future floods					
I am not worried about future floods					
In my opinion, I think Climate change (unstable weather parameters such as precipitation) will increase flooding in the future					
Flood Management					
There are flood management/defence present in my community?					
Government alone should take full responsibility of flood					

management in this community					
Individuals/community should take responsibility of flood management in this community					
For effective flood management, it is better to be handled by both government and other local communities members (a collective efforts)					
Improvements in flood management need to be made to decrease the risk of flooding					
You had received information about the flood management/defence in your community from government/local leaders, media, etc.					
People can learn how they can live with the risk of floods					
Moving away from flood areas is the best option to prevent flooding and its effects in the future					
The authorities (government/local) have done well in protecting people from flooding					
I am quite satisfied with the authorities work on flood protection in the community?					
Communication on flood risk management between authorities (state/local) and the communities' members can be improved					
Flood risk management should be a part of people's everyday lives					
Flood risk management rather than solely using flood defence structure will be better at reducing flood risk in your community?					
Taking precautionary measures defend one's property/farmland against flooding					
Information received on the flood management in my community had increased my awareness flood risk					

Thank you for your time in completing this questionnaire, it is much appreciated.

SECTION D: VULNERABILITY OF HOUSEHOLDS TO FLOODS: EXPOSURE AND SUSCEPTIBILITY FACTORS

Variables	Question	Response		Code		Instruction
D1	How vulnerable are you (farming activities and livelihoods) to flooding?	Not highly vulnerable		1		
		Not vulnerable		2		
		Neutral		3		
		Vulnerable		4		
		Highly vulnerable		5		
D2	What do you think is responsible for your vulnerability to flooding?	Inadequate government support		1		
		Poverty		2		
		Climate change		3		
		Environmental degradation		4		
		Cultural attachment		5		
		Other, please specify				
D3	Do you have an alternative source of livelihood?	Yes		1		
		No		2		
D4	If yes, please specify					
D5	What is the total area of your household's farmland?	< 1ha		1		
		1-3 ha		2		
		4-5ha		3		
		>5ha		4		
D6	How far (in km) is your farmland from a water body?					
D7	Do flood often affect your household's farmland/field crops?	Yes		1		
		No		2		
D8	If Yes, how?					
D9	Does your household own a house/building?	Yes		1		
		No		2		
D10	House conditions (directly observed by interviewer)	**Features**		**Yes**	**No**	
		Floor	Compressed soil	1	0	
			Cement concrete	1	0	
			Patterned tile	1	0	
		Walls	Zinc	1	0	
			Wooden	1	0	

			planks			
			Cement/ brick	1	0	
		Roof	Thatch	1	0	
			Iron/cement sheet	1	0	
			Cement concrete	1	0	
D11	Do you have access to early warning system?	Yes		1		
		No		2		
D12	Do you have access to meteorological data?	Yes		1		
		No		2		
D13	Do you have access to health service?	Yes		1		
		No		2		
D14	Do you have access to financial aid to face flood disasters?	Yes		1		
		No		2		

SECTION E: ADVERSE EFFECTS OF FLOOD ON HOUSEHOLDS AND THEIR LIVELIHOODS

Variables	**Question**	**Response**		**Code**		**Instruction**
E1	Have you been affected by the flood in your community?	Yes		1		
		No		2		
E2	Which adverse effects did your household experience because of the most recent flood event?			Yes	No	
		Material damage	Damaged/flooded house of residence	1	0	
			Damaged/lost properties & goods (e.g., refrigerator, motorbike, televisio	1	0	

			n, mobile phone/tablet, computer/laptop, stove)			
			Damaged infrastructure (roads, bridges, electricity, water, sanitation, telecommunication, etc.)	1	0	
			Damage of public facilities (e.g., public/religious buildings, institutions)	1	0	
			Culturally important places were destroyed (e.g. cemetery)	1	0	
		Health damage	Sickness of a household member	1	0	
			Death of a household member	1	0	

			Injury of a household member	1	0	
			Fear/psychological impact on household members	1	0	
		Economic losses	No income during flood	1	0	
			Incurring costs for repair activities of property /for replacing damaged property	1	0	
			Had to spend savings	1	0	
			Incurred health expenses due to flood	1	0	
		Displacement	Household members had to leave the houses temporarily	1	0	
			Household	1	0	

			members moved away from the village permanently			
		Lack of food/drinking water	Drinking water polluted /no drinking water available for the household	1	0	
			No food available for the household	1	0	
		Interruption of social activities	Interruption of education/schools were closed	1	0	
			Social life was disturbed	1	0	
		Lack of mobility	Movement was difficult	1	0	
		Environmental degradation	Environment was polluted	1	0	
			Loss of important plants/trees/ecosystems	1	0	
		Others	*Please specify* ______			
E3	Which adverse effects with regards to farming did your household experience	Loss of farmland		1	0	
		Crop damage		1	0	
		Disruption of activities		1	0	

	because of flood events?	Scarcity of labor	1	0	
		Decrease in yield	1	0	
		Reduction of seed quality	1	0	
		Loss of livestock/Fishes	1	0	
		Destruction of stored processed goods/produce	1	0	
		Others, *please specify*			
E4	Which of this group most affected by flooding?	Farmers	1		
		Pastoralists	2		
		Fishermen	3		
		Others, *please specify*			
E5	**Can you please estimate how much house/property damage** (e.g., house of residence, motorbike, crops, livestock, refrigerator, television, mobile phone/tablet, computer/laptop, stove, etc.) you incurred due to the most recent flood event?		Amount in Naira (₦) _____________		
E6	**How often do you experience the house/property damag**es (e.g., house of residence, motorbike, crops, livestock, refrigerator, television, mobile phone/tablet, computer/laptop, stove, etc.) mentioned above (estimation; *please answer in YEARS)?*		Approximately every___ years		
E7	If you had to spend savings to take care of damage from the last flood event, can you please estimate how much you had to spend?		Amount in Naira (₦) _____________		
E8	How often do you have to spend your savings due to flood damage (estimation; please answer in YEARS)?		Approximately every __years		
E9	If you lost out on any income because of the last flood event, can you please estimate how much it was?		Amount in Naira (₦)		
E10	How often do you experience income loss due to flood (estimation; please answer in YEARS)?		Approximately every ___years		
E11	If you incurred health expenses because of the last flood event, can you please estimate how much it was?		Amount in Naira (₦)		
E12	How often do you incurred health expenses due to flood (estimation; please answer in YEARS)?		Approximately every ___years		
E13	If you incurred costs for repair activities of property/for replacing damaged property because of the last flood event, can you please estimate how much it was?		Amount in Naira (₦) ______		
E14	How often do you incurred costs for repair activities of property/for replacing damaged property due to flood (estimation; please answer in YEARS)?		Approximately every ________years		

E15	What are the good impacts of flooding in your area?		
E16	What will you say is the worst impact of flood in your community?		

SECTION F: RESILIENCE, ADAPTATION AND COPING CAPACITY OF HOUSEHOLD TO FLOOD RISKS

Variables	Question	Response	Code	Instructions
F1	Are you aware of flood early warning systems or facilities in your community?	Yes	**1**	
		No	2	
F2	Have you received any education/sensitization on flood management/disasters?	Yes	1	
		No	2	
F3	If yes, please give the name of the agency who gave the training	Agency______________________ ____________		
F4	Do you receive any warning before flood events?	Yes	1	
		No	2	
F5	If Yes, how did you receive the information? (tick all that apply)	Radio	1	
		Television	2	
		Newspaper	3	
		Social media	4	
		Community based information	5	
		Friends/relatives	6	
		SMS/Text messages	7	
		Others, please specify		
F6	Are the flood early warning messages information very clear to you?	Not clear at all	1	
		Not clear	2	
		Neutral	3	
		Clear	4	
		Very clear	5	
F7	Do you think the flood early warning messages are early enough?	Yes	1	
		No	2	
F8	What are the local knowledges that use to alert you that flood is about to happen in your community? (What local flood early warning system have you identified in your community?)			
F9	Do you have means of evacuation?	Yes	1	
		No	2	

F10	What evacuation facilities are available in your community?				
F11	Do you take any actions/adjustment (adaptation strategies) against the impact of flood?		Yes	1	
			No	2	
F12	Adaptation strategies do you undertake concerning flood risk management: ***Which adjustments did you make that help your household to alleviate flood impacts?***			**Yes**	**No**
		Infrastructural	Building drainage infrastructure	1	0
			Strengthen house	1	0
			Clearing drainage infrastructure	1	0
			Raising foundation of house	1	0
			Flood defence structures around houses	1	0
			Building an embankment/embankments/dikes close to the river	1	0
			Raising entrances	1	0
			Land filling (with stones, sand, waste etc.)	1	0
			Having canoes	1	0
			Building walkways around the house (planks, stones, etc.)	1	0
			Other measures, please specify		
		Relocation	Temporarily moving all household members to a safe place	1	0
			Sending kids away to relatives at a safe place	1	0
			Having a temporary house in a safe zone	1	0
			Permanently move away from flooded area	1	0
			Other measures, please specify		
		Preparedness	Contingency plan	1	0
			Attending flood preparedness training	1	0
			Storing food reserves in safe places	1	0
			Storing medication	1	0
			Hanging items in the house to a high place	1	0
			Making arrangements with relatives/neighbours/community members to help each other out in case of emergency	1	0
			Other measures, please specify		

		Economic	Accept additional employment to save more	1	0
			Saving money in anticipation of the flood	1	0
			Buying insurance	1	0
			Other measures, please specify		
F13	Adaptation measures for farming: ***Which adjustments did you make that help your household to alleviate flood impacts?***			Yes	No
		Diversification of crop varieties		1	0
		Crop substitution		1	0
		Changing cropping calendar		1	0
		Grass/tree lines		1	0
		Focus on livestock activities		1	0
		Evacuate livestock before the flood		1	0
		Rock /Soil bunds in plot		1	0
		Tree planting (e.g., mangroves)		1	0
		Fallowing		1	0
		Convert to a new land use		1	0
		Other measures, please specify			
F15	Do you have government-implemented flood protection measures in place in your community?			Yes	1
				No	2
F16	If yes, please what are these measures				
F17	What do you think the government or other institutions in terms of adaptation measures can do to control flooding in your community?				
F18	What do you think your community can do to adapt to flooding?				

APPENDIX 2: Focus group discussions guide

Guide to Focus Group Discussions (FGDs)

What are the causes flood in your community and Kogi state generally? What makes your community to flood every time?

Specifically, what has been the effect of flood on your community, activities, livelihoods and house, damages etc.? Are there any advantage flood gives you?

Why do you decide to settle here knowing that flood affects yearly?

What do you do before, during and after to avoid future floods event?

Do women play any role(s) in case of flood events? What are the roles?

How do you know that flooding would occur in a particular year?

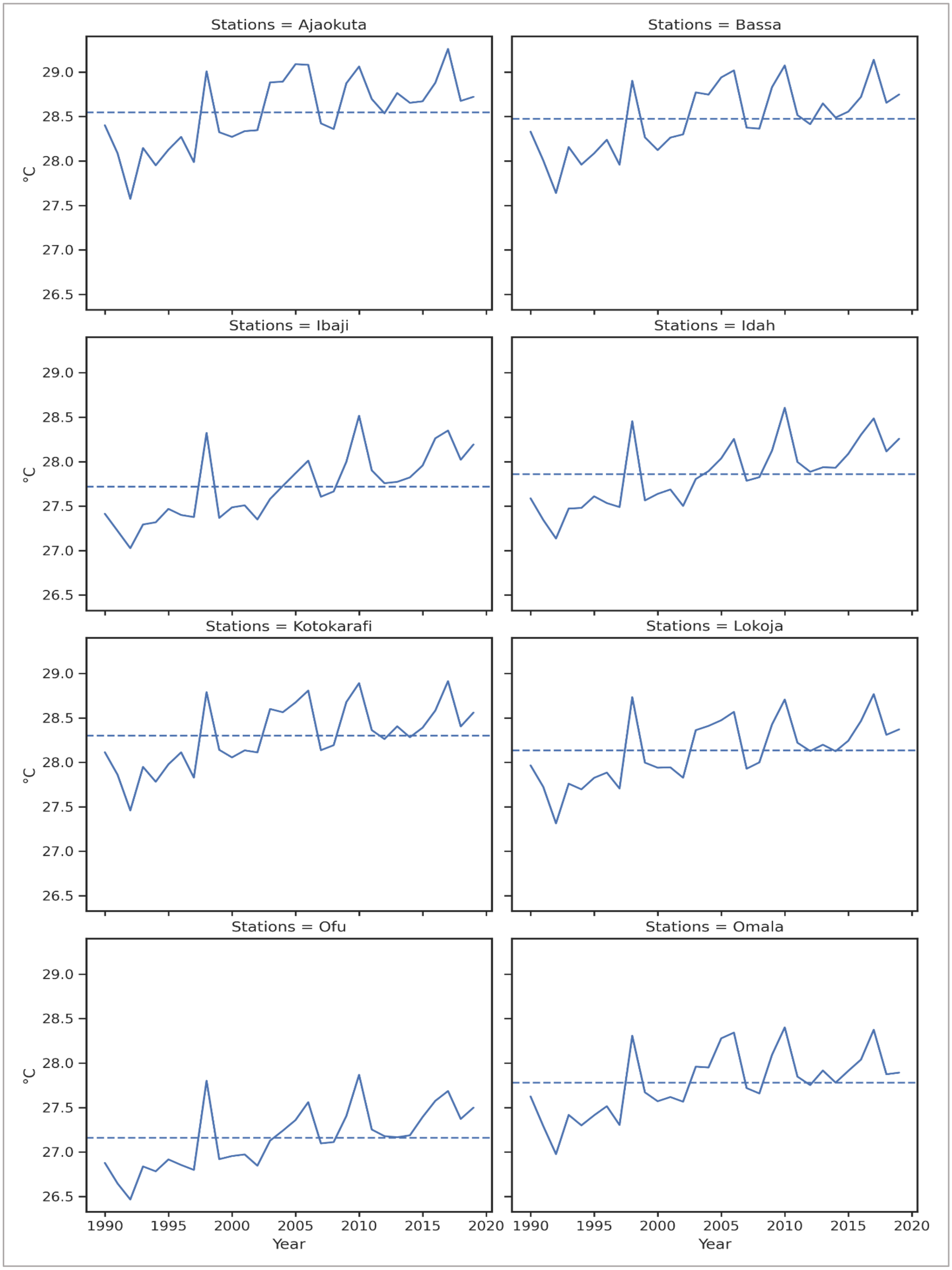
How do you adapt or cope or manage flooding?

Has any organization help you in dealing with flood? Please name them and what they have done in helping you.

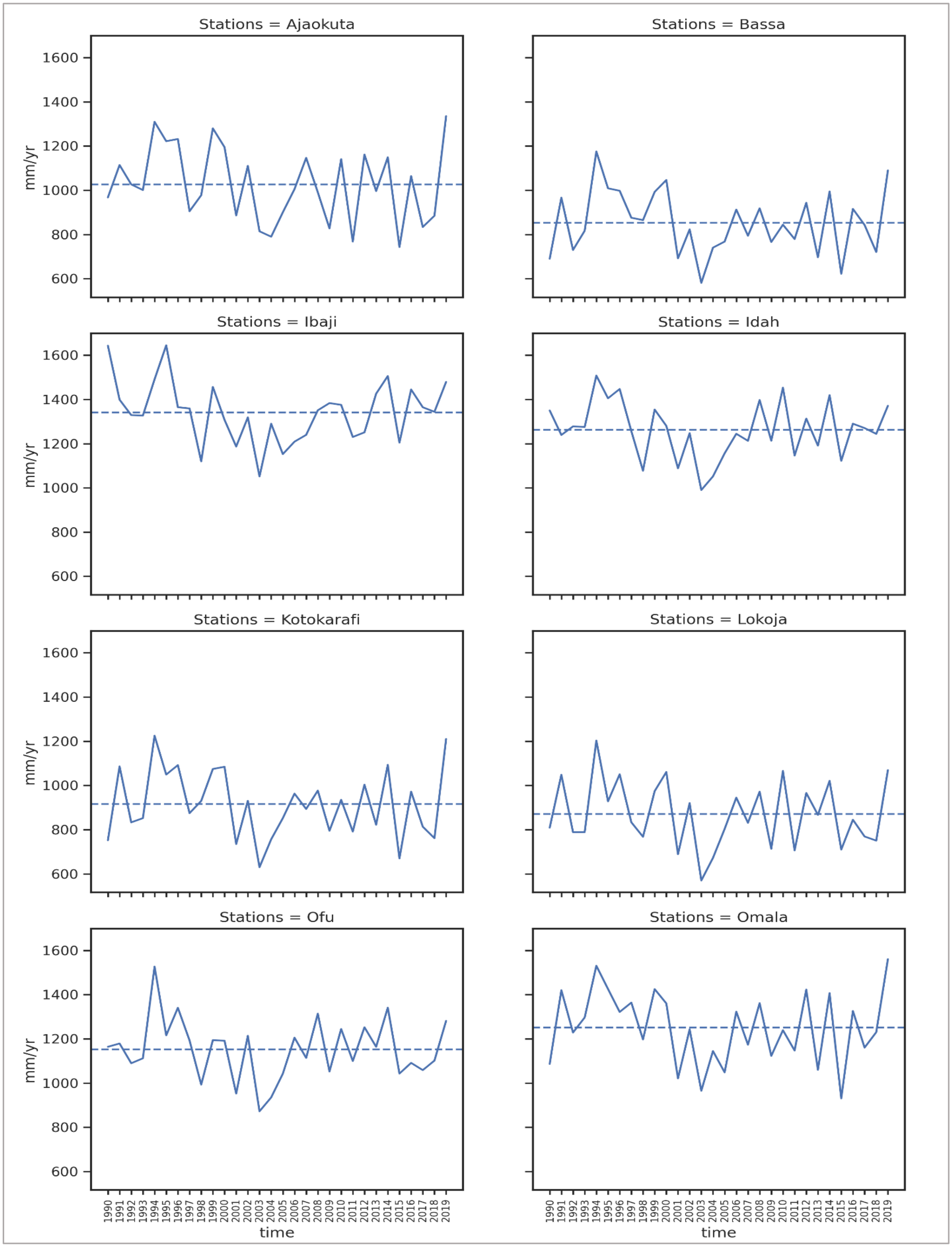
What has government done for you to reduce the impact of flood? What do you think government can do to help you solving this flood problem going forward?

As a community, what can be done to reduce the negative impacts of flood?

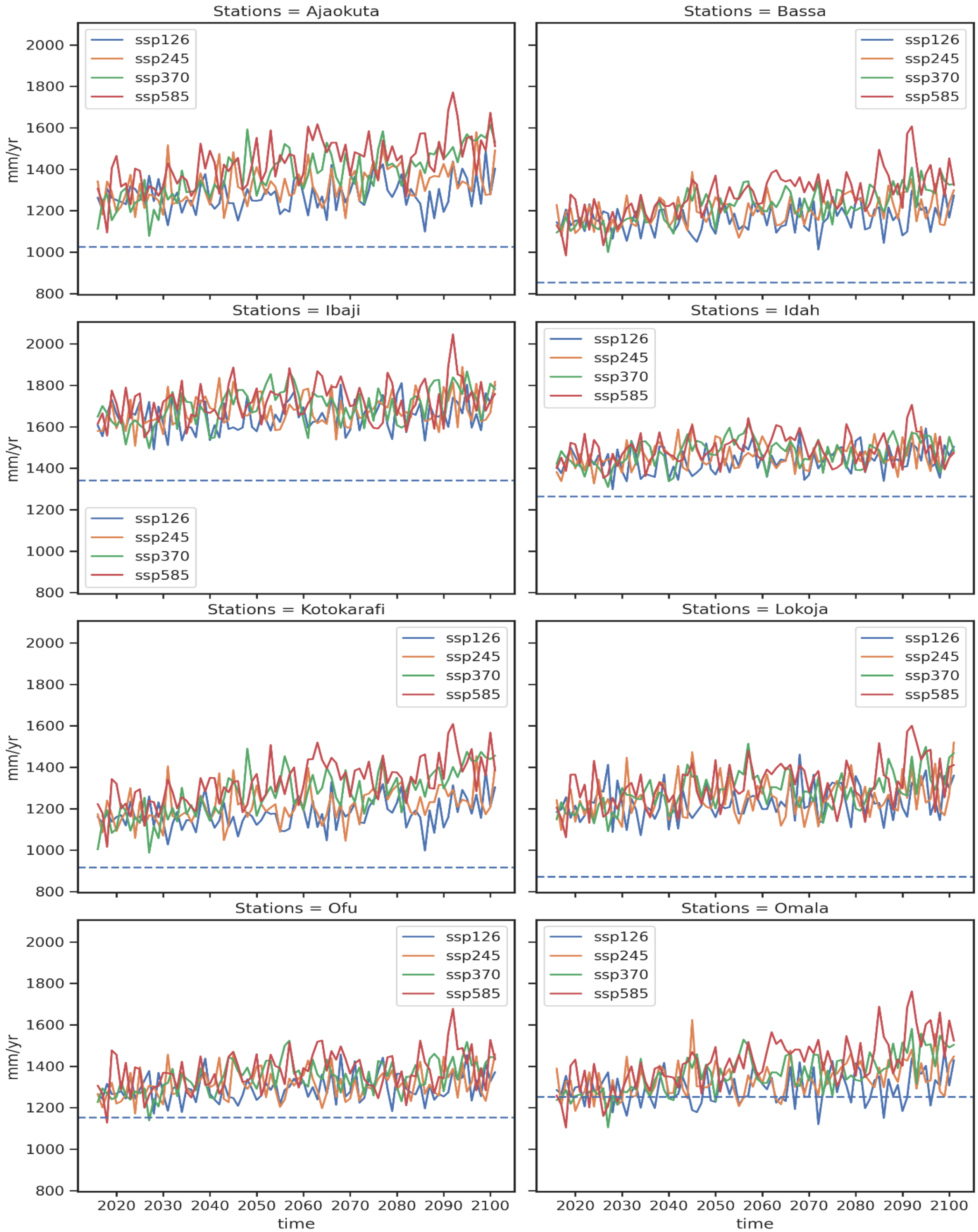
APPENDIX 3: Historical annual temperature variation across the community (1990 - 2020)



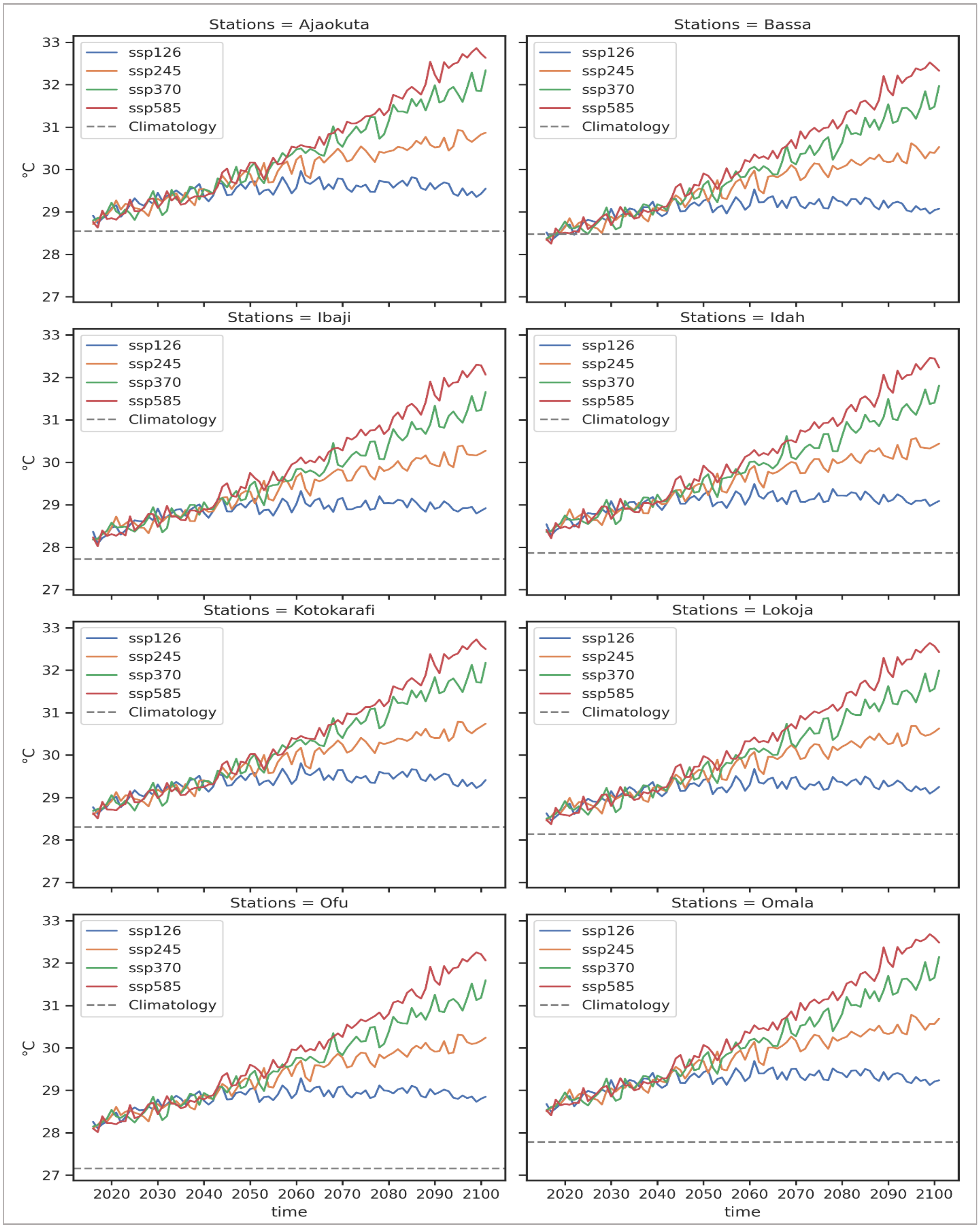
APPENDIX 4: Historical annual precipitation variation in the community (1990 - 2020)



APPENDIX 5: Future precipitation projection (2020-2100) in Kogi State under different scenarios



APPENDIX 6: Future temperature projection (2020-2100) in Kogi State under different scenarios



APPENDIX 7: Scores of vulnerability indicators used for the study

- **Scores of exposure indicators**

Village	Average Elevation (AE) *m*	Closeness of farmlands to river bodies (CRB) *m*	Floodwater duration (FD) *days*	Shared of exposed farmland (SEF) *%*
Geregu	51	100.40	43.00	60
Adogo	71	123.00	40.00	90
Eroko	40	87.00	48.00	70
Icheu	45	203.33	43.00	55
Shintaku	52	83.33	45.00	45
Odogwu	29	165.71	57.00	65
Ogba Ojubo	26	88.40	58.00	80
Onyedaga	27	115.00	60.00	90
Ichekene	33	97.00	38.00	30
Ichala Edeke	33	85.00	46.00	80
Adaha	44	119.00	45.00	95
Akpaku	49	215.00	48.00	90
Koton karfee	41	230.00	55.00	85
Kakanda	57	56.00	50.00	85
Adankolo	43	95.00	43.00	80
Karara	52	230.00	35.00	100
Itobe	84	142.00	45.00	95
Olukudu	223	121.75	48.50	85
Bagana	58	67.50	30.00	95
Abejukolo	109	60.80	35.50	85

Source: Author's analysis of data from the field (2021)

❖ **Scores of susceptibility Indicators**

Communities	Household size (HS)	House conditions (HCs)	Household past flood experience (PFE)	Households dependency on agric. production (HDAP)	Lack of access to improved drinking water (%) (LAIW)
Geregu	6.36	15	100	50	60
Adogo	5.24	19	100	95	95
Eroko	6.79	16	100	85	90
Icheu	9.89	17	100	85	80
Shintaku	6.00	11	95	55	50
Odogwu	8.35	14	100	100	85
Ogba Ojubo	7.16	15	100	95	95
Onyedaga	8.89	14	100	100	85
Ichekene	8.42	17	100	85	75
Ichala Edeke	10.60	20	100	100	100
Adaha	6.85	20	100	95	95
Akpaku	6.75	16	100	95	95
Koton karfee	6.85	16	100	95	60
Kakanda (Budon)	7.80	14	100	85	90
Adankolo	7.44	18	100	95	75
Karara	7.79	18	100	95	60
Itobe	6.91	19	100	100	75
Olukudu	5.78	20	100	95	25
Bagana	8.40	18	75	85	95
Abejukolo	10.23	17	85	85	65

Source: Author's analysis of data from the field (2021)

❖ **Score of lack of resilience indicator**

Community	% Literacy rate of population with higher education (LR)	Access to Flood warning system/facilities/information (AFWS)	Flood Education (training) Access Rate (FEAR)	Evacuation means and facilities (EMF)	Long term residents at least 10 years + (LTR)	Access to healthcare and social services (AHS)	Access to financial aid to face flood disasters (AFA)	Access to flood management measures (AFMM)	Diversification of Economic Activities (DEA)
Geregu	35	30	5	15	90	15	0	0	10
Adogo	10	75	55	90	90	0	0	10	10
Eroko	45	100	50	35	100	5	10	0	5
Icheu	25	90	25	50	100	15	0	0	80
Shintaku	45	85	0	65	100	0	45	45	65
Odogwu	5	20	10	10	90	10	0	0	20
Ogba Ojubo	0	5	5	40	95	0	0	0	5
Onyedaga	5	45	10	25	95	0	0	30	10
Ichekene	20	60	30	65	90	50	0	5	65
Ichala Edeke	5	80	0	100	100	0	0	0	55
Adaha	35	95	0	100	95	85	0	0	95
Akpaku	15	95	5	95	85	100	0	0	100
Koton karfee	45	95	0	95	95	15	0	0	95
Kakanda	0	100	5	100	5	15	95	0	0
Adankolo	5	100	15	85	5	0	100	0	0
Karara	0	95	10	100	85	0	100	0	0
Itobe	25	95	90	90	0	0	50	5	0
Olukudu	25	100	5	95	85	0	55	0	0
Bagana	5	100	5	5	85	0	30	0	0
Abejukolo	10	95	5	0	90	60	25	0	25

Source: Author's analysis of data from the field (2021)

❖ Correlation among the preliminary set of indicators

	AE	CRB	FD	SEF	HS	HCs	PFE	HDPA	LAIW	LR	AFWS	FEAR	FME	LTR	AHS	AFA	AFMM	DEA
AE	-																	
CRB	-0.09	-																
FD	-0.18	0.15	-															
SEF	0.22	0.16	0.00	-														
HS	-0.27	-0.10	-0.12	-0.08	-													
HCs	0.39	0.09	-0.43	0.45*	0.07	-												
PFE	-0.14	0.38	0.57**	-0.16	-0.28	-0.03	-											
HDPA	0.03	0.31	0.28	0.56**	0.22	.508*	0.19	-										
LAIW	-0.66**	-0.15	0.08	0.20	0.29	0.07	-0.05	0.35	-									
LR	0.09	0.14	0.06	-0.36	-0.43	-0.13	0.16	-0.48*	-0.38	-								
AFWS	0.36	0.09	-0.48*	0.32	-0.03	0.41	-0.23	0.10	-0.16	0.23	-							
FEAR	0.05	0.04	-0.13	0.02	-0.22	0.27	0.19	0.20	0.14	0.14	0.13	-						
FME	0.15	0.33	0.03	0.26	-0.33	0.41	0.53*	0.33	-0.07	0.07	.479*	0.10	-					
LTR	-0.10	0.17	0.04	-0.26	0.11	-0.10	-0.11	-0.17	-0.02	0.27	-0.30	-0.37	-0.33	-				
AHS	-0.05	0.16	-0.12	0.01	0.06	0.10	-0.02	0.03	0.20	0.14	0.17	-0.22	0.10	0.16	-			
AFA	0.29	-0.09	-0.28	0.27	-0.11	0.05	-0.05	0.00	-0.35	-0.29	.470*	0.01	0.35	-0.69**	-0.31	-		
AFMM	-0.11	-0.18	0.17	-0.28	-0.18	-0.56*	-0.01	-0.36	-0.20	0.22	-0.11	-0.02	-0.08	0.16	-0.22	-0.02	-	
DEA	-0.27	0.43	0.08	-0.27	0.10	-0.03	0.16	-0.04	0.09	0.45*	0.16	-0.29	0.29	0.41	0.65**	-.49*	0.07	-

Note. $^{*}p < 0.5$, $^{**}p < 0.01$

Source: Author's computation of field data, 2021

APPENDIX 8: Parameter estimates of the marginal effects table

Table A: Parameter Estimates of the Marginal effects from the Multinomial Logistic Regression for the Determinant of Households Willingness to Relocate

	Delta-method					
	dy/dx	**Std. Err.**	**z**	**P>|z|**	**[95% Conf.**	**Interval]**
LGA						
_predict						
Not very likely	.0205482	.0129367	1.59	0.112	-.0048073	.0459037
Not Likely	-.0112631	.012625	-0.89	0.372	-.0360076	.0134814
Indifferent	8.76e-08	.0001681	0.00	1.000	-.0003293	.0003295
Likely	-.0127847	.0134724	-0.95	0.343	-.0391901	.0136208
Very Likely	.0034995	.0128946	0.27	0.786	-.0217734	.0287724
Gender						
_predict						
Not very likely	-.0061603	.0555097	-0.11	0.912	-.1149573	.1026367
Not Likely	-.0316901	.0555858	-0.57	0.569	-.1406363	.0772562
Indifferent	-1.52e-08	.0000372	-0.00	1.000	-.000073	.000073
Likely	-.0705784	.0561292	-1.26	0.209	-.1805895	.0394327
Very Likely	.1084285	.0638796	1.70	0.090	-.0167732	.2336303
Age						
_predict						
Not very likely	.0025341	.0024185	1.05	0.295	-.002206	.0072742
Not Likely	-.0003	.0021697	-0.14	0.890	-.0045525	.0039525
Indifferent	-1.20e-09	2.44e-06	-0.00	1.000	-4.78e-06	4.78e-06
Likely	-.0027861	.002499	-1.11	0.265	-.007684	.0021118
Very Likely	.000552	.0028629	0.19	0.847	-.0050591	.0061631
Education						
_predict						
Not very likely	-.0609934	.0245542	-2.48	0.013	-.1091187	-.0128681
Not Likely	.0128517	.0231	0.56	0.578	-.0324236	.058127
Indifferent	1.33e-08	.0000276	0.00	1.000	-.0000541	.0000541
Likely	.0056138	.0239908	0.23	0.815	-.0414072	.0526349
Very Likely	.0425275	.027783	1.53	0.126	-.0119262	.0969812
Length of stay						
_predict						
Not very likely	.0214692	.0320434	0.67	0.503	-.0413348	.0842731
Not Likely	.0272174	.03221	0.84	0.398	-.0359131	.0903478
Indifferent	-8.31e-09	.000017	-0.00	1.000	-.0000333	.0000333
Likely	.0192302	.0299959	0.64	0.521	-.0395606	.0780211
Very Likely	-.0679165	.0411958	-1.65	0.099	-.1486588	.0128258
Occupation						
_predict						
Not very likely	.0094393	.015731	0.60	0.548	-.0213928	.0402715
Not Likely	.0077718	.0145799	0.53	0.594	-.0208043	.0363479
Indifferent	6.68e-09	.000014	0.00	1.000	-.0000274	.0000274
Likely	.0168605	.0116736	1.44	0.149	-.0060192	.0397403
Very Likely	-.0340713	.0123852	-2.75	0.006	-.0583458	-.0097968
Income						
_predict						
Not very likely	.0005907	.0207753	0.03	0.977	-.0401281	.0413096
Not Likely	.0573359	.0179708	3.19	0.001	.0221138	.092558
Indifferent	2.32e-08	.000046	0.00	1.000	-.0000902	.0000902
Likely	.0318583	.0200013	1.59	0.111	-.0073435	.0710602
Very Likely	-.0897851	.020481	-4.38	0.000	-.1299272	-.0496431
Household Size						
_predict						
Not very likely	.0044062	.0068564	0.64	0.520	-.0090322	.0178445
Not Likely	.0025008	.0062127	0.40	0.687	-.0096758	.0146774
Indifferent	-4.49e-09	8.84e-06	-0.00	1.000	-.0000173	.0000173
Likely	-.0182475	.0083454	-2.19	0.029	-.0346043	-.0018908
Very Likely	.0113407	.0083261	1.36	0.173	-.0049782	.0276595

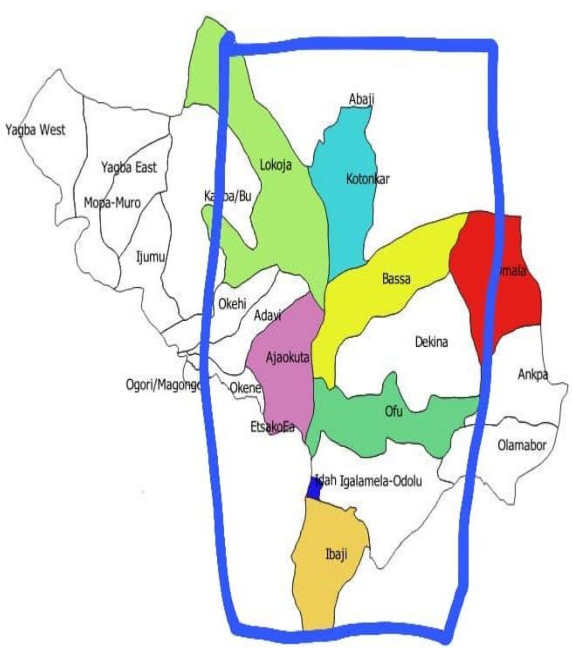
Table "A" Cont. (1)

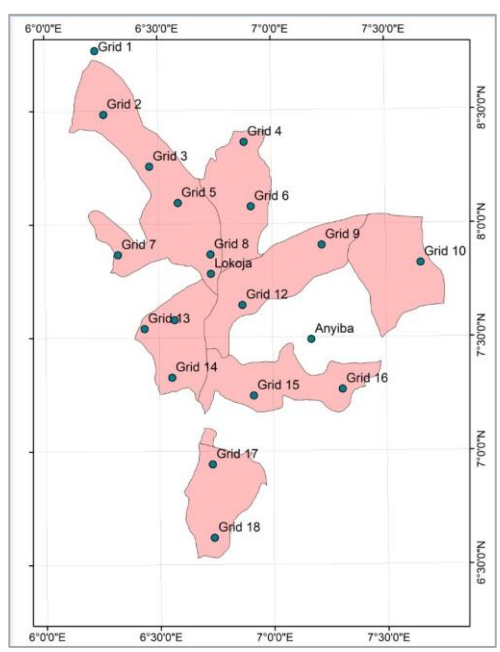
	Delta-method					
	dy/dx	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
Floodwater stay period						
_predict						
Not very likely	.0527101	.0342756	1.54	0.124	-.0144689	
Not Likely	-.0236267	.0268649	-0.88	0.379	-.076281	
Indifferent	2.74e-08	.0000533	0.00	1.000	-.0001045	
Likely	-.0421395	.0245274	-1.72	0.086	-.0902123	
Very Likely	.0130561	.0260188	0.50	0.616	-.0379398	
Floodwater stay period						
_predict						
Not very likely	.0527101	.0342756	1.54	0.124	-.0144689	.119889
Not Likely	-.0236267	.0268649	-0.88	0.379	-.076281	.0290275
Indifferent	2.74e-08	.0000533	0.00	1.000	-.0001045	.0001046
Likely	-.0421395	.0245274	-1.72	0.086	-.0902123	.0059333
Very Likely	.0130561	.0260188	0.50	0.616	-.0379398	.0640519
Evacuation means						
_predict						
Not very likely	.1108864	.0555245	2.00	0.046	.0020603	.2197125
Not Likely	.0785204	.0533999	1.47	0.141	-.0261414	.1831822
Indifferent	2.88e-07	.0005529	0.00	1.000	-.0010834	.001084
Likely	.0874913	.0677677	1.29	0.197	-.0453309	.2203135
Very Likely	-.276898	.092788	-2.98	0.003	-.4587592	-.0950368
Access to health services						
_predict						
Not very likely	.085364	.0891537	0.96	0.338	-.0893741	.2601021
Not Likely	.0691954	.0741087	0.93	0.350	-.076055	.2144458
Indifferent	-6.20e-08	.0001221	-0.00	1.000	-.0002394	.0002393
Likely	-.0151467	.0527108	-0.29	0.774	-.1184579	.0881645
Very Likely	-.1394133	.0592689	-2.35	0.019	-.2555782	-.0232485
Alternative livelihood						
_predict						
Not very likely	-.0470438	.0603554	-0.78	0.436	-.1653381	.0712506
Not Likely	.0809136	.0531024	1.52	0.128	-.0231653	.1849925
Indifferent	-5.34e-08	.0001049	-0.00	1.000	-.0002056	.0002055
Likely	.0185319	.0594916	0.31	0.755	-.0980695	.1351334
Very Likely	-.0524016	.0733442	-0.71	0.475	-.1961536	.0913504
Usability of the area						
_predict						
Not very likely	.0590256	.0260857	2.26	0.024	.0078985	.1101526
Not Likely	.0633755	.0226178	2.80	0.005	.0190454	.1077057
Indifferent	5.47e-09	.0000116	0.00	1.000	-.0000227	.0000227
Likely	.0172216	.0408289	0.42	0.673	-.0628017	.0972448
Very Likely	-.1396228	.0751111	-1.86	0.063	-.2868378	.0075923
Access to flood Mgt. Info						
_predict						
Not very likely	.0697041	.0444332	1.57	0.117	-.0173834	.1567916
Not Likely	-.1313087	.0557984	-2.35	0.019	-.2406716	-.0219458
Indifferent	-6.51e-08	.0001258	-0.00	1.000	-.0002466	.0002465
Likely	.0832339	.0335034	2.48	0.013	.0175685	.1488993
Very Likely	-.0216289	.0435147	-0.50	0.619	-.1069162	.0636583
Flood experience						
_predict						
Not very likely	-.1306194	.0407289	-3.21	0.001	-.2104465	-.0507922
Not Likely	-.0053524	.0378981	-0.14	0.888	-.0796314	.0689265
Indifferent	-2.94e-08	.0000584	-0.00	1.000	-.0001145	.0001144
Likely	-.0895863	.0465859	-1.92	0.054	-.1808929	.0017204
Very Likely	.2255574	.0667557	3.38	0.001	.0947187	.3563962

Table "A" Cont. (2)

	Delta-method					
	dy/dx	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
Flood frequency						
_predict						
Not very likely	.0115526	.0528649	0.22	0.827	-.0920608	.1151659
Not Likely	.0697722	.0475943	1.47	0.143	-.0235109	.1630553
Indifferent	-1.72e-07	.0003337	-0.00	1.000	-.0006542	.0006538
Likely	-.1335485	.0978522	-1.36	0.172	-.3253353	.0582382
Very Likely	.0522234	.0672458	0.78	0.437	-.0795758	.1840227
Flood affecting farmland						
_predict						
Not very likely	-.0085135	.0672614	-0.13	0.899	-.1403433	.1233164
Not Likely	.0038988	.0629704	0.06	0.951	-.1195209	.1273186
Indifferent	-3.47e-08	.0000684	-0.00	1.000	-.0001342	.0001341
Likely	-.2343626	.1123291	-2.09	0.037	-.4545236	-.0142016
Very Likely	.2389762	.1045474	2.29	0.022	.0340671	.4438854
Flood training participation						
_predict						
Not very likely	.0289969	.0453105	0.64	0.522	-.05981	.1178038
Not Likely	-.0759338	.0525538	-1.44	0.148	-.1789374	.0270698
Indifferent	5.22e-08	.0001002	0.00	1.000	-.0001963	.0001964
Likely	-.0180615	.0450926	-0.40	0.689	-.1064415	.0703184
Very Likely	.0649992	.0439012	1.48	0.139	-.0210456	.1510439

Grids in the selection of the CHIRPS Dataset





APPENDIX 9: Published article in Water Journal, MDPI

water

MDPI

Article

Understanding Flood Vulnerability in Local Communities of Kogi State, Nigeria, Using an Index-Based Approach

Peter Oyedele [1,2,*], Edinam Kola [1], Felix Olorunfemi [3] and Yvonne Walz [2]

[1] West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) Graduate Research Program on Climate Change and Disaster Risk Management, Department of Geography, Université de Lomé, Lomé 01BP1515, Togo

[2] Institute of Environmental and Human Security, United Nations University, Platz der Vereinten Nationen 1, 53113 Bonn, Germany

[3] Nigerian Institute of Social and Economic Research, P.M.B 5, UI Post Office, Oyo Road, Ibadan 200132, Oyo State, Nigeria

* Correspondence: bolupeter@gmail.com or oyedele.p@edu.wascal.org; Tel.: +234-703-655-3040

Abstract: In West Africa, the impacts of flooding are becoming more severe with climate warming. Flood-prone communities in Kogi State in north-central Nigeria are affected by annual flooding and some extreme flood events. The negative impacts remain a major obstacle to development, environmental sustainability, and human security, exacerbating poverty in the region. Reducing and managing the impacts of flooding are increasingly becoming a challenge for individual households. Analysing vulnerability to flooding (a function of exposure, susceptibility, and lack of resilience) and identifying its causes using an index-based approach to achieve sustainable flood risk management were the focus of this study. A semi-structured questionnaire was used to collect relevant data from 400 households in 20 purposively selected communities. Based on expert opinions and an extensive literature review, 16 sets of relevant indicators were developed. These indicators were normalised and aggregated to compute the flood vulnerability index (FVI) for each community. This was then used to compare, classify, and rank communities in terms of their vulnerability to flooding. The results of the study showed that the selected communities were at varying levels of the risk of flooding. Four of the communities including the Onyedega, Ogba Ojubo, Odogwu, and Ichala Edeke communities were found to have very high vulnerability to flooding compared to others. Several factors such as poor building structures, lack of evacuation and flood management measures, over-dependence of households on agriculture, lack of diversification of economic activities, and weak household economic capacity were identified as causes. These findings are useful for developing flood risk reduction and adaptation strategies, such as ecosystem-based approaches, to reduce current and future vulnerability to flooding in Nigeria and other developing countries with similar conditions.

Keywords: flood vulnerability; indicators; flood-prone communities; lack of resilience; Kogi State; Nigeria

check for updates

Citation: Oyedele, P.; Kola, E.; Olorunfemi, F.; Walz, Y. Understanding Flood Vulnerability in Local Communities of Kogi State, Nigeria, Using an Index-Based Approach. *Water* **2022**, *14*, 2746. https://doi.org/10.3390/w14172746

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Received: 30 July 2022
Accepted: 31 August 2022
Published: 2 September 2022

1. Introduction

The frequency and severity of weather-related events such as floods are undoubtedly rising [1], due to the increasing risks associated with urbanization and the potential impacts of climate change [2]. Over the following decades, climate change is projected to have an increasingly negative impact on hydrological regimes and flood risks [3]. Floods continue to be one of the most frequently occurring and dangerous natural hazards, affecting human lives and resulting in significant economic losses around the world [4,5]. The recurrence of flooding events and the risk that goes along with them have a greater negative impact on developing countries [6] due to a variety of factors, including unstable economies, a lack of understanding of the hazard, inadequate preparation, and coping capacity [6,7]. Flood risk assessments and management are compulsory to determine the highest-risk areas in order to reduce the accompanied risk [8].

APPENDIX 10: Authorization letters to conduct research

WASCAL
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Université de Lomé

Lomé ,..0 2 SEPT 2020

N° 98/CC&DRM/D/DA/WASCAL/UL/2020

Dr. Komi AGBOKA
WASCAL TOGO
Climate change & Disaster Risks Management
Programme Director
Université de Lomé
01P.O. Box: 1515
kagboka@gmail.com

To: **Mr. OYEDELE Peter Boluwaji**
WASCAL Doctoral Student
Climate Change & Disaster Risks Management,
Université de Lomé, Togo
bolupeter@gmail.com
Tel : +228 93397724,
Cell : +234 7036553040
bolupeter@gmail.com
oyedele.p@edu.wascal.org

RESEARCH TRIP AUTHORIZATION TO NIGERIA

Dear Mr. Oyedele,

In reference to your doctoral thesis proposal on « Flood Risks and Farming Households Decision-making to Flood Disasters in Kogi State, Nigeria » which you defended on the 27th August 2020 and after you have sumitted the reviewed proposal on the 1st September 2020, you are hereby authorized to travel to the Republic of Nigeria for the field work.

Note that your activities in the field, the research timeline and budget will be validated and sent to WASCAL Head Quaters in Accra, and will also be communicated to you.

Sincerely,

UNIVERSITE DE LOME Faculté des Sciences de l'Homme et de la Société DIRECTOR DRP - CCDRM DRP - CCDRM / WASCAL

Dr. Komi AGBOKA,
WASCAL Togo
Programme Director

West African Science Service Centre on Climate Change and Adapted land Use
Centre Ouest-Africain de Service Scientifique sur les Changements Climatiques et l'Utilisation Adaptée des Terres

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Université de Lomé

27 NOV 2020

Prof Komi AGBOKA,
Director,
WASCAL Programme
Université de Lomé
01P.O. Box: 1515
Tel: 00228 90300895
E-mail: kagboka@gmail.com
Lomé,
TOGO

Mrs. D.O. ENEHE
Director,
Climate Change Department
Ministry of Environment and Natural Resources
Lokoja, Kogi State.

Dear Madam,

LETTER OF INTRODUCTION

I am pleased to introduce **Peter Boluwaji OYEDELE**, a Nigerian and postgraduate male student in Climate Change and Disaster Risk Management with West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Université de Lomé, Togo.

Mr. Oyedele is pursuing his doctoral programme on the topic : **Flood Risk and Farming Households' Decision-making to Flood Disasters in Kogi State, Nigeria.** Kindly grant him the necessary assistance he may need during the course of his research fieldwork.

Thank you for your kind consideration.

Yours sincerely,

UNIVERSITE DE LOME Faculté des Sciences de l'Homme et de la Société DIRECTOR DRP - CCDRM DRP - CCDRM I WASCAL

Dr. AGBOKA Komi,
Associate Professor

West African Science Service Centre on Climate Change and Adapted land Use
Centre Ouest-Africain de Service Scientifique sur les Changements Climatiques et l'Utilisation Adaptée des Terres

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01P.O. Box: 1515
Tel: 00228 90300895
E-mail: kagboka@gmail.com
Lomé,
TOGO

The Director,
Of Research, Planning and Environment
(RPE) Department,
National Inland Waterways Authority (NIWA),
National Headquarters,
Lokoja, Kogi State.

Dear Sir,

LETTER OF INTRODUCTION

I am pleased to introduce Peter Boluwaji OYEDELE, a Nigerian and postgraduate male student in Climate Change and Disaster Risk Management with West African Science Service Center on Climate Change and Adapted Land Use (**WASCAL**), Université de Lomé, Togo.

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West African Science Service Centre on Climate Change and Adapted land Use
Centre Ouest-Africain de Service Scientifique sur les Changements Climatiques et l'Utilisation Adaptée des Terres

27 NOV 2020

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Director,
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Tel: 00228 90300895
E-mail: kagboka@gmail.com
Lomé,
TOGO

The Director of Administration,
State Emergency Management Agency
(SEMA),
Lokoja, Kogi State.

Dear Madam,

LETTER OF INTRODUCTION

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UNIVERSITE DE LOME Faculté des Sciences de l'Homme et de la Société DIRECTOR DRP - CCDRM DRP - CCDRM / WASCAL

Dr. AGBOKA Komi
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Lomé, 27 NOV 2020

TO WHOM IT MAY CONCERN

I am pleased to introduce **Peter Boluwaji OYEDELE**, a Nigerian and postgraduate male student in Climate Change and Disaster Risk Management with the West African Science Service Center on Climate Change and Adapted Land Use (**WASCAL**), Université de Lomé, Togo.

Mr. Oyedele is pursuing his doctoral programme on the topic : **Flood Risk and Farming Households' Decision-making to Flood Disasters in Kogi State, Nigeria.** Kindly grant him the necessary assistance he may need during the course of his research fieldwork.

In witness whereoff this recommendation letter is issued to him.

UNIVERSITÉ DE LOMÉ Faculté des Sciences de l'Homme et de la Société ★ DIRECTOR DRP - CCDRM ★ DRP - CCDRM / WASCAL

Prof Komi AGBOKA
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West African Science Service Centre on Climate Change and Adapted land Use
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